Chapter 3. Affected Environment and Environmental Impacts

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter describes the existing human environment, including natural and man-made resources, of the project area, and characterizes its current condition as a baseline for environmental analysis. Potential environmental effects of Summit's proposed project and the No Action Alternative are then disclosed to inform the public and DOE's decision whether to provide financial assistance for the TCEP. This chapter includes the following sections:

- Introduction and Project Setting (Section 3.1)
- Impacts Assessment Background and Definitions (Section 3.2)
- Affected environment, environmental impacts, and mitigation (Sections 3.3 through 3.19)

3.1 Introduction and Project Setting

The proposed polygen plant site is located in Ector County approximately 15 mi (24 km) southwest of the city of Odessa (see Figure 2.1). Most of its associated linear facilities would extend outward from the plant site across parts of Ector County, mostly in the western part of the county. One waterline would extend into nearby Midland County (WL1) and another slightly into Crane County (WL3).

Ector County is located in the Llano Estacado and Arid Llano Estacado subecoregions, which are in the High Plains ecoregion of Texas (Figure 3.1). The Llano Estacado is one of the largest mesas or tablelands on the North American continent and straddles the Texas–New Mexico border between I-40 on the north and I-20 on the south, roughly between Amarillo and Midland-Odessa, Texas. The region is characterized by mostly treeless flat plateaus, few perennial streams, relatively low annual precipitation, and high wind velocities (Howard et al. 2003). The land is fertile when irrigated. Irrigation water is mined from the deeper parts of the Ogallala Aquifer by electric pumps because there is almost no usable surface water. The Llano Estacado has an extremely low population density, with most of the area residents located in the Texas cities of Amarillo, Lubbock, Midland, and Odessa (U.S. Census Bureau 2002).[1]

In the Llano Estacado lies much of the Permian Basin, a sedimentary basin extending from Lubbock to just south of Midland and Odessa, and extending westward into the southeastern part of the adjacent state of New Mexico (Figure 3.1; Dutton et al. 2004). The Permian Basin is one of the largest petroleum-producing basins in the U.S. It accounts for 19 percent of total U.S. oil production, and it contains approximately 22 percent of U.S. oil reserves (Dutton et al. 2004; Oxy Permian 2011). The Permian Basin encompasses all or parts of 49 counties in West Texas and all or parts of five counties in New Mexico (Figure 3.1).

[1] The results of the 2010 census were not available when the draft EIS was prepared; the 2010 results will be included in the final EIS.

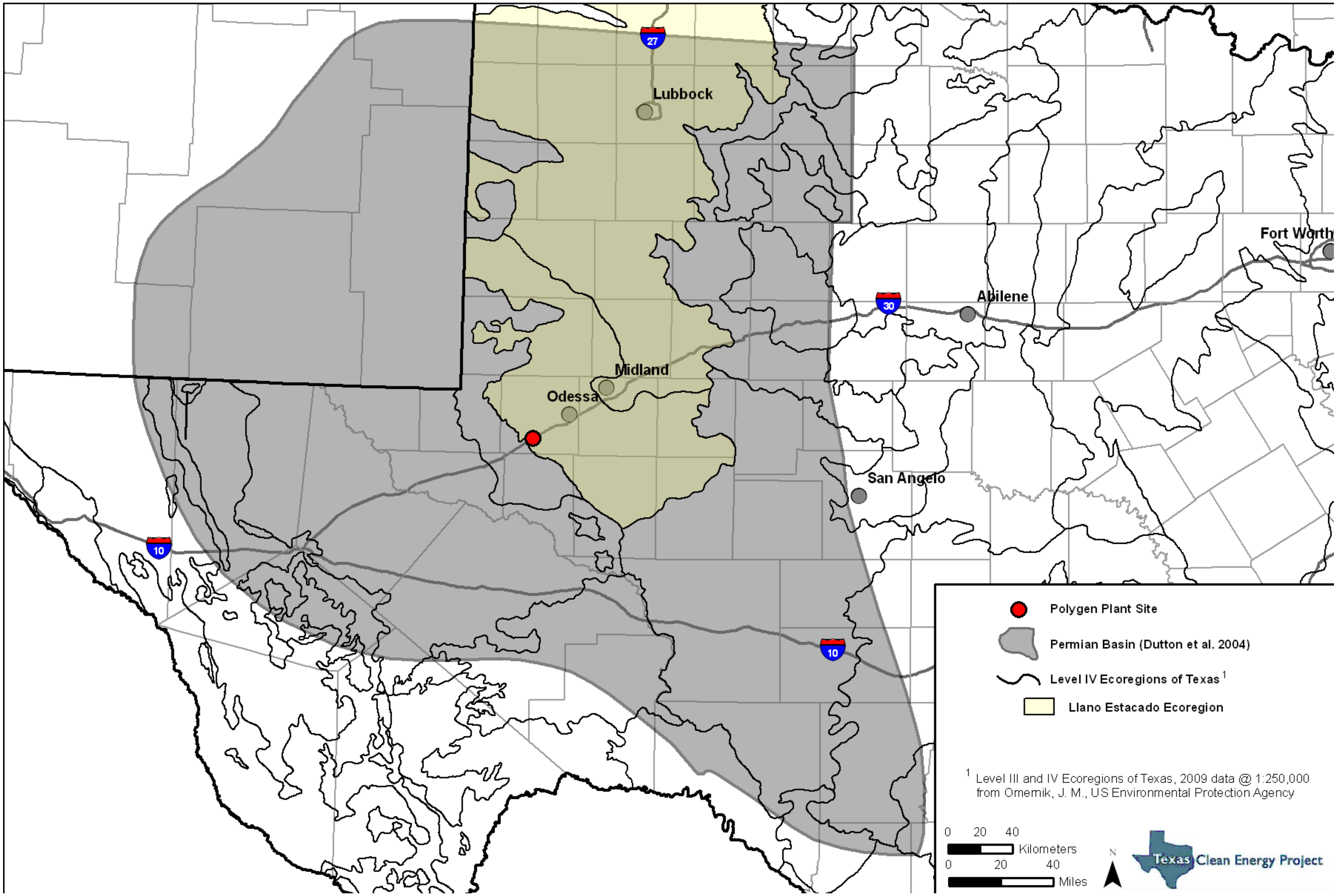

Figure 3.1. Location of the TCEP in the Permian Basin.

3.1.1 Polygen Plant Site

The proposed polygen plant site is a nearly rectangular, 600-ac (243-ha) parcel of land. Site elevation ranges from 2,920 to 2,969 ft (890–905 m) above mean sea level, with a ground slope of less than 0.5 percent (DOE 2007). The site is located in a rural setting that historically has been occupied by ranching and oil and gas industry activities; it is dominated by Mesquite Shrub-Grassland vegetation (see Section 3.8 for details), which is not rare or unique in this region.

The proposed polygen plant site was donated to Summit by the Odessa Chamber of Commerce in April 2010; however, several utility, oil, and gas companies continue to lease easements for access to subsurface oil and gas resources. RRC records reveal six permitted or developed natural gas and oil wells are located on the proposed polygen plant site; however, only one oil well and one gas well remain active (SWCA Environmental Consultants [SWCA] 2010). Crude oil pipeline, natural gas pipeline, and condensate pipeline systems are also present on the site. Other existing structures on the site include gravel roads, abandoned oil- and gas-related structures, and overhead electricity distribution lines. No other structures or improvements are known to have historically occurred at the site (Peyton et al. 2010). No prime or unique farmland soils exist in the plant site, and the site is free from hazardous or radioactive materials, chemicals, or wastes that would be subject to regulation under the Comprehensive Environmental Response, Compensation, and Liability Act the Resource Conservation and Recovery Act or the Nuclear Regulatory Commission (Horizon Environmental Services 2006a).

The polygen plant site's southern boundary borders CR 1216 and is less than 0.5 mi (0.8 km) from I-20. A UPRR line also runs along the site's southern border. Other existing structures at the polygen plant site include gravel roads, abandoned oil- and gas-related structures, pipelines, and overhead electricity distribution lines.

Oil and gas development and ranching activities are the predominant land uses in the area. Remnant oil well pad sites and associated industrial structures are present in the area around the polygen plant site, with concentrations occurring mainly west and south of the site. Neighboring properties include undeveloped industrial space and facilities that support the oil and gas industry. The community of Penwell, Texas, is located immediately south of the proposed polygen plant site. The community has a population of approximately 41 individuals (U.S. Census Bureau 2002), but recent accounts indicate that as few as a dozen people remain in residence in the community (DOE 2007). There are seven occupied residences in Penwell, the closest of which is approximately 0.25 mi (0.40 km) from the polygen plant site (SWCA 2010a). The community has four to five businesses, including a post office and operating oil and gas industrial entities.

3.1.2 Linear Facilities

The TCEP would require the construction of linear facilities consisting of one electrical transmission line, one or more process water pipelines, a natural gas pipeline, a CO_2 pipeline, two access roads, and a rail spur. This EIS addresses six options for potential transmission line corridors, four options for potential water supply pipeline corridors, one option for a potential natural gas corridor, one option for a potential CO_2 pipeline corridor, two options for access roads, and one option for a rail spur. For locations of the proposed and existing linear facilities, see Figure 2.1.

To the fullest extent possible and to limit the need for new ROW, the proposed corridors for the linear facilities were located along existing linear facilities including roads, transmission lines, and pipelines.

3.1.3 Polygen Plant Site Access

Improved roads exist close to the proposed polygen plant site. The nearest improved road that provides access to the site is FM 1601. Although this road could serve as the access road connecting the polygen plant site to the I-20 interchange, its use would require construction of an underpass, overpass, or at-grade intersection with the UPRR line.

Summit's preferred plant access would be at the northeast corner of the proposed polygen plant site. Ector County has agreed to build an access road to the site on the eastern side of the property. This road would be accessed from FM 866, which also connects to I-20. Use of FM 866 would require the construction of approximately 3.7 mi (5.6 km) of new road.

A rail line owned by UPRR borders the polygen plant site to the south. Access to the plant site from this rail line would require construction of a rail spur to connect the main UPRR line to the plant's internal rail loop.

3.2 Impacts Assessment Background and Definitions

Summit's proposed project and its options, as described in Chapter 2, could cause changes or modifications to the existing environment. The analysis in this chapter provides a quantitative or qualitative comparison (depending on the available data and nature of the impact) of the proposed project and its options and describes the extent of those impacts in the context of the existing environment.

Under the No Action Alternative, the TCEP would not be constructed or operated. The No Action Alternative forms the baseline against which the potential impacts associated with DOE's Proposed Action (and Summit's proposed project) are compared. However, should the TCEP not be developed, Summit has stated that the site would be sold and it is possible that the purchaser of the site would develop that tract for industrial, commercial, or residential uses that could impose effects similar to those that would be imposed by the TCEP.

For the analysis, DOE used data gathered during field surveys, existing data, and appropriate scientific methodologies. DOE conducted a site reconnaissance of the polygen plant site on April 7 and 8, 2010, followed by a data collection survey of the project area on July 5 through July 9, 2010. A third field investigation was conducted on November 2 and 3, 2010. DOE documented the existing conditions on the proposed polygen plant site and along the various proposed linear facilities.

Available existing data that were used in the analysis include but are not limited to: landscape-level data such as U.S. Geological Survey land use/land cover data; Texas Natural Resources Information System public spaces and parks data, National Hydrography Dataset (NHD) data, Soils Survey Geographic Database soils data, state agency information on wildlife habitat boundaries, and available county parcel zoning data.

RPS Group, on behalf of Summit, conducted the air quality analysis including dispersion modeling for the project using the American Meteorological Society and EPA Regulatory Model (AERMOD) in preparation of the air emissions permit application. The air quality analysis also evaluated potential human health effects from project emissions using TCEQ effects screening limits (ESL) (TCEQ 2010a).

3.2.1 Region of Influence

ROIs vary by resource or use depending on the geographic extent of the resources or use and the extent of the effects of the proposed project on a resource or use. In some cases, the ROI is the proposed polygen plant site and linear facilities only (for example, soils) because that is the extent of the effect of the proposed project on the resource. In other cases, the ROI is much larger, encompassing administrative or natural boundaries (for example, socioeconomic conditions or wildlife and habitat) because effects on the resource extend beyond the project physical boundaries. The ROI for each resource or use is defined in the Background section for each resource description.

3.2.2 Types of Impacts

Impacts (or effects) are modifications to the existing environment and effects on humans brought about by an action. Impacts can be beneficial or adverse; they can result from the action directly or indirectly; and they can be temporary, permanent, or cumulative in nature.

Direct impacts from a proposed project affect a specific resource, and generally occur at the same time and place. *Indirect impacts* can result from one resource affecting another (e.g., soil erosion and sedimentation affecting water resources) or can occur later in time or removed in location. Indirect impacts described in this EIS are those that are reasonably expected to occur. *Cumulative effects* result from the incremental effects of an action when added to other past, present, and reasonably foreseeable future actions. Direct and indirect effects are described in the Environmental Impacts sections for each resource area. Cumulative effects are discussed in Chapter 5. Disclosures of irreversible and irretrievable commitment of resources and the impacts of the proposed project's short-term resource use on the long-term productivity of the project area are discussed in Chapter 6.

3.2.3 No Action Alternative

For the purposes of analysis, the No Action Alternative is assumed to be equivalent to a "no build" alternative, meaning that the TCEP would not be developed and rural land uses, including residential development, grazing, dispersed recreation, and light commercial and industrial development, would continue in the project area. Summit has stated that, should the TCEP not go forward, the polygen plant site would be sold. It is possible that the purchaser of the site could develop that tract for industrial, commercial, or residential uses that could impose impacts to existing environmental conditions.

3.2.4 General Assumptions

The following are the general assumptions used for this EIS. Assumptions associated with a specific resource (e.g., wildlife habitat) are included in the impacts analysis for that resource.

- Acreages were calculated using computer-based geographic information systems (GIS); there may be a slight variation in total acres among resources. These variations are negligible and did not affect the analyses.
- All acreages and percentages presented in this chapter pertain to all lands in the polygen plant site and associated linear facilities, unless otherwise specified.
- The impacts analysis takes into account the mitigation measures to which Summit has committed and which are described in Chapter 2 (see Section 2.5).
- Summit's proposed project and its options incorporate the implementation of applicable controls and measures.
- Summit would meet all federal, state, and local regulatory requirements.

3.3 Air Quality and Greenhouse Gas Emissions

3.3.1 Background

This section identifies and describes the air quality and GHG emissions that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project on regional air quality and human health. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

3.3.2 Region of Influence

The ROI for air quality encompasses a 31-mi (50-km) radius around the proposed polygen plant. It is the same as the Area of Significant Impact used for the air dispersion modeling for the TCEP. For consistency, the term ROI is used in this section.

3.3.3 Methodology and Indicators

Various state and federal air quality standards and emissions limits have been established to minimize air pollutant emissions and resulting adverse air quality impacts, including the potential for human health impacts. Potential impacts and their indicators are shown in Table 3.1.

Table 3.1. Indicators of Potential Air Quality Impacts

Potential Impact	**Impact Indicator**
Emissions of criteria air pollutants and HAP	Tons of emissions per year for each air contaminant
Change in air quality related to the National Ambient Air Quality Standards (NAAQS)	
Consumption of Prevention of Significant Deterioration (PSD) increments as defined by the Clean Air Act	
Reduction in visibility and increase in regional haze in Class I areas*	
Deposition of N_2 and sulfur in Class I areas*	
Conflict with local or regional air quality management plans	
Emissions of GHGs (CO_2 emissions)	
Solar loss, fogging, icing, or salt deposition on nearby residents	Estimated total solids emission rate, frequency of plumes
Discharge of odors into the air	Odor sources and estimated quantity

*A Class I area is defined under the Clean Air Act as a national park greater than 6,000 ac (2,428 ha), wilderness area or national memorial park greater than 5,000 ac (2,024 ha), or international park that existed in 1977.

Construction of the TCEP and its linear facilities would increase dust, airborne chemicals, and vehicular emissions in the ROI. During construction of the project, temporary and localized increases in concentrations of nitrogen dioxide (NO_2), CO, SO_2, volatile organic compounds, PM with aerodynamic diameters equal to or less than 0.00039 in (10 micrometers) (PM_{10}), and fine PM with aerodynamic diameters equal to or less than 0.000098 in (2.5 micrometers) ($PM_{2.5}$) would result from exhaust emissions of workers' vehicles, heavy construction equipment, diesel generators, and other machinery and tools. Increased emissions of dust would also result from clearing, excavating, and grading activities associated with construction. A qualitative analysis was performed for the air quality impacts associated with construction.

Plant operations would also result in emissions of air pollutants and GHGs. Although the TCEP would produce lower air pollutant emissions as compared to conventional coal-fueled plants or older IGCC plants, unplanned upsets and subsequent startups would result in the emission of a large portion of the total air pollutants emitted during early years of plant operation. Plant upsets include any serious malfunction in the IGCC process that would result in the sudden shutdown of the turbine and other plant components, requiring subsequent plant restart. Emissions would be expected to decrease each year, however, as operator learning and experience would reduce the frequency and types of unplanned restart events. Air dispersion modeling was based on year-round plant operation (8,760 hours per year); plant maintenance and unplanned restarts as a result of plant upsets were assumed to occur 60 times per year.

The proposed project would be a new Title V Major Source as defined by the PSD regulations and the Clean Air Act and would emit NO_x, SO_2, PM_{10}, $PM_{2.5}$, CO, and H_2SO_4 in quantities that trigger PSD review for these constituents. Operational impacts of the project were evaluated on the basis of estimated emissions of specified air pollutants as processed with an air dispersion model for Class II areas, as required by PSD review requirements. PSD Class I visibility impairment analysis was not required for the TCEP because the polygen site is greater than 62 mi (100 km) away from the nearest Class I area.

> A **Title V Major Source** is defined as any source emitting or having the potential to emit 1) 100 tn (91 t) per year or more of any criteria pollutant; 2) 10 tn (9 t) per year or more of any HAP or 25 tn (22 t) per year of any combination of HAPs.

In addition to air pollutant emissions from plant operations, workers' and plant vehicles would provide an ongoing source of exhaust and dust emissions for the life of the project. A qualitative assessment of fugitive dust and emissions was used to determine impacts from these sources. Plume emissions from cooling towers were also qualitatively assessed to estimate the likelihood of localized decreases in visibility in the region from solids deposition.

A health effects evaluation was also performed for the emissions of HAPs from the TCEP's operations using the TCEQ ESLs. Other air quality impacts analyses performed for the proposed project were an ozone (O_3) impacts analysis and a review of SO_2, H_2SO_4, and H_2S emissions.

The following sections provide a summary of the PSD Class II area modeling and ESL analysis results. A detailed description of the AERMOD modeling approach used for TCEP, including modeling assumptions and data, is presented in *Air Quality Analysis: Permit Nos. 92350 and Prevention of Significant Deterioration (PSD)-TX-1218 Integrated Gasification Combined-Cycle Power Plant*, provided for the TCEP air permit application (RPS Group 2010) and incorporated into this EIS by reference.

3.3.3.1 MODELING APPROACH

Air dispersion modeling for the project was conducted using AERMOD. This is the EPA regulatory default model for local (within 31 mi [50 km] of the project area) air quality analysis. Model inputs and control parameter options were selected in accordance with protocols established in:

- EPA Guidelines on Air Quality Models;

- TCEQ Air Quality Modeling Guidelines (Revised, February 1999, RG-25);
- *TCEQ Modeling and Effects Review Applicability: How to Determine the Scope of Modeling and Effects Review for Air Permits* (October 2001, RG-324); and
- written guidance (Texas Natural Resource Conservation Commission 1998 Memorandum: Background Concentration Determination for Use in NAAQS Analyzes; TCEQ Draft Ozone Procedures; 2010 EPA Memorandum: Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS).

The air dispersion modeling ROI for the NAAQS/PSD increment analysis included on-site and off-site sources within 31 mi (50 km) of the proposed polygen plant site. This modeling was performed to determine whether NAAQS and PSD increments would be exceeded by TCEP operations. Predicted pollutant concentrations at each receptor, spaced at 82-ft (25-m) intervals within the polygen plant site and at progressively wider spacing outside of plant site boundaries, were compared to significant impact levels (SILs) as defined by EPA (EPA 2010a, 2010b, 2010c, 2010d). Additional information on the development of the receptor grid is provided in the *Air Quality Analysis: Permit Nos. 92350 and Prevention of Significant Deterioration (PSD)-TX-1218 Integrated Gasification Combined-Cycle Power Plant*, provided for the TCEP air permit application (RPS Group 2010) and incorporated into this EIS by reference.

The receptor grids used for the modeling analyses are as follows:

- 82-ft (25-m) spacing on the entire polygen plant site
- 82-ft (25-m) spacing extending from the property line out 328 ft (100 m) and within 1,640 ft (500 m) of the nearest source
- 328-ft (100-m) spacing within 328 ft (100 m) to 3,280 ft (1,000 m) of the sources;
- 1,640-ft (500-m) spacing within 3,280 ft (1,000 m) to 1,640 ft (500 m) of the sources
- 3,280-ft (1,000-m) spacing within 16,404 ft (5,000 m) to greater than 49,212 ft (15,000 m) of the sources (an additional grid out to greater than 85,302 ft [26,000 m] was used for the SO_2 1-hour AOI modeling)

Dust emissions during the operation of the TCEP would result from windblown dust generated from disturbed areas and dust generated from vehicle traffic on unpaved roads and other surfaces. Most of the dust generated from the project area during construction would be controlled through mitigation, such as through the use of spray trucks or a dust palliative. However, incidents of windblown dust are unpredictable and typically occur several times per year, most often during the late winter and early spring. At such times, short-duration, windblown dust plumes in the region significantly impair visibility. These dust plumes result from exposed soils that are picked up during strong wind events. The TCEP would not contribute more windblown dust than would other dry desert or agricultural areas, and the implementation of dust controls would make the TCEP less susceptible to release of windblown dust than native bare soil or the agricultural areas near the polygen plant site. Consequently, dust emissions were not considered in modeling.

3.3.3.2 EFFECTS SCREENING LIMITS

The TCEP air quality analysis also evaluated potential human health effects from project emissions using TCEQ ESLs (TCEQ 2010a). Health-based ESLs are set at levels below that which has been shown to cause adverse health effects in humans or laboratory animals. This establishes a basis to determine whether the constituent concentrations in TCEP's emissions could affect human health.

The TCEQ uses a three-tiered ESL process to assess effects on human health from air emissions:

- Tier I: Estimated off-site short-term and long-term (as applicable) concentrations are compared to applicable ESLs. If the estimated concentration is less than the ESL, the concentration would not harm human health and no further review occurs.

- Tier II: If an ESL exceedance is predicted to occur in Tier I, the receptor type at the site of exceedance is evaluated. There are two types of receptors: industrial and nonindustrial. If the maximum predicted concentration at an industrial receptor is less than 2× ESL or if the maximum concentration at a nonindustrial receptor is less than the ESL, the concentrations would not harm human health, and no further review occurs.
- Tier III: If an ESL exceedance is predicted to occur in Tier II, additional case-specific factors that have a bearing on the predicted concentration are considered. The frequency of exceeding the ESL at a receptor is determined for 2×, 4×, and 10× ESL. The receptor/magnitude/frequency combination is subsequently evaluated for potential adverse effects on human health.

3.3.4 Affected Environment

3.3.4.1 WIND

Wind speed and direction are important components in determining air quality impacts. Winds in the ROI predominately flow from the south-southeast and from the southeast, and to a lesser extent from the southwest. The frequency, direction, and speed of winds in 2005 at the Midland Airport weather station (25 mi [40 km] east of the polygen plant site) are illustrated in Figure 3.2. Windy conditions during the late winter and early spring contribute to naturally occurring windblown dust in the region, although dust storms may be exacerbated by land disturbances that expose soil and/or result in the removal of vegetation.

3.3.4.2 LOCAL AND REGIONAL AIR QUALITY

National Ambient Air Quality Standards

As directed by the federal Clean Air Act, EPA has established NAAQS for six criteria pollutants (see Table 3.2). These standards were adopted by EPA to protect public health (primary standards) and public welfare (secondary standards). The six pollutants are CO, NO_2, O_3, PM (PM_{10} and $PM_{2.5}$), SO_2, and lead. States are required to adopt standards that are at least as stringent as the NAAQS. Texas ambient air quality standards are identical to the NAAQS (40 C.F.R. §§ 50.4–50.16; and 30 Texas Administrative Code [TEX. ADMIN. CODE] Chapter 101, § 21).

Recent Air Quality Monitoring Data and National Ambient Air Quality Standards Exceedances

The TCEQ Monitoring Operations Division maintains a network of air quality monitoring sites throughout the state. An assessment of existing criteria pollutants levels in the region is based on data collected and reported by the TCEQ in 2009 (TCEQ 2009). The only monitoring station in Ector County is for $PM_{2.5}$. Therefore, conservative representative monitoring data were obtained from other monitors in the state, following TCEQ guidance for background concentration determination in NAAQS analyses (RPS Group 2010). The monitoring stations were selected based on the comparisons of population and emissions of the counties where the monitors are located to Ector County. A summary of the representative monitoring results are provided in Table 3.3.

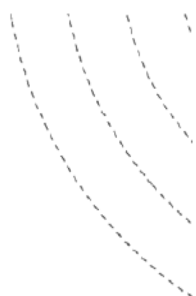

Figure 3.2. Distribution of winds (percent) at the Midland Airport.

Table 3.2. National Ambient Air Quality Standards

Pollutant	**Averaging Time**	**Primary µg/m³ (ppm)**	**Secondary µg/m³ (ppm)**
CO	1-hour	40,000 (35)	–*
	8-hour	10,000 (9)	–
NO_2	Annual	100 (0.053)	100 (0.053)
	1-hour	188 (0.10)	–
O_3	(1-hour)†	(0.12)	(0.12)
	8-hour	(0.075)	(0.075)
PM_{10}	24-hour	150	150
	(annual)‡	50	50
$PM_{2.5}$	24-hour	35	35
	Annual	15	15
SO_2	1-hour§	196 (0.075)	–
	3-hour§	–	1,300 (0.5)
	(24-hour)§	365 (0.14)	–
	(annual)§	80 (0.03)	–
Lead	Calendar quarter	1.5	1.5
Lead	Rolling 3-month average	0.15	0.15

Source: 40 C.F.R. Part 50.
Note: µg/m³ = micrograms per cubic meter.
* No standard.
† O_3 1-hour standard revoked by EPA on June 15, 2005.
‡ PM_{10} Annual standard revoked effective December 17, 2006.
§ On June 2, 2010, EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010. The secondary SO_2 standard was not revised at this time; however, the secondary standard is undergoing a separate review by EPA.

Table 3.3. Air Monitoring Data for Texas Commission on Environmental Quality Monitoring Sites (2009)

Monitoring Site	**CO**		**O_3**		**PM_{10}**		**$PM_{2.5}$**		**NO_2**		**SO_2**[*]	**Lead**[†]
NAAQS	**Maximum Concentration 1-hour 40,000 μg/m^3**	**Maximum Concentration 8-hour 10,000 μg/m^3**	**Maximum Concentration 1-hour 0.12 ppm**	**Fourth Highest Concentration 8-hour 0.075 ppm**	**Maximum Concentration 24-hour 150 μg/m^3**	**Arithmetic Annual Mean Revoked**	**Maximum Concentration 24-hour 35 μg/m^3**	**Arithmetic Annual Mean 15 μg/m^3**	**Maximum Concentration 1-hour 188 μg/m^3**	**Arithmetic Annual Mean 100 μg/m^3**	**Arithmetic Annual Mean 80 μg/m^3**	**Rolling 3-month average 0.15 μg/m^3**
Washington Street, Laredo, Webb County	3,013	1,858	–	0.052	–	–	–	–	–	–	–	–
700 Zaragosa Street, Laredo, Webb County	3,145	2,219	–	–	–	–	–	–	–	–	–	–
14790 CR 1145, Tyler, Smith County	–	–	–	–	–	–	–	6.86	18.80	7.50	–	–
2600 B Webberville Road, Austin, Travis County	–	–	–	–	41	18	–	–	–	–	–	–
12200 Lime Creek Road, Austin, Travis County	–	–	–	–	41	14	–	–	–	–	–	–
Barrett and Monahans Streets, Odessa, Ector County	–	–	–	–	–	–	16.20	–	–	–	–	–

Note: Dashed line (–) indicates that the air pollutant was not monitored at the monitoring site. μg/m^3 = micrograms per cubic meter.

* 2009 monitoring data were not collected for SO_2.

† 2009 monitoring data were not collected for lead.

As shown in Table 3.3, the air quality in Ector and surrounding Webb, Smith, and Travis Counties is generally good, with pollutant levels below the NAAQS. The major air pollutants in the region are CO, PM, volatile organic chemicals, and O_3 from vehicular travel along local paved roads and I-20. Hydrocarbon emissions also occur from oil and gas wells and related transmission and storage facilities.

Duke Energy Field Services is the only existing large emissions point source within 1.0 mi (1.6 km) of the polygen plant site. Within a 10-mi (16-km) radius, the Block 31 Gas Plant, Walton Compressor Station, Shell Western E and P Incorporated, Sands Hills Gas Plant, Odessa Cement Plant, and several active and abandoned limestone quarries are present. These existing sources contribute to concentrations of airborne pollutants and dust in the region.

Description of Criteria Air Pollutants

Carbon Monoxide

CO is formed from the combustion of carbon-based products, especially in an O_2 deficient atmosphere. Of the criteria pollutants, CO is one of the most commonly occurring pollutants in Ector County. Motor vehicles are the primary source of CO in Ector County.

Ozone

Stratospheric O_3 occurs naturally, but it can also be formed from the reaction of volatile organic compounds and NO_X in the presence of heat and sunlight. In 2009, maximum concentrations of O_3 were moderate, but did not exceed the 8-hour standard at the nearest monitoring station in Webb County.

Particulate Matter

PM_{10} and $PM_{2.5}$ occurs from a variety of activities such as construction, agriculture, industrial processes, vehicular travel, and wind erosion. Because of the rural nature of the area and the limited number of mobile and point sources, PM_{10} and $PM_{2.5}$ concentrations are low to moderate in this region, as indicated by the monitoring results in Ector, Smith, and Travis Counties.

Nitrogen Dioxide

NO_2 is a gas that forms primarily when fuel is burned at high temperatures; common sources include vehicle exhaust, industry, and power plant emissions. NO_2 is a precursor to O_3 and can contribute to haze and visibility reduction. Ambient concentrations of NO_2 are well below the standard in this region, as indicated by the monitoring station in Smith County.

Sulfur Dioxide

SO_2 exists as a gas associated with the burning of sulfur-bearing coal, oil, or diesel fuel. In the atmosphere, it can combine with water vapor and O_2 gas to form a weak H_2SO_4, which precipitates as acid rain that can adversely affect the environment. Ambient concentrations of SO_2 are extremely low in Ector County due to the lack of major sources. For that reason, SO_2 is not included in Ector County monitoring efforts.

Lead

No lead sources are identified in Ector County; therefore, lead is not included in recent Ector County monitoring efforts (TCEQ 2009).

Clean Air Act Attainment Status

Based on the NAAQS, all air basins (or portions thereof) are designated as either in attainment or not in attainment with respect to criteria air pollutants (42 U.S.C § 7407). A particular geographic region may be designated an attainment area for some air pollutants and nonattainment for others. Ector County is part of the Midland-Odessa-San Angelo Intrastate Air Quality Control Region, which is in attainment for the six criteria air pollutants and has no history of nonattainment. Regionally, the closest nonattainment area is approximately 215 mi (346 km) away, in El Paso County.

3.3.4.3 HAZARDOUS AIR POLLUTANTS

HAPs, also known as air toxics, are pollutants that can cause health effects (e.g., cancer) in humans or may cause adverse environmental and ecological effects. In 2001, EPA developed a national network for monitoring ambient levels of air toxic emissions. Based on the latest National-Scale Air Toxics Assessment in 2002, cancer, neurological, and respiratory risks from HAP emissions to residents in the ROI are estimated to be very low (average total risk is less than 1 in a million). Most HAP emissions in Ector County originate from background sources and petroleum compounds from oil and gas wells; mobile sources account for most of the remaining HAP emissions. Primary HAPs for the county are toluene, xylene, benzene, hexane, 2,2,4-trimethylpentane, methanol, formaldehyde, and vinyl acetate.

Radionuclide Emissions

Coal, which would be combusted as part of polygen plant operations, is largely composed of organic matter but also contains some trace elements such as uranium and thorium that are naturally radioactive. Analyses of the types of coals that would be used in the polygen plant show that concentrations of uranium and thorium fall in the range from slightly below 1 to 4 ppm. Although there are research gaps related to the ultimate fate of radionuclides in advanced coal technologies, EPA has determined that current levels of radionuclide emissions (both parent elements and various decay products) from coal-fueled boilers represent a level of risk that protects the public health with a margin of safety. Consequently, the consequences of TCEP radionuclide emissions were not evaluated.

Mercury

The TCEP could be subject to the Clean Air Mercury Rule because it would generate approximately 275 MW of electricity and would sell more than one-third of its potential electric output. The rule established standards of performance that limit Hg emissions from coal-fueled power plants. However, that rule was vacated by a federal court and new rules are scheduled to be proposed by March 2011.

3.3.4.4 GREENHOUSE GASES

In *Massachusetts v. EPA, et al*., 549 U.S. 497 (2007), the U.S. Supreme Court ruled that GHGs meet the Clean Air Act's definition of a pollutant and that EPA has authority to regulate GHGs. Recent federal regulation (40 C.F.R. Part 98, Reporting of GHG Emissions) requires annual monitoring, record-keeping, and reporting of GHG emissions for large sources and suppliers. Because the TCEP would be an electrical generating unit emitting more than 27,558 tn (25,000 t) of GHG emissions per year, it would be required to report emissions of CO_2 under Subpart C of this rule. Also, because the polygen plant would be a supplier of CO_2, the amount of CO_2 captured in the process and its end use (urea production and EOR) would be reported annually.

TCEQ issued a PSD construction permit for the TCEP on December 28, 2010. As a result, the TCEP is not affected by EPA's Tailoring Rule and related EPA actions, which determined that GHG emissions became subject to regulation under the federal Clean Air Act as of January 2, 2011. EPA's regulatory actions regarding GHGs have been challenged in court by various parties, including the State of Texas. If the PSD permit for the TCEP had been issued after January 2, 2011, then, depending on the outcome of legal challenges to EPA's regulatory actions, the PSD permit issued to the TCEP could have included limits on GHG emissions reflecting the best available control technology for control of those emissions. The PSD permit issued for TCEP does not contain limits on GHG emissions, and no best available control technology determination for GHG emissions from the TCEP was required. However, the TCEP is designed to capture 90 percent of the carbon content of the coal used to power the generation of electricity. This would result in a lower rate of CO_2 emissions per MW/hour than any existing coal-fired power plant, or a typical natural gas–fired power plant.

The State of Texas does not currently have a climate change or GHG action plan.

3.3.4.5 PROXIMITY TO CLASS I AND II AREAS

There is no Class I area in the air quality ROI. The closest Class I area is the Carlsbad Caverns National Park, located 108 mi (174 km) west of the polygen plant.

The ROI is located in a Class II area, and is required to comply with PSD increments for pollutant concentrations. Allowable PSD increments currently exist for three criteria air pollutants: SO_2, NO_2, and PM (both PM_{10} and $PM_{2.5}$). The final rule for PSD increments for annual and 24-hour $PM_{2.5}$ was published by EPA on October 20, 2010. However, the ''trigger date'' of the new increments is October 20, 2011, which is one year after the date of promulgation of this final rule (permit must be issued by that date). As a result, the TCEP is not subject to the new $PM_{2.5}$ increment requirements at this time.

3.3.4.6 AIR QUALITY MANAGEMENT PLANS

No local air quality management plans exist for the ROI.

3.3.5 Environmental Impacts of Summit's Proposed Project

Direct impacts to air quality would result from construction vehicle exhaust and dust-generating activities (e.g., soil excavation and site grading) during project construction, and stationary source emissions (combustion turbine, flare, gasifier, cooling towers, sulfur recovery system, and coal handling) during project operations.

3.3.5.1 SENSITIVE RECEPTORS

The proposed polygen plant site is primarily rural and has generally been used for oil and gas production, ranching, and agricultures activities. There are no sensitive receptors such as schools or hospitals within 1.0 mi (1.6 km) of the polygen plant site; however, there are seven residences in and around Penwell, to the south of the proposed plant site. All other sensitive populations are over 10 mi (16.1 km) east of the polygen plant site in the city of Odessa.

3.3.5.2 PROJECT EMISSIONS

Summary of Emissions during Construction

During construction, operation of worker vehicles and construction equipment and vehicles would result in localized and short-term criteria pollutant emissions. In addition, land clearing and excavation, road surface construction, and cut-and-fill operations would generate dust (PM_{10} and $PM_{2.5}$). Construction impacts would be minimized through the implementation of dust controls such that impacts attributable to dust emissions would be localized and temporary.

Summary of Emissions during Operations

A summary of the maximum operational emissions from the TCEP is provided in Table 3.4. Maximum annual emissions would exceed both PSD and Title V Major Source thresholds for NO_x, SO_2, CO, PM_{10}, $PM_{2.5}$, and H_2SO_4 (i.e., 100 tn [91 t] per year). Plant-wide emissions of HAPs are below the major source thresholds of 10 tn (9 t) per year for individual HAPs and 25 tn (23 t) per year for total combined HAPs (see Table 3.6). Operational emissions for the TCEP would increase existing county-wide criteria pollutant emissions, ranging from 2 percent for NO_2 to 20 percent for SO_2 and $PM_{2.5}$.

Combustion turbine operations would be the largest contributor to polygen plant NO_2 and H_2SO_4 emissions, and gasifier flares during plant startup would be the largest source of CO and SO_2 emissions. Because the frequency of unplanned plant startups should progressively decrease from year one onward, estimated CO and SO_2 emissions would be expected to decrease over time.

PM emissions are typically the greatest for large industrial processes with high air flow. For the TCEP, the combustion turbine and urea granulation stack meet these criteria and would contribute the highest PM load, even with control technologies installed.

Table 3.4. Annual, Maximum Operation Emissions by Air Contaminant

Source	NO_2 Emissions (tn [t] per year)	CO Emissions (tn [t] per year)	SO_2 Emissions (tn [t] per year)	PM_{10} Emissions (tn [t] per year)	$PM_{2.5}$ Emissions (tn [t] per year)	H_2SO_4 Emissions (tn [t] per year)
Combustion turbine (including startup) and duct burner	165.79 (150.40)	310.97 (282.11)	78.10 (70.85)	118.80 (107.77)	118.80 (107.77)	11.96 (10.85)
	240.20 (108.95)*	1,705.80 (773.74)*	–	–	–	–
Combustion turbine lube oil vent	–	–	–	0.22 (0.20)	0.22 (0.20)	–
Steam turbine lube oil vent	–	–	–	0.22 (0.20)	0.22 (0.20)	–
H_2SO_4 plant vent	11.57 (10.50)	0.51 (0.46)	10.19 (9.24)	2.68 (2.43)	2.68 (2.43)	2.68 (2.43)
Urea granulation stack	–	–	–	199.20 (180.71)	199.20 (180.71)	–
Coal mill dryer vent train (×2)	33.50 (30.39)	61.42 (55.72)	3.18 (2.88)	41.68 (37.81)	41.68 (37.81)	–
Cooling tower	–	–	–	5.82 (5.28)	0.04 (0.036)	–
Gasifier flare startup	11.99 (10.88)	545.24 (494.63)	159.46 (144.67)	–	–	–
	133.26 (60.45)*	6,058.17 (2,747.94)*	1,771.78 (803.61)*	–	–	–
Gasifier flare (×2)	0.24 (0.22)	1.22 (1.11)	<0.01 (<0.01)	–	–	–
Natural gas fired auxiliary boiler	1.06 (0.96)	2.31 (2.10)	0.18 (0.16)	0.47 (0.43)	0.47 (0.43)	–
Railcar unloading	–	–	–	0.02 (0.018)	<0.01 (<0.01)	–
Coal unloading conveyor	–	–	–	0.02 (0.018)	<0.01 (<0.01)	–
Crusher feed conveyor (×2)	–	–	–	0.02 (0.018)	<0.01 (<0.01)	–
Coal crusher building	–	–	–	0.06 (0.05)	0.06 (0.05)	–
Plant feed conveyor (×2)	–	–	–	0.16 (0.15)	0.02 (0.018)	–

Table 3.4. Annual, Maximum Operation Emissions by Air Contaminant

Source	NO_2 Emissions (tn [t] per year)	CO Emissions (tn [t] per year)	SO_2 Emissions (tn [t] per year)	PM_{10} Emissions (tn [t] per year)	$PM_{2.5}$ Emissions (tn [t] per year)	H_2SO_4 Emissions (tn [t] per year)
Coal transfer tower	–	–	–	1.13 (1.03)	1.13 (1.03)	–
Tripper feed conveyor (×2)	–	–	–	0.02 (0.018)	<0.01 (<0.01)	–
Silo fill tripper conveyor (×2)	–	–	–	0.02 (0.018)	<0.01 (<0.01)	–
Gasifier feed silo (×2)	–	–	–	0.02 (0.018)	<0.01 (<0.01)	–
Slag storage pile (×2)	–	–	–	0.26 (0.24)	0.04 (0.36)	–
Slag transfer tower(×2)	–	–	–	0.01 (<0.01)	<0.01 (<0.01)	–
Slag transfer conveyor	–	–	–	<0.01 (<0.01)	<0.01 (<0.01)	–
Slag loadout conveyor	–	–	–	<0.01 (<0.01)	<0.01 (<0.01)	–
Slag rail loading station	–	–	–	<0.01 (<0.01)	<0.01 (<0.01)	–
Urea storage conveyor	–	–	–	1.45 (1.32)	0.22 (0.20)	–
Urea transfer tower (×2)	–	–	–	1.12 (1.02)	1.12 (1.02)	–
Urea tripper conveyor	–	–	–	1.01 (0.92)	0.15 (0.14)	–
Urea storage building	–	–	–	0.52 (0.47)	0.08 (0.07)	–
Urea reclaim conveyor	–	–	–	2.32 (2.10)	0.35 (0.32)	–
Urea loadout conveyor	–	–	–	0.43 (0.39)	0.07 (0.06)	–
Urea rail loading station	–	–	–	0.56 (0.51)	0.56 (0.51)	–
CO_2 compressor bypass vent †	–	243.09 (220.53)	–	–	–	–

Table 3.4. Annual, Maximum Operation Emissions by Air Contaminant

Source	NO_2 Emissions (tn [t] per year)	CO Emissions (tn [t] per year)	SO_2 Emissions (tn [t] per year)	PM_{10} Emissions (tn [t] per year)	$PM_{2.5}$ Emissions (tn [t] per year)	H_2SO_4 Emissions (tn [t] per year)
Diesel-fired emergency generator(×2)	1.02 (0.93)	0.60 (0.54)	<0.01 (<0.01)	0.04 (0.036)	0.04 (0.036)	–
Diesel fire water pump engine	0.03 (0.027)	0.05 (0.045)	<0.01 (<0.01)	<0.01 (<0.01)	<0.01 (<0.01)	–
Fugitives: raw syngas	–	7.31 (6.63)	–	–	–	–
Fugitives: clean syngas	–	0.13 (0.12)	–	–	–	–
Fugitives: acid gas	–	0.01 (<0.01)	–	–	–	–
Active/live coal storage pile	–	–	–	0.52 (0.47)	0.08 (0.07)	–
Inactive coal storage pile	–	–	–	1.24 (1.12)	0.18 (0.16)	–
Proposed project total annual emissions	225.00 (204.12)	1,173.00 (1,064.13)	251.10 (227.79)	380.00 (344.73)	367.00 (332.94)	15.00 (13.61)
2005 Ector County emissions	12,777 (11,591)	26,573 (24,107)	2,105 (1,910)	6,175 (5,602)	1,800 (1,633)	n/a
Estimated increase in current emissions	2%	4%	20%	6%	20%	n/a

Note: No significant lead sources were identified in ROI; therefore, lead was not carried forward for analysis. O_3 was analyzed separately using TCEQ guidance, the results of which are not comparable for inclusion in this table (see Other Air Quality Impacts Section 3.3.5.3). n/a = not available.
*Maximum short-term emissions rates (lbs [kg]/hour) during startup, shutdown, and maintenance.
†Annual emissions are based on venting 5 percent of the time during maintenance operations (438 hours per year).

Project Significant Impact Level Exceedances

Emissions of the criteria air pollutants would exceed the threshold for PSD review; therefore, ground-level concentrations that would be caused by the TCEP emission sources were modeled and compared with EPA-established SILs to determine if more detailed analysis was required. The highest modeled concentration for each criteria air pollutant is shown in Table 3.5. The maximum NO_2 (annual), CO (1-hour and 8-hour), and SO_2 (annual) modeling results were lower than the respective SILs, indicating an extremely low likelihood of a significant air quality impact; therefore, no further analysis was conducted. The maximum NO_2 (1-hour), PM_{10} (24-hour), $PM_{2.5}$ (24-hour and annual), and SO_2 (1-hour, 3-hour, and 24-hour) modeling results were higher than the respective SILs, however, and triggered the NAAQS and PSD increment modeling analysis.

Table 3.5. TCEP Sources Modeling Results by Air Contaminant

Pollutant	Regulation	Averaging Period	Maximum Concentration (μg/m³)	Modeling SIL (μg/m³)
NO_2	NAAQS	1-hour*	**94.40**	7.50
		Annual	0.30	1.00
CO	NAAQS	1-hour	1,718.00	2,000.00
		8-hour	400.00	500.00
PM_{10}	NAAQS	24-hour	**10.80**	5.00
		Annual†	**1.30**	1.00
$PM_{2.5}$	NAAQS	24-hour	**5.50**	1.20
		Annual	**0.79**	0.30
SO_2	TEX. ADMIN. CODE Chapter 112	30-min	83.80	–
	NAAQS	1-hour	**52.20**	7.80§
		3-hour	**58.40**	25.00§
		24-hour*	**18.30**	5.00
		Annual†	0.20	1.00
H_2S	TEX. ADMIN. CODE Chapter 112	1-hour	6.90	n/a
H_2SO_4	TEX. ADMIN. CODE Chapter 112	1-hour	0.60	n/a
		24-hour	0.20	n/a
Lead	NAAQS	3-month rolling average	<0.01	n/a

Note: n/a = not available; bolded text in shaded cells indicates that modeling results exceeded SIL. μg/m³ = micrograms per cubic meter.
* The SILs used for the 1-hour NO_2 and 1-hour SO_2 NAAQS demonstration were based on the EPA proposed interim SILs (EPA 2010a, 2010b).
† NAAQS for annual PM_{10}, and 24-hour and annual SO_2 have been revoked by EPA.
§ The 1-hour value is the average at each receptor over five years modeled, whereas the 3-hour value is the maximum from one year.

Project Contributions to National Ambient Air Quality Standards and Prevention of Significant Deterioration Exceedances

A full NAAQS/PSD increment analysis was conducted for the four criteria pollutants that exceeded their respective SILs: NO_2, PM_{10}, $PM_{2.5}$, and SO_2. Emission sources included in the modeling were the on-site sources at the proposed polygen plant site (including upset emissions from plant startup, shutdown, and maintenance operations) and off-site sources in the ROI. Based on the modeling results, operational emissions from the TCEP would not lead to an exceedance of either the PSD increment or the NAAQS for any criteria air pollutants in the region (Table 3.6). However, plant operations would incrementally increase the concentration of those constituents, ranging from an increase (over background concentrations) of up to 9 percent for PM_{10} to 200 percent for NO_2 at receptors with the highest modeled concentration. Additional information regarding the use of receptor grids in NAAQS/PSD analysis is provided in the *Air Quality Analysis: Permit Nos. 92350 and Prevention of Significant Deterioration (PSD)-TX-1218 Integrated Gasification Combined-Cycle Power Plant*, provided for the TCEP air permit application (RPS Group 2010) and incorporated into this EIS by reference.

Table 3.6. National Ambient Air Quality Standards and Prevention of Significant Deterioration Modeling Results by Air Contaminant

Pollutant	Period	Background Concentration ($\mu g/m^3$)	Modeling Result ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	Increase from Background (%)	PSD Allowable Increment ($\mu g/m^3$)	NAAQS Standard ($\mu g/m^3$)
NO_2	1-hour	39.60	81.60	121.00	206	–	188.00
PM_{10}	24-hour	41.00	11.90	53.00	29	30.00	150.00
	Annual	18.00	1.65	20.00	9	17.00	– *
$PM_{2.5}$	24-hour	18.00	11.70	30.00	62	–	35.00
	Annual	8.10	1.17	9.00	14	–	15.00
SO_2	1-hour	–	131.00	131.00	–	–	196.00
	3-hour	–	124.00	124.00	–	512.00	1,200.00
	24-hour	–	71.80	71.80	–	91.00	– *

Note: $\mu g/m^3$ = micrograms per cubic meter.

* NAAQS for annual PM_{10} and 24-hour SO_2 have been revoked by EPA.

Project Effects Screening Limits Results

HAP emissions from TCEP operations that could have a negative effect on human health were screened using TCEQ's ESLs. As shown in Table 3.7, the maximum predicted concentrations for all identified toxic compounds were below their respective ESLs, except for Tier I short-term coal dust. However, because the Tier II maximum concentration at a nonindustrial receptor was lower than the Tier I short-term ESL, the coal dust concentrations met the Tier II requirements for public health and no further analysis was performed, consistent with TCEQ regulations.

Mercury

TCEP operations would produce an estimated 0.02 tn (0.018 t) of Hg per year after 95 percent removal of Hg occurred through the syngas cleanup system. Upon plant startup, the TCEP would be required to comply with the Texas State plan for Clean Air Mercury Rule, as well as meet the federal new source performance standard emission limits. Continuous monitoring for Hg would also be required.

Greenhouse Gas Emissions

TCEP would produce electricity and hydrogen fuel while emitting CO_2. Annual noncaptured CO_2 emissions from TCEP operations would be approximately 300,000 tn (272,155 t) per year of CO_2 (Summit 2010a). This estimate of TCEP emissions is based on the total amount of CO_2 to be generated by the TCEP, minus the CO_2 removal that would occur as a result of the carbon capture technology and subsequent injection for EOR.

Table 3.7. Effects Screening Limits Modeling Results by Hazardous Air Pollutant

HAP	Annual Emission Rate	Tier I: Short-term Impacts		Tier I: Annual Impacts		Tier II: Nonindustrial
	(tn [t] per year)	Maximum Concentration (μg/m³)	ESL (μg/m³)	Maximum Concentration (μg/m³)	ESL (μg/m³)	Maximum Concentration (μg/m³)
NH_3	–	133.30	170.00	1.70	17.00	–
COS*	2.61 (2.37)	12.20	135.00	0.29	2.60	–
Hg*	0.02 (0.018)	0.001	0.25	<0.01	0.03	–
Hydrogen chloride*	3.83 (3.47)	0.06	190.00	<0.01	8.40	–
Hydrogen fluoride*	2.31 (2.10)	0.04	18.00	<0.01	0.60	–
Formaldehyde*	2.96 (2.69)	0.13	15.00	0.16	3.30	–
Propane	–	59.60	18,000.00	0.24	1,800.00	–
Diesel	–	96.60	1,000.00	0.47	100.00	–
Urea	–	45.80	50.00	0.74	5.00	–
Coal dust†	–	**10.70**	**9.00**	0.26	0.90	7.70
Silica	–	9.70	14.00	0.11	0.27	–
Methanol*	–	129.90	2,620.00	3.12	262.00	–

Note: μg/m³ = micrograms per cubic meter.
* HAPs identified under National Emission Standards for HAPs.
† **Bolded text in shaded cells** indicates that maximum predicted results exceed ESL.

Local Plume Visibility, Shadowing, Fogging, and Water Deposition

As previously stated, the polygen plant would be greater than 62 mi (100 km) from the nearest Class I area; therefore, no PSD Class I visibility impairment analysis is required.

TCEP would have two main sources of water vapor plumes: the gas turbine exhaust stack and the cooling tower. The height of the cooling tower would be less than the height of the gas turbine exhaust stack. Because of its reduced height, the cooling tower presents a greater concern than the gas turbine exhaust stack for impacts such as ground-level fogging, water deposition, and solids deposition (including precipitates).

Cooling tower "fogging" occurs when the condensed water vapor plume comes in contact with the ground for short time periods near the tower. Evaporated water would be pure water, although water droplets carried with the exhaust air (called drift) would have the same concentration of impurities as the water entering and circulating through the tower. Water treatment additives could contain anti-corrosion, anti-scaling, anti-fouling, and biocidal additives that could create emissions of volatile organic compounds, PM, and toxic compounds. The drift is not expected to cause excessive pitting or corrosion of metal on nearby structures or equipment because of the relatively small amount of water released and the presence of trace amounts of anti-corrosion additives. Similarly, the treatment additives are not expected to cause noticeable adverse impacts to local biota, owing to the very small amounts that would be released.

Deposition of solids could occur because the TCEP would use process water that may contain total dissolved solids and other PM. Effects from vapor plumes and solids deposition would be most pronounced within 300 ft (91 m) of the vapor source and would decrease rapidly with distance from the source. The greatest concern would be for the creation of traffic hazards on FM 1601 and I-20 as a result of the vapor plume and solids deposition. However, I-20 is located more than 300 ft (91 m) from the proposed plant site, and only 80 ft (24 m) of FM 1601 would be within the buffer zone where it connects with CR 1216 in Penwell. Nearby residences could also be affected by fogging, water deposition, icing, or solids deposition under rare meteorological events. Given the prevailing winds are from south to north, Summit would build the wet cooling towers on the northern side of the plant facilities, if possible, to reduce impacts to existing roads, residences, and to plant operations from cooling tower fogging or icing conditions. There is also a very small potential for localized fog generation to occur from the solar evaporation ponds, if the ponds are chosen as the brine water disposal method.

The drift rate and associated deposition of solids would be reduced by employing baffle-like devices, called drift eliminators, to limit losses to less than 0.01 percent of the circulation rate. TCEP would also comply with the Texas Administrative Code visibility and opacity requirements to minimize visible NO_x and PM in stack emissions.

Odors

TCEP operations would produce two odorous compounds: H_2S and NH_3. Both gases would normally only be emitted as small quantities of fugitive emissions (e.g., through valve or pump packing); however, depending on the wind direction, even small volumes of H_2S and NH_3 odor could create a nuisance for the seven residences within 1.0 mi (1.6 km) of the polygen plant site. Although the likelihood of a large, accidental release, such as a pipe rupture, is low, such an event would result in odors that would be noticeable beyond the boundaries of the TCEP. Texas regulates H_2S odors under nuisance laws; upon receipt of an odor complaint, the TCEQ would investigate the odor for frequency, intensity, duration, and offensiveness. There are no odor regulations for NH_3.

Other odors could be emitted from activities such as equipment maintenance, coal storage, and coal handling. However, these potential odors would be limited to the plant site and would not affect off-site areas.

3.3.5.3 OTHER AIR QUALITY IMPACTS

Based on additional air quality analyses conducted for the air permit application, the project would not be expected to cause noticeable impacts on economic growth, soil, and vegetation. Construction and operation of the TCEP would not limit additional industrial development or economic growth in the region. Modeled ESL concentrations are also within acceptable ranges to protect soil and vegetation (RPS Group 2010).

Following TCEQ guidance, an O_3 impacts analysis was also conducted and it was determined that the proposed polygen plant would be compliant with the 8-hour O_3 standard. In addition, the emissions of sulfur compounds from the TCEP facilities would not exceed the state standards for sulfur compound concentrations.

3.3.6 Mitigation

Project emissions during construction and operation would not cause an exceedance of NAAQS and PSD increments and would not be expected to cause noticeable air quality or human health impacts. Therefore, additional mitigation has not been identified beyond the required compliance with state and federal air quality regulations, as well as implementation of standard construction controls identified in Chapter 2, Table 2.8.

3.4 Climate

3.4.1 Background

This section identifies and describes the climate that could affect or be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

Climate is defined as average weather patterns over a period of time ranging from a few months to thousands of years. Climate fundamentally shapes our surroundings. Temperature, precipitation, winds, and meteorological events (e.g., first and last frosts and beginning and end of rainy seasons) all influence the distribution of water, soils, plants, and wildlife across the globe. Consequently, climate can have dramatic effects on local ecosystems, infrastructure, and human health. Climate can also affect the operations of industrial facilities such as the proposed TCEP.

3.4.2 Region of Influence

The climate ROI is the project area comprising the polygen plant site and utility and transportation linear facilities.

3.4.3 Methodology and Indicators

The impacts analysis for climate and meteorology impacts used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.8.

Table 3.8. Indicators of Potential Climate and Meteorology Impacts

Potential Impact	Impact Indicator
Impacts to TCEP construction from temperature variations and extremes Impacts to TCEP operation or generation of safety hazards from temperature variations and extremes	Expected temperature range
Impacts to TCEP construction from severe weather events Impacts to TCEP operation or generation of safety hazards from severe weather events	Probability of severe weather events such as tornado, floods, or drought conditions Acres of polygen plant site and linear facilities in the floodplain

3.4.4 Affected Environment

3.4.4.1 EXISTING CLIMATE

Temperatures in southeastern Ector County, Texas, are typical of semiarid climates, ranging from the low 30s (degrees Fahrenheit) (just below 0 degrees Celsius) during the winter to the mid 90s (degrees Fahrenheit) (mid-30s degrees Celsius) during the summer. Precipitation in the region is low. Although it is typically in the form of rain, traces of snow, sleet, and hail have been reported. Rainfall occurs primarily during spring and early summer thunderstorms. Due to the flat topography, local flooding can occur during rains, but is typically short in duration. Precipitation amounts are minimal in the region during the remainder of the year, and droughts occur on a frequent basis.

Averaging the temperature and precipitation data for the three locations that characterize the climatology in the project area (stations in Odessa, Midland, and Grandfalls, Texas) yields an average high temperature of 77.9 degrees Fahrenheit (25.5 degrees Celsius), an average low temperature of 49.5 degrees Fahrenheit (9.7 degrees Celsius), and an average precipitation level of 14.1 in (35.8 cm) annually.

3.4.4.2 SEVERE WEATHER EVENTS

Severe weather events for the project area are tornadoes, floods, and drought. The TCEP is located more than 300 mi (483 km) inland (northwest) of the Gulf Coast. For this reason, coastal hurricanes do not occur in the region.

The National Oceanic and Atmospheric Administration reports tornado activity in the U.S. The Fujita Scale is a standard qualitative metric to characterize tornado intensity based on the damage caused. This scale ranges from F0 (weak) to F6 (violent). From 1950 to 2009, 37 tornadoes were reported in Ector County, including 30 F0 tornadoes, three F1 tornadoes, and four F2 tornadoes (National Oceanic and Atmospheric Administration 2010a).

The polygen plant is located outside of the 100-year floodplain. The National Oceanic and Atmospheric Administration database shows that, from 1993 to 2006, 60 floods were reported in Ector County. Thirty-six of these floods caused no damage, 18 caused damage between $5,000 and $30,000, and three caused damage between $75,000 and $300,000. The most severe flood occurred in the early fall of 2004 with approximately $2 million of damage. Total flood damage in Ector County since 1993 is $3.2 million.

Texas has suffered notable periods of drought since the 1930s with extended periods of severe to extreme drought in 1933–1935, 1950–1957, 1962–1967, 1988–1990, 1996, and 1998–2002. These droughts were more common and widespread in the Rio Grande Basin in the western part of the state. A statewide network of data collection sites, operated by state and federal agencies, has been established to monitor drought conditions. These sites provide real-time climate, steam flow, aquifer, and reservoir information to water management professionals to develop drought mitigation and response plans.

3.4.5 Environmental Impacts of Summit's Proposed Project

3.4.5.1 CONSTRUCTION IMPACTS

Severe temperature or weather conditions could temporarily delay construction of the polygen plant if some aspects of construction and material deliveries could not be performed during unusually cold or wet weather. However, impacts would be minimal and temporary, because the region's climate is relatively mild. A strong thunderstorm, flood, or tornado could also cause construction delays. Based on historical tornado activity in Ector County, there could be six F1 or greater tornadoes in the county over the lifespan of the TCEP. The probability of a tornado greater than F1 intensity across Ector County is approximately one every eight years, and the polygen plant covers only 0.04 percent of the combined land area of the county. Therefore, the chance for significant direct and indirect impacts from a tornado during construction would be low. The risks posed to construction safety by climate and severe weather would be mitigated through compliance with all applicable industry standards and with federal, state, and local regulatory requirements.

Severe or extreme drought conditions could increase the potential for wildfires in the area. Drought conditions would also increase the number of water trucks needed to reduce fugitive dust emissions and to support other construction activities. In dry, hot weather, construction workers could need to wear a dust mask and work for shorter time intervals between breaks.

3.4.5.2 OPERATIONAL IMPACTS

Historically, summer temperatures are generally very warm, winters are relatively mild, and significant snowfalls are rare. The polygen plant site would be designed to operate under the expected range of temperature and precipitation conditions.

The possibility of a strong tornado in the region poses the potential for both direct and indirect impacts on plant operations. A strong tornado could directly impact plant operations if sufficient damage were incurred at the plant site, resulting in infrastructure loss or potential release of H_2SO_4 or other hazardous materials stored on-site. Indirect impacts could occur if a strong tornado struck nearby communities and affected the ability of workers or supplies to reach the polygen plant site. The probability of a tornado greater than F1 intensity across Ector County is approximately one every eight years, and the polygen plant covers only 0.04 percent of the land area of the county. Therefore, the chance for significant direct and indirect impacts from a tornado during operations would be low.

It is also very unlikely that a flood would cause a direct or indirect impact to operations at the polygen plant site because it is located outside of the 100-year floodplain. The risks posed to operational safety would be mitigated through compliance with all applicable industry standards and with federal, state, and local regulatory requirements.

Severe or extreme drought conditions could increase the potential for wildfires in the area. Ready availability of water is crucial for both fire protection and daily plant operations. The preferred process water option (WL1) is to use municipal waste water, which would continue to be available during droughts. If the municipal waste water supply became insufficient during a drought, the deficit could be covered by using brackish ground water (WL4) if the FSH main waterline is constructed.

Certain meteorological conditions could influence a slight potential for induced microclimate affects, such as shadowing, fogging, or icing of the wet cooling tower vapor plume, or fog generation over the solar evaporation pond. Such localized occurrences would be infrequent and usually last only a few hours.

3.4.6 Mitigation

Given the prevailing winds are from south to north, Summit would build the wet cooling towers on the northern side of the plant facilities if possible, to reduce impacts to existing roads, residences, and to plant operations from cooling tower fogging or icing conditions.

3.5 Soils, Geology, and Mineral Resources

3.5.1 Background

This section identifies and describes soils, geology, and mineral resources that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

3.5.2 Region of Influence

There are three ROIs considered for soils, geology, and mineral resources:

- The soils ROI applies to all soils within a 1.0-mi (1.6-km) radius of the proposed polygen plant site and linear facilities. Further, in accordance with TCEQ requirements for Class I injection wells, DOE examined potential soils impacts up to 2.5 mi (4 km), the area of review required by the TCEQ, from the brine water injection well locations that could be constructed on the polygen plant site.
- The geology ROI was used to evaluate the potential for geologic events (e.g., earthquakes, landslides, and sinkholes) that could affect the construction and operation of the TCEP. The analysis considered impacts for the proposed polygen plant (including the 2.5-mi [4-km] radius for the proposed Class I waste water injection wells) and associated linear facilities. For EOR activities, DOE examined geologic impacts in the EOR fields that would use the CO_2 captured at the TCEP and sold by Summit. Because the specific EOR fields are currently unknown, this ROI includes the oil reservoirs in the Permian Basin currently served by, or within a short distance of, the Kinder Morgan pipeline network. Summit has engaged in preliminary discussions with potential buyers of the TCEP CO_2, all of which are located in Texas (Hattenbach 2011). Therefore, DOE assumes that only those 20 counties in Texas associated with Kinder Morgan EOR fields could be affected (Figure 3.3).
- The mineral resources ROI consists of the area that would be occupied by the proposed polygen plant and related linear facilities and the EOR fields in the Permian Basin that would use the CO_2 captured at the TCEP and sold by Summit for EOR. The mineral resources ROI at EOR sites could extend as deep as 15,000 ft (4,572 m) below the surface depending on which oil reservoir is under production. As with the geology ROI, DOE assumes that only those 20 counties in Texas associated with Kinder Morgan EOR fields could be affected (Figure 3.3).

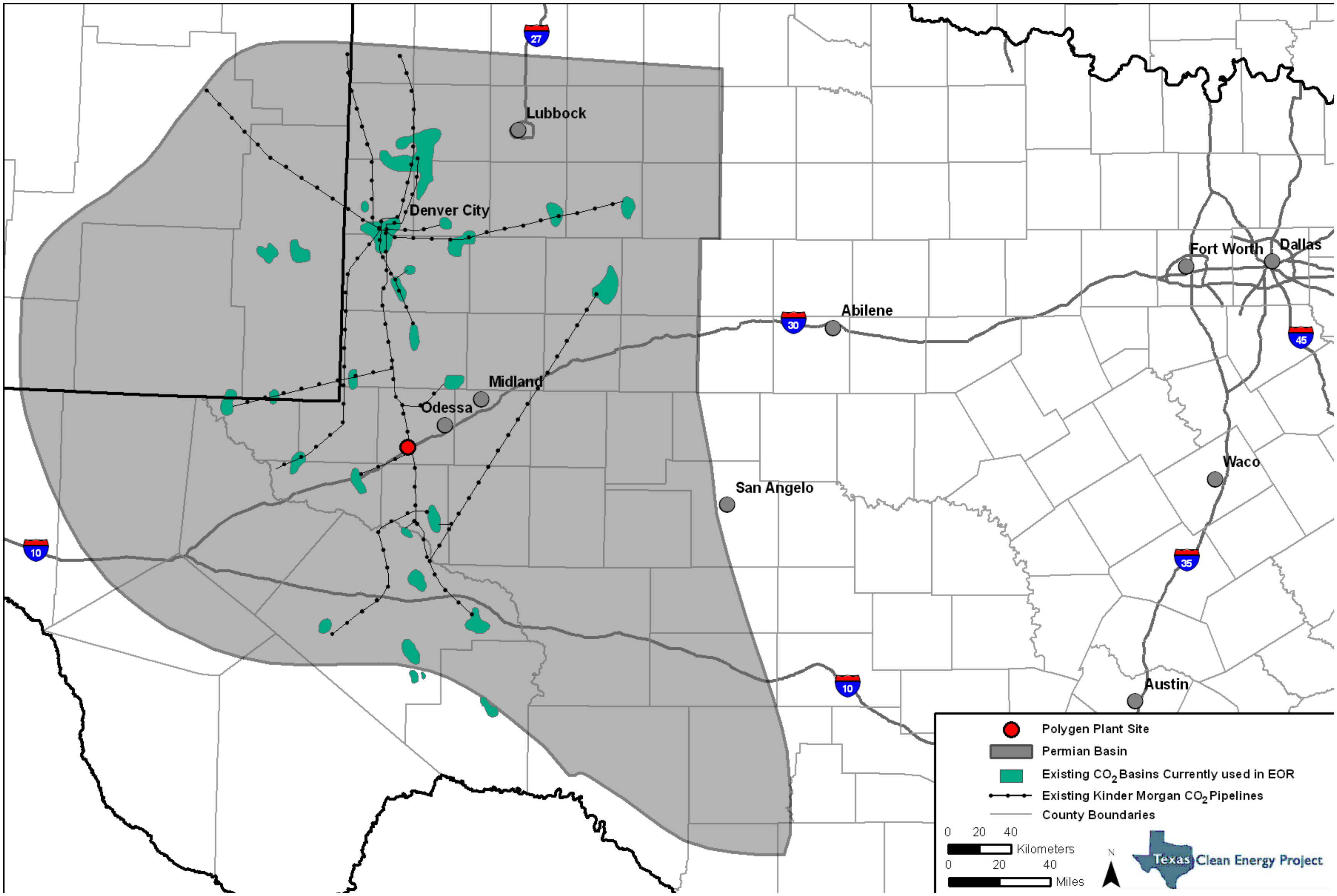

Figure 3.3. Distribution of carbon dioxide pipelines in the Permian Basin.

3.5.3 Methodology and Indicators

The impacts analysis for soils, geology, and mineral resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Table 3.9 shows these potential impacts and their indicators.

Table 3.9. Indicators of Potential Soils, Geology, and Mineral Resource Impacts

Potential Impact	Impact Indicator
Permanent and temporary removal of soils	Acres of soil disturbance
Erosion of soils	
Conversion of prime farmland soils	
Change in soil characteristics and composition	
Contamination of soil from spills of hazardous materials	Acres of soil contamination
Disturbance to the polygen plant and linear facilities from geologic-related events (e.g., earthquakes, landslides, sinkholes)	Acres of project area disturbance
Restricted access to mineral resources	Acres of surface disturbance
Alteration of geologic formations	Area of subsurface disturbance

3.5.4 Affected Environment

3.5.4.1 SOILS

Soils in the ROI have been mapped by the Natural Resources Conservation Service. A complete list of soil types in the surface ROI, and the total surface area of soil types that could be impacted by the TCEP, are included in the site assessment report developed for the TCEP (SWCA 2010a) and incorporated by reference.

The potential for wind and water erosion are two important considerations relating to project impacts to soils. The wind and water erosion potential in the soils ROI are summarized in Table 3.10. In general, most of the soils have a moderate wind and water erosion potential.

Table 3.10. Wind and Water Erosion Potential of Soils as Total Land Area and Percentage of Area Potentially Affected in the Soils Region of Influence

Erosion Potential	Wind Erosion (ac [ha])	Percent	Water Erosion (ac [ha])	Percent
High	17,435 (7,056)	11	1,473 (596)	1
Moderate	116,735 (47,241)	75	122,198 (49,452)	79
Low	20,224 (8,184)	13	31,524 (12,757)	20
n/a	971 (371)	1	170 (69)	0
Total	**155,365 (62,874)**	**100**	**155,365 (62,874)**	**100**

Note: n/a = not available.

The Natural Resources Conservation Service defines prime farmland as land that has the best combination of physical characteristics for producing food, feed, forage, and oil seed crops (crops that are grown primarily for the oil contained in the seeds such as soybeans) and is available for these uses (Natural Resources Conservation Service 2007). None of the soil map units in soils ROI around the polygen plant site are considered to be prime or unique farmland soils. There are, however, two areas in the construction ROW of WL1 that contain prime farmland soils. Randall clay soils account for 0.49 ac (0.20 ha) and Stegall loam soils, if irrigated, account for 1.91 ac (0.77 ha) along the eastern extent of WL1. Neither area is currently under cultivation.

Horizon Environmental Services performed a Phase 1 environmental site assessment on the proposed polygen plant site in April 2006. The results of that assessment do not indicate any recorded or observed soil contamination on the polygen plant site (Horizon Environmental Services 2006).

3.5.4.2 GEOLOGY

The proposed polygen plant site is located in the flat to shallowly sloping northern flank of the Pecos River Basin just west of the Concho Ridge, which forms the divide between Monahans Draw and the Colorado River drainage basin (Wermund 1996). The elevation of the polygen plant site varies from 2,969 ft (905 m) to 2,920 ft (890 m) above mean sea level.

The near-surface geologic units of the geology ROI are described in Table 3.11. On the surface, the polygen plant site and linear facilities occur almost entirely on geologic units consisting of unconsolidated caliche, windblown sand, and alluvial deposits. Texas Water Development Board (TWDB) drilling records confirm the presence of the Lower Cretaceous Antlers Sand Formation at a depth of 77 ft (23 m) below the surface, followed by the Cox Sandstone and the Dockum Group at progressively lower depths (TWDB 2010a).

Table 3.11. Near-surface Geology Units in the Geology Region of Influence

Geologic Unit	Description	Thickness
Windblown sand	Sand and silt in sheets, dunes, and ridges	Various
Quaternary alluvium	Siliceous and igneous pebbles of various ages	Approximately 50 ft (15 m) on polygen plant site
Antler Sand	Fine to coarse-grained sandstone with some cross-bedding	Up to 90 ft (27 m)
Cox Sandstone	Medium to fine-grained sandstone with some silt and quartz pebble interbeds	Up to 40 ft (12 m)
Dockum Group	Shale and siltstone with sandstone and gravel beds Micaceous with reddish brown to yellow-orange beds of various thickness	Up to 275 ft (84 m)

The TCEP could involve on-site brine water injection and would involve off-site EOR activities that could affect geologic formations thousands of feet below the surface. Table 3.12 provides descriptions of subsurface geology in the Permian Basin down to 15,000 ft (4,572 m) below ground level and a general description of those stratigraphic units as either being potential ground water sources in the area, potential barriers to fluid migration (for example, an anhydrite deposit), potential targets for brine water injection (for example, deep brine aquifers), or potential suitable formations for EOR/sequestration activities (in other words, rock layers with oil reservoirs).

Table 3.12. Generalized Stratigraphy of the Permian Basin

System	Series		Stratigraphic Unit	Description
Quaternary	–		Cenozoic Pecos Alluvium	Potential ground water source
Tertiary	–		Volcanic Rocks	Potential ground water source
Cretaceous	Gulf		Undifferentiated	Potential ground water source
	Comanche	Trinity	Undifferentiated	Potential ground water source
		Washita		
		Fredericks-burg	Undifferentiated	Potential ground water source
Triassic	Dockum		Undifferentiated	Potential ground water source
Permian	Ochoan		Dewey Lake Red Beds	Potential barrier to fluid migration (siltstone)
			Rustler Formation	Potential ground water source
			Salado Formation	Potential barrier to fluid migration (halite and anhydrite deposits)
			Castile Formation	Potential barrier to fluid migration (anhydrite deposit)
	Guadalupian		Tansill Formation	Potential barrier to fluid migration (anhydrite and dolomite)
			Yates Formation	Potentially suitable for EOR/sequestration
			Seven Rivers Formation	Potentially suitable for EOR/sequestration
			Queen Formation	Potential target for brine water injection Potentially suitable for EOR/sequestration
			Grayburg Formation	Potential target for brine water injection Potentially suitable for EOR/sequestration
			San Andres Formation	Potential target for brine water injection Potentially suitable for EOR/sequestration
	Leonardian		Holt	Potentially suitable for EOR/sequestration
			Glorieta	Potentially suitable for EOR/sequestration
			Clear Fork	Potentially suitable for EOR/sequestration
			Abo/Wichita	Potentially suitable for EOR/sequestration
	Wolfcampian		Wolfcamp	Potentially suitable for EOR/sequestration
Pennsylvanian	Virgilian		Cisco	Potentially suitable for EOR/sequestration
	Missourian		Canyon	Potentially suitable for EOR/sequestration
	Desmoinian		Strawn	Potentially suitable for EOR/sequestration

Table 3.12. Generalized Stratigraphy of the Permian Basin

System	Series	Stratigraphic Unit	Description
	Atokan	Atoka	Potentially suitable for EOR/sequestration
Mississippian	Chesterian	Barnett	Potentially suitable for EOR/sequestration
Devonian	Famennian	Woodford	Potentially suitable for EOR/sequestration
	Pragian, Lochkovian	Thirtyone	Potentially suitable for EOR/sequestration
Silurian	Pridolian, Lodlovian, Wenlockian, Llandoverian	Wristen Group	Potentially suitable for EOR/sequestration
Ordovician	Ashgillian	Fusselman	Potentially suitable for EOR/sequestration
	Caradocian	Montoya	Potentially suitable for EOR/sequestration
	Llandeilian, Llanvirnian	Simpson Group	Potentially suitable for EOR/sequestration
	Arenigian, Tremadocian	Ellenburger	Potentially suitable for EOR/sequestration

Note: Thicknesses of individual stratigraphic units and the entire stratigraphic column vary significantly depending on the specific location in the Permian Basin.

The Queen, Grayburg, and Upper San Andres Formations beneath the proposed polygen plant site have been identified as potentially viable injection zones for the brine water injection well option. These formations have sufficient thickness and permeability to accept within their pore spaces the projected supply of brine water. They are also thought to be sufficiently isolated from aquifers that permitting obstacles would be unlikely. The Rustler Formation, which is a potential drinking water source, is separated from the Queen Formation by approximately 1,000 ft (1,609 m) of strata consisting of five barrier formations: Salado, Castile, Tansill, Yates, and Seven Rivers Formations (see Table 3.12).

Although earthquakes do occur in Texas, the state has a relatively low risk from earthquake activity. There are three areas in the state where most earthquake activity occurs (University of Texas Institute for Geophysics 2010). West Texas is one of these areas and has experienced three natural earthquakes since the 1930s. The city of Valentine in Jeff Davis County experienced an earthquake with a magnitude of 6.0 on the Richter scale in 1931. An earthquake with a 5.3 magnitude occurred near the city of Alpine in Brewster County in 1995. In addition, an earthquake with a 4.6 magnitude occurred approximately 50 mi (80 km) northwest of the polygen plant site along the New Mexico border in Andrews County in 1992. Smaller quakes induced by over-pressurization of fluid injection associated with oil and gas production and waste disposal activities have also been known to occur in West Texas. Although these quakes are typically between 3.0 and 4.0 in magnitude, the largest (4.6) occurred in 1978 approximately 110 mi (177 km) northeast of the proposed polygen plant site near the city of Snyder, Scurry County, Texas (University of Texas Institute for Geophysics 2010).

3.5.4.3 MINERAL RESOURCES

Although the proposed polygen plant site contains sand, gravel, and clay deposits, none of these are economically extractable. Of the six permitted or developed natural gas and oil wells on the proposed plant site, two are currently active (one oil well and one gas well).

The TCEP would be located almost in the center of the Permian Basin geologic province, which encompasses all or parts of 54 counties in West Texas and New Mexico (see Figure 3.3). The Permian Basin remains one of the largest oil-producing regions in the U.S. According to the Texas Bureau of Economic Geology, cumulative production through 2000 was 28.9 billion barrels (Dutton et al. 2004). The Permian Basin accounted for 17 percent of total U.S. oil production in 2002, and contains approximately 22 percent of proven domestic oil reserves. It is also the location of 29 percent of estimated, future, domestic reserve growth. Although production from the Permian Basin peaked in the early 1970s, cumulative production to date represents approximately 27 percent of the original oil in place (Dutton et al. 2004).

Carbon Sequestration and Enhanced Oil Recovery

After oil production began to drop from peak levels in the 1970s, companies began to explore technologies to further recover oil from depleted reservoirs. Initial production relies on pressure of the fluids in the reservoir to push fluids toward a producing well (fluids flow from areas of high fluid pressure toward areas of low fluid pressure, such as a producing well). In addition to the fluid pressure of the oil itself, natural gas pressure would push the oil from above and water pressure would push the oil from below, with the result that the oil (and other fluids) would move toward producing wells. After time, the pressure that drives the flow of oil dissipates or the quantity of mobile oil decreases such that the remaining oil ceases to flow. Most of the oil (usually 40–90 percent) still remains trapped in the reservoir in the pore spaces (NETL 2009). The industry learned that they could inject water or natural gas to help push or sweep some of the remaining oil (as much as 10–30 percent) toward the producing wells (NETL 2009).

Following a successful pilot program in the 1970s at the Scurry Area Canyon Reef Operators Committee oil field in the city of Snyder, Scurry County, Texas, field operators in the Permian Basin learned that CO_2 could be injected (usually alternated with water injection) to move more oil to producing wells. This became known as EOR and could be used to recover another 5–20 percent by flooding the reservoir with CO_2 (Holtz et al. 1999). CO_2, an abundant by-product of nearby natural gas production and processing facilities, had previously been vented to the atmosphere. CO_2 contains properties of both a liquid and a gas under the specific temperature and pressure conditions of deep oil reservoirs, where it becomes miscible (or mixable) with oil. Injecting pressurized CO_2 into an oil reservoir causes some of the CO_2 to dissolve into the oil, which changes the oil's viscosity (or the measure of the ease of flow) and allows this oil to move toward production wells. Water injection is often alternated with CO_2 injection to increase fluid pressure and to help move the oil toward the producing wells. CO_2 that is dissolved in the recovered oil can be captured, compressed, and recycled back to the injection wells for other cycles of use. Generally, CO_2 and water are injected into the reservoir in the same volume that oil is recovered, such that average fluid pressure in the reservoir is approximately the same as the initial fluid pressure in the reservoir. With each cycle of injection of CO_2, a portion of the CO_2 becomes trapped in the reservoir. As more oil is produced, more CO_2 is trapped, leaving the CO_2 permanently stored underground. The CO_2 EOR process is illustrated in Figure 3.4 (NETL 2009).

The geologic conditions that cause oil and natural gas to become trapped and stored in underground reservoirs also make those reservoirs suitable for both EOR and long-term CO_2 sequestration. Environmental concerns about EOR with CO_2 primarily focus on leakage of CO_2 from the reservoir into ground water. Since 1972, the Scurry Area Canyon Reef Operators Committee oil field, which is located approximately 100 mi (161 km) northeast of the proposed polygen plant site, has been intensively monitored for impacts to ground water (Smyth et al. 2006). Monitoring results indicate that no systematic impacts to ground water have occurred as a result of CO_2 injection practices (Smyth et al. 2009).

By the mid 1980s, demand for CO_2 for use in EOR had increased dramatically. Major oil companies had constructed hundreds of miles of CO_2 pipelines to transport CO_2 from natural underground reservoirs from as far away as Utah, Colorado, and Oklahoma to the Permian Basin. Today, approximately 2,200 mi (3,541 km) of CO_2 supply pipelines converge in Denver City, Texas, approximately 80 mi (129 km) north of the proposed polygen plant site (see Figure 3.3). Denver City is the world's largest CO_2 pipeline hub. By 1999, more than 50 oil fields in Texas and New Mexico were being supplied through the CO_2 distribution system originating from Denver City (Holtz et al. 1999).

As of 2007, more than 3,600 mi (5,794 km) of CO_2 pipelines were constructed in the U.S., most of which service the Permian Basin (Folger and Parfomak 2007). The current supply capacity to the Permian Basin is more than 1 billion ft^3 (28.3 million m^3) per day (Kinder Morgan 2010a). Currently, more than 1.6 billion ft^3 (45.3 million m^3) of CO_2 are injected per day into Permian Basin oil fields, resulting in an additional daily recovery of 170,000 barrels. Demand has exceeded supply since 2009 and is estimated to exceed current supply by approximately 500 million ft^3 (14.2 million m^3) per day. EOR in the Permian Basin has the potential to substantially contribute to future domestic oil production.

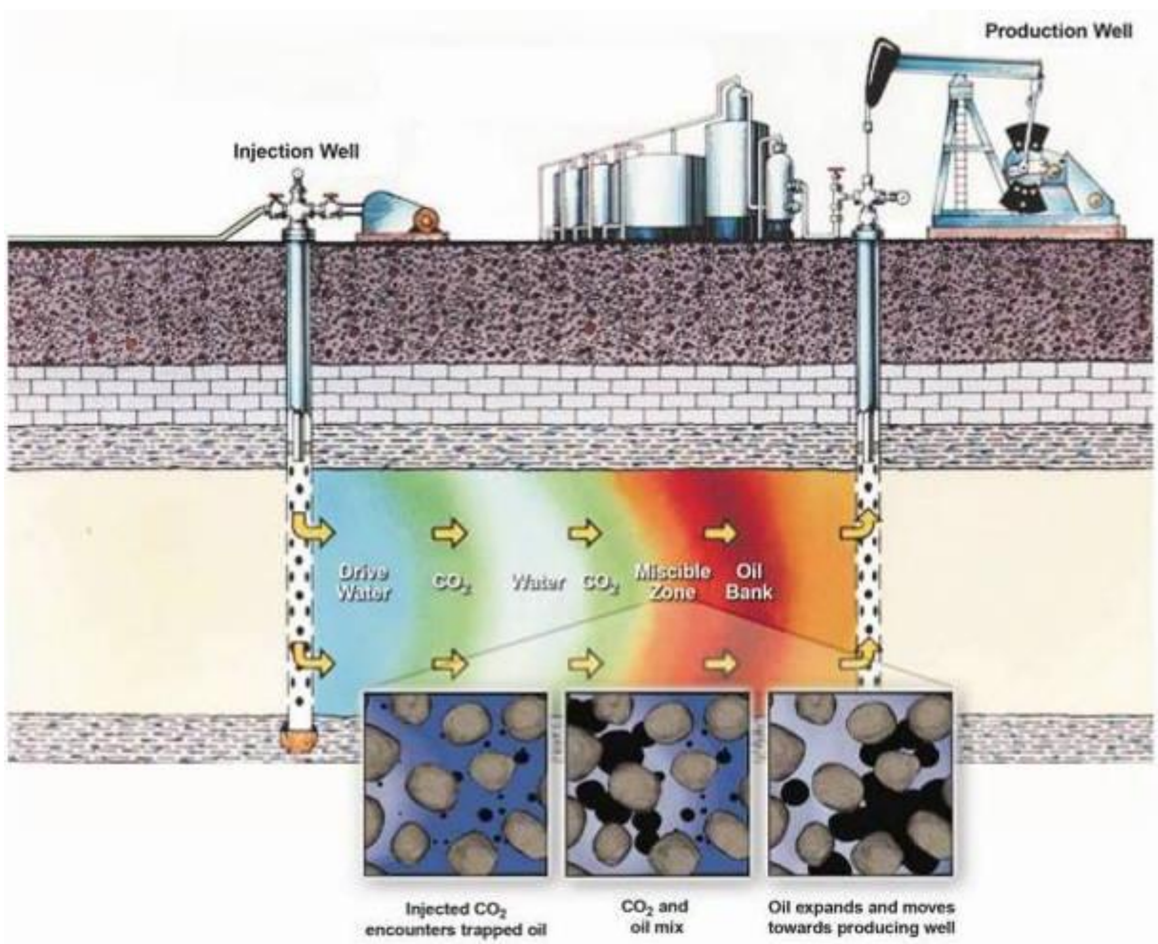

Figure 3.4. Carbon dioxide enhanced oil recovery process (NETL 2009).

Enhanced Oil Recovery Injection/Carbon Dioxide Sequestration Sites

The TCEP's CO_2 would be delivered to the existing Kinder Morgan Central Basin Pipeline system where it would co-mingle with CO_2 from other sources. Over the commercial life of the project, TCEP CO_2 may be injected into any of the more than 1,300 individual oil and gas reservoirs in the Permian Basin through the Kinder Morgan distribution system. CO_2 would likely be injected into multiple geological formations at various locations throughout the Texas portion of the Permian Basin fed by the Kinder Morgan distribution lines (see Figure 3.3; Hattenbach 2011). Regardless of the formations that would ultimately be affected, certain generalizations can be made based on similarities among the formations. Table 3.12, above, identifies the specific formations that are suitable candidates for EOR/sequestration activities.

The TCEP's CO_2 would be sold to multiple oil field operators who would pay Kinder Morgan for pipeline transportation services. Oil field operators would decide based on a variety of operating and market factors whether to offer to purchase TCEP's CO_2. Summit would be required to ensure that field operators to which it sold the captured CO_2 would meet MVA requirements and tax benefit requirements (as described in Section 2.4.4.3).

Most reservoirs in the Permian Basin share the following geologic conditions that favor successful oil reservoir sequestration (Dutton et al. 2004):

- Reservoirs tend to be several thousand feet below the ground surface.
- Reservoirs are hydrogeologically isolated from any potable water aquifer (i.e., there are one or more thick and laterally continuous, low-permeability rock units between the reservoir and any potential drinking water supply), as indicated by the fact that the reservoirs contain trapped oil and gas that could not move upward over geologic time.
- Natural structures such as faults and interformational fractures that would allow upward fluid migration into shallow aquifers are rare in the region.
- Geologic hazards, including faults through the reservoirs and overlying strata, are rare in the region.
- Generally, reservoirs are confined by geologic structures such as faults or basin margins, which would prevent potential lateral migration of injected CO_2.

3.5.5 Environmental Impacts of Summit's Proposed Project

3.5.5.1 SOILS

Disturbance to soils would primarily occur during construction of the polygen plant and associated linear facilities. Potential impacts during construction would include permanent or temporary removal of soils, erosion of soils, contamination of soils from hazardous material spills, changes in soil composition due to the introduction of fill materials, and conversion of prime farmland.

Site grading to obtain the construction elevations would be an initial construction activity. During construction, soil would be removed for any foundations required for the project's structures. This soil would be placed on a temporary storage site, protected from erosion and runoff, and would be reused as topsoil replacement or as fill. Removing and replacing these soils would likely result in changes to soil composition and characteristics, such as rain water infiltration rate. Fill material would be moved from other portions of the polygen plant site to provide a level bed for the on-site rail loop and plant facilities. Soils impacts would be permanent for areas converted into impervious surface areas (e.g., facilities, structures, pads, rail loop and parking). Construction-related impacts to soils in areas not converted to impervious surfaces would be temporary, and these areas would be restored after construction is completed.

Most of the soils in the project area have a moderate ranking for both wind and water erosion potential (see Table 3.10). During construction activities, there would be the potential for wind erosion and the generation of dust. Controls, such as the stabilization of disturbed areas and wetting of exposed soils, would be used to minimize these impacts. Once construction is finished, the disturbance to soils would be reduced. As disturbed areas become revegetated or otherwise stabilized, further impacts to soils would be negligible.

The potential for soil contamination from spills of hazardous materials during operations would be low based on the use of proper storage facilities and implementation of spill response controls and procedures. An SPCC plan would be prepared in accordance with 40 C.F.R. § 112.7. Personnel would be trained to respond to petroleum and chemical spills and the necessary spill control equipment would be available on site. A very slight potential exists for the deposition of salts with drift from the wet cooling tower option.

The TCEP would have a negligible impact to prime farmland because the proposed polygen plant site contains no prime farmland and only WL1 would temporarily affect approximately 2.4 ac (1.0 ha) of prime farmland. Prime farmland soils (not currently in agricultural production) at this location would be segregated and returned to their original locations upon completion of construction.

3.5.5.2 GEOLOGY

Polygen Plant Site

Geologic units exposed on the proposed polygen plant site consist of sand, gravel, and clay deposits. The relatively flat surface topography of the polygen plant site and lack of karst geology substantially reduces the likelihood of any potential impacts from landslides or other slope failures during construction or plant operations. Similarly, because the area has a low risk of significant seismic events (infrequent, most with a Richter magnitude below 5.0), the probability of effects from seismicity would be low. The polygen plant site should not be affected by subsidence (sinking or lowering of the ground surface), because most factors known to cause subsidence, such as karst geology or geological faulting, are not present.

Karst geology is characterized by barren, rocky ground, caves, sinkholes, underground rivers, and the absence of surface streams and lakes. It results from the excavating effects of underground water on massive soluble limestone. The term originally applied to the Karst, a limestone area on the Dalmatian coast on the Adriatic Sea, but has been extended to mean all areas with similar features. Karst geology is found in widely scattered sections of the world, including the Midwest, Texas, Kentucky, and Florida in the U.S.

Brine Water Injection Wells

If concentrated brine water injection wells were constructed on the site, brine and displaced native fluids could migrate from the target strata into other adjoining strata there. This risk is very low as the geologic characteristics of the potential brine aquifers or reservoirs that would accept the brine water would be sufficient to prevent leakage into overlying drinking water aquifers and the target aquifers/reservoirs in the deeper strata in themselves are highly saline. Reservoirs that would be used are hydrogeologically isolated from any potable water aquifers (i.e., there are one or more thick and laterally continuous, low-permeability rock units between the reservoir and any potential drinking water supply). There would be sufficient vertical separation (over 1,000 ft [1,609 m]) and five barrier formations between the target injection zone and potential drinking water aquifers to allow injection well operations at the polygen plant site. The brine water injection wells, if used, would be used to dispose of brine water that is expected to be nonhazardous. The wells would be located, constructed, and operated as Class I wells in accordance with EPA and TCEQ regulations.

Seismic events caused by the deep well injection of brine water would be unlikely. Operational procedures would be developed to limit injection pressures to levels below the formation fracturing pressure, and formation response to injection would be monitored to detect potential seismic activity. In any event, the magnitude of induced seismic activity seen in similar scenarios (no greater than magnitude 4.6) is unlikely to cause damage to the polygen plant or other facilities in the area.

Although target formations will alter over geologic time through rock-water chemical reactions, and although some chemical constituents could be mobilized, these changes are unlikely to result in adverse environmental effects due to the depth of target formations and the presence of overlying geologic seals.

Linear Facilities

Unconsolidated caliche, windblown sand, and alluvial deposits comprise most of the surface area that would be affected by all of the linear facility options. Potential impacts to geologic resources and from events such as earthquakes, landslides, and subsidence would be the same for construction and operation of the proposed linear facilities, as discussed above for the polygen plant site.

Enhance Oil Recovery Sequestration Site(s)

Although specific EOR sequestration sites are not known, based on the geology of the Permian Basin, geologic impacts as a result of using TCEP's CO_2 for EOR in the Permian Basin would not be expected. Although over-pressuring of geologic formations due to CO_2 injection could induce seismic activity, field operators would monitor and limit injection fluid pressures to levels below the formation fracturing pressure to avoid this condition and would monitor for seismic activity. Based on experience with EOR in the Permian Basin, land surface subsidence or heaving would not be expected to occur.

3.5.5.3 MINERAL RESOURCES

Polygen Plant Site

Six permitted or developed natural gas and oil wells exist on the proposed polygen plant site, although only two are currently operating. Access to and the condition of those facilities would be maintained by the well operators. Summit would accommodate these wells in the polygen plant design and site layout. There are no other economically extractable mineral resources on the polygen plant site. Consequently, the project would not unduly hinder access to mineral resources beneath the plant site.

Brine Water Injection Wells

An option to dispose of brine water is to inject it into reservoirs below the polygen plant site or in other areas in the Permian Basin that are known to be oil-bearing. The risk of potential economic loss is very low because the prospects for oil recovery from those formations are poor, as the target strata and surrounding strata have been explored for hydrocarbons and found not to have economical deposits. Prior to the submission of a Class I waste water injection well permit application to the TCEQ, a detailed review of conditions at the injection well sites would be undertaken to select injection intervals that do not contain economically viable quantities of oil or natural gas.

Linear Facilities

Minor obstructions to mineral resource access along the linear facilities could occur during construction and operational phases of the project. Extraction of petroleum resources could occur from locations outside the ROW, so access would not be hindered. Access to any other economically extractable mineral resource in the ROW would require local relocation of the linear facility or maintenance of facility support; or the resource would not be accessible in the ROW.

EOR Sequestration Site(s)

Use of CO_2 produced by the proposed TCEP and sold by Summit for EOR would likely have a beneficial impact to continued production from oil and gas reservoirs in the Permian Basin that are within a reasonable connector pipeline distance of the Kinder Morgan pipeline system. The demand for CO_2 in the basin already exceeds the supply. The addition of TCEP's CO_2 to the supply market would help field operators maintain petroleum reservoir fluid pressures, which could benefit the production of oil and gas in reservoirs by further forcing the migration of oil and gas toward extraction wells.

Mineral resources and rock strata could be affected by the injection of CO_2 for EOR. Reservoir fluid acidity (pH) and concentrations of dissolved mineral matter would change, and relatively minor amounts of mineral matter would dissolve and precipitate at different distances from the points of injection. Oil and gas in deeper formations could be accessed without undue corrosion and safety problems if suitable drilling practices, well casing materials, and well casing cements were used on wells that penetrated through the CO_2 floods to reach deeper resources. The costs of such wells would increase.

3.5.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 in Chapter 2. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to soils, geology, or mineral resources include segregating prime farmland soils during construction and returning them to their original locations upon completion of construction.

3.6 Ground Water Resources

3.6.1 Background

This section identifies and describes the ground water resources that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

3.6.2 Region of Influence

Process water for the proposed polygen plant could be obtained from one of several options. Although the preferred option for process water is to use recycled municipal waste water from the GCA Odessa South Facility in Odessa, Texas (WL1), three other options (WL2–WL4) would use ground water. In addition, construction and operation of on-site brine water injection wells and injection of CO_2 for EOR would have the potential to affect ground water resources. Thus, three ROIs are considered for ground water resources:

- The process water ROI consists of the aquifers that could be used to obtain water for plant processes. The polygen plant would require a minimum of 3.5 million gal (13 million L) per day and a maximum of 5.5 million gal (21 million L) per day. The aquifers that could be used for process water are the Capitan Reef Complex Aquifer (Oxy Permian, WL2) and the Edwards-Trinity (Plateau) Aquifer (FSH, WL3, and WL4) (Figures 3.5 and 3.6).
- The project area ROI consists of the aquifers that underlie the proposed polygen plant site and linear facility options. This would include the areas within a 2.5-mi (4.0-km) buffer around the plant site and along each linear facility corridor. This ROI also includes the required 2.5-mi (4.0-km) area of review required by the TCEQ for the potential on-site deep injection wells. The Dockum, Edwards-Trinity (Plateau), Ogallala, and Pecos Valley Aquifers underlie these areas (Figures 3.5 and 3.6).
- The EOR ROI consists of the aquifers at the EOR fields that would use CO_2 produced by the TCEP. Because the specific EOR fields are currently unknown, this ROI includes the oil reservoirs in the Permian Basin currently served by, or within a short distance of, the Kinder Morgan pipeline network. Summit has engaged in preliminary discussions with potential buyers of the TCEP CO_2, all of whom are located in Texas (Hattenbach 2011). Therefore, DOE assumes only those aquifers associated with Permian Basin EOR fields in Texas would be addressed. These aquifers include the Capitan Reef Complex, Dockum, Edwards-Trinity (High Plains), Edwards-Trinity (Plateau), Pecos Valley, Ogallala, and Rustler Aquifers (Figures 3.5 and 3.6).

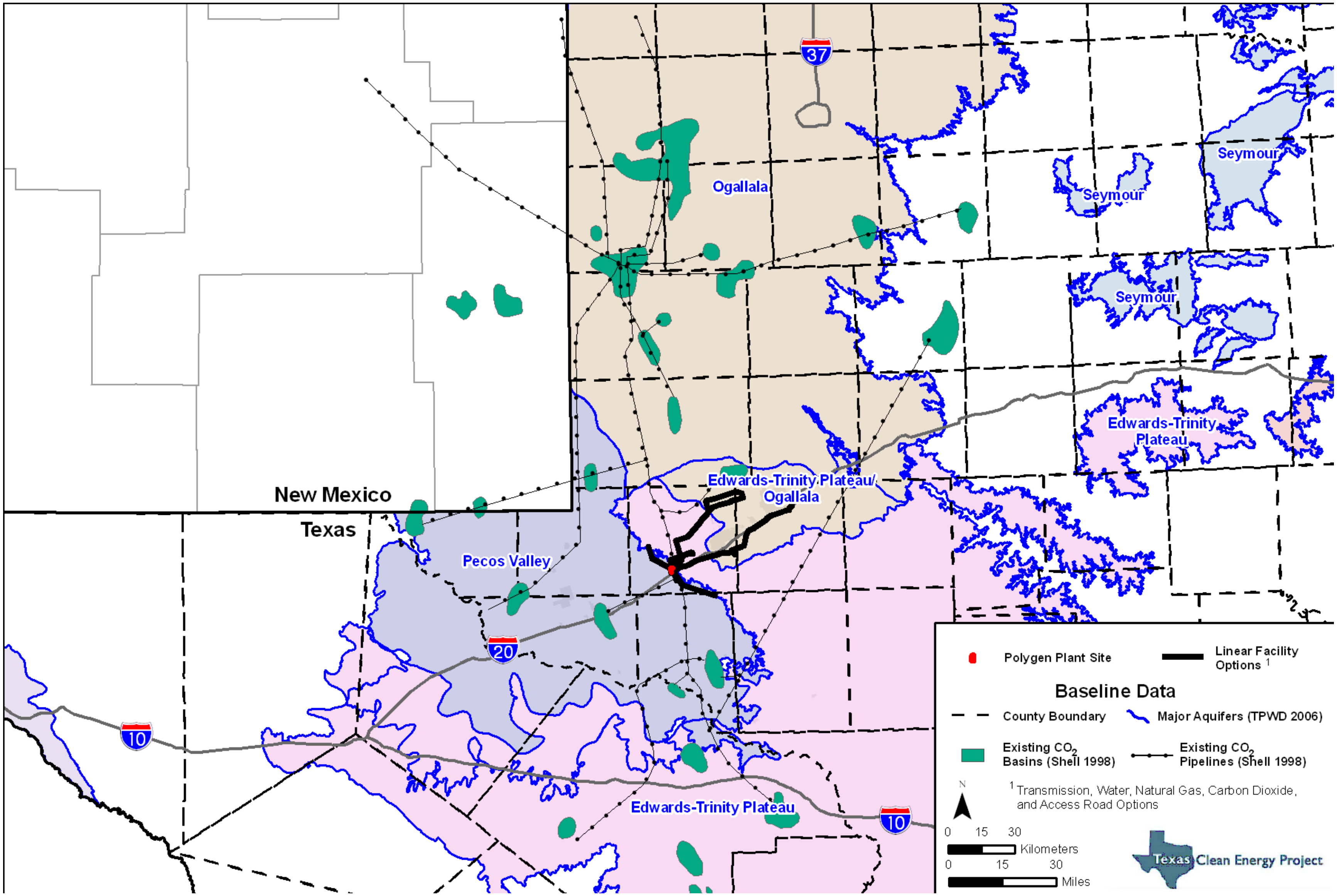

Figure 3.5. Major aquifers in the ground water regions of influence.

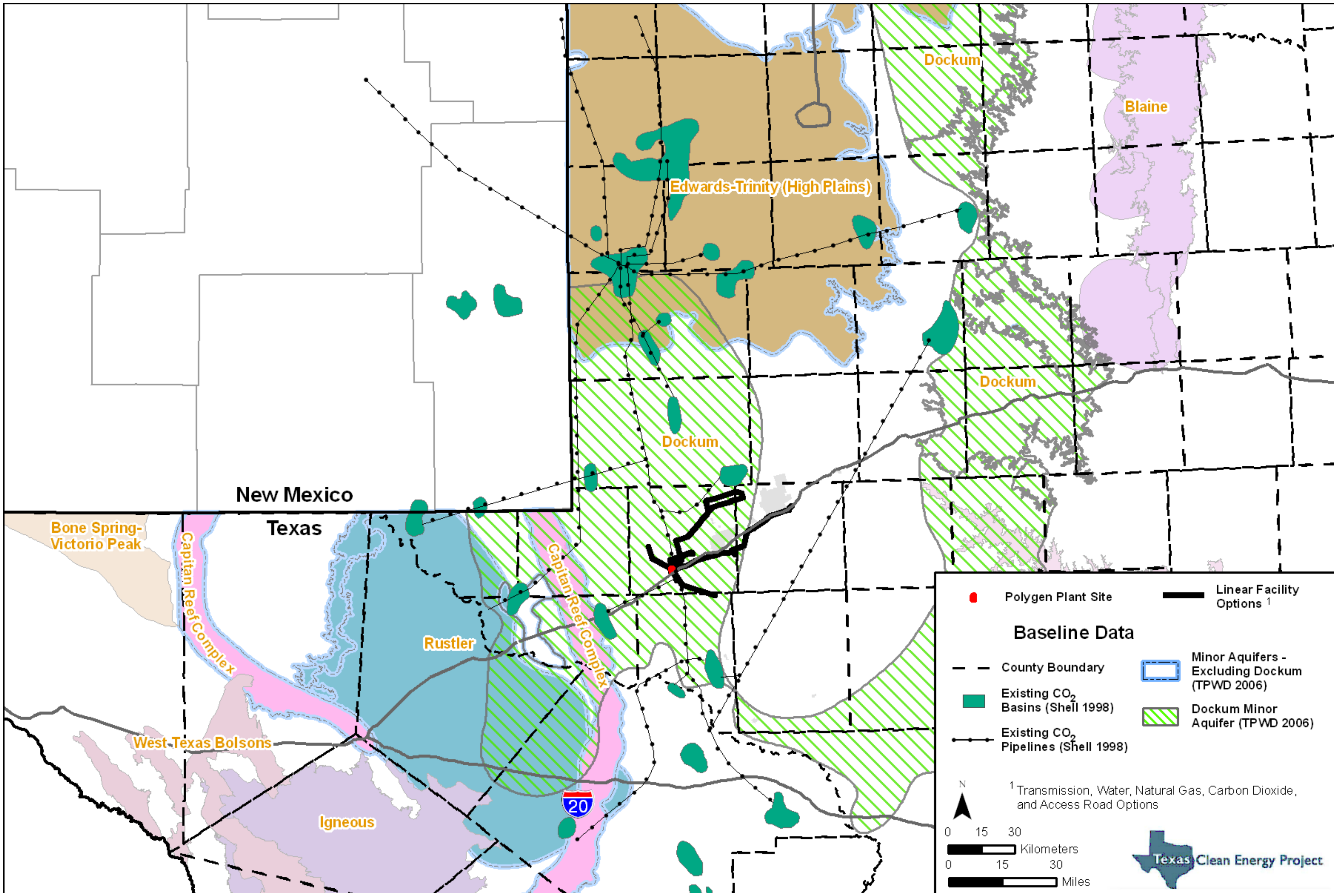

Figure 3.6. Minor aquifers in the ground water regions of influence.

3.6.3 Methodology and Indicators

3.6.3.1 IMPACT INDICATORS

The impacts analysis for ground water resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts to ground water resources and their indicators are shown in Table 3.13.

Table 3.13. Indicators of Potential Impacts to Ground Water Resources

Potential Impact	Impact Indicator
Reduction in ground water supplies that could affect the availability of a ground water source to existing water rights holders	Volume of ground water used
Reduction in ground water supplies that could interfere with ground water recharge	
Reduction in ground water supplies that could reduce discharge rates to existing springs or seeps	
Reduction in ground water recharge from temporary or permanent impervious cover (e.g., buildings, roads)	Acres of impervious cover
Contamination of ground water through surface spills that would infiltrate to ground water	Water quality conditions
Contamination of ground water from leaks in buried pipelines or wells (particularly injection and/or abandoned oil/gas wells)	
Contamination of ground water from injection of CO_2 for EOR	
Reduction in ground water quality from movement of poor quality ground water into areas of higher quality ground water due to pumping or injection	

3.6.3.2 REGULATORY REQUIREMENTS

EPA administers the Sole Source Aquifer Protection Program under section 1424(e) of the Safe Drinking Water Act of 1974. EPA defines a sole- or principal-source aquifer as an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer (EPA 2007). These areas have no alternative drinking water source (or sources) that could physically, legally, and economically supply all who depend on the aquifer for drinking water. A designation as a sole-source aquifer protects an area's ground water resource by requiring EPA to review certain proposed projects in the designated area. All proposed projects receiving federal funds are subject to review to minimize danger to sole-source aquifers.

In Texas, ground water resources are regulated by the TCEQ and by Ground Water Conservation Districts, which are locally governed districts that manage ground water supplies. Priority Ground Water Management Areas are areas designated and delineated by TCEQ that are experiencing, or are expected to experience in the next 25 years, critical ground water problems, including shortages of surface water or ground water, land subsidence resulting from ground water withdrawal, or contamination of ground water supplies.

The proposed polygen plant site and the ground water wells serving the Oxy Permian pipeline system are not in the regulatory jurisdiction of any Ground Water Conservation District, nor have any Priority Ground Water Management Areas been designated in Winkler or Ector County (EPA 2010; TWDB 2010b). No designated sole-source aquifers occur in project area (EPA 2007). Wells serving the proposed FSH system and a portion of the FSH pipeline lie in the Middle Pecos Ground Water Conservation District (TWDB 2010b). None of the remaining linear facilities fall in an established Ground Water Conservation District.

The construction, testing, and operation of Class I injection wells that could be used in disposal of waste process water from the polygen plant is regulated by the TCEQ, and would require a permit pursuant to the Texas Water Code, Chapter 27, and the Texas Health and Safety Code, Chapter 361. Potential impacts were assessed for a 2.5-mi (4.0-km) radius around each well.

The construction, testing, and operation of injection wells used in oil and gas recovery is regulated by the RRC under 16 TEX. ADMIN. CODE Chapter 3, Rule 3.46 to enforce drinking water standards promulgated by EPA. Current RRC requirements for Class II wells include making best efforts to identify all wells in a 0.25-mi (0.40-km) radius of the proposed injection well and providing evidence that all abandoned wells intersecting the injection formation have been plugged. EOR operators who may purchase CO_2 from the TCEP would be regulated by the RRC to enforce drinking water standards promulgated by EPA.

3.6.4 Affected Environment

The TWDB state water plan involves 16 regional planning groups that review water use projections and water availability for their regions. Ector County lies in Region F, which includes Crane, Midland, Upton, and 28 other counties in West Texas. The largest withdrawals of ground water in the region are for irrigation and municipal uses. Most recent studies indicate that the total Region F water use in 2010 was 202 billion gal (765 billion L) or 620,000 ac-ft per year with 157 billion gal (596 billion L) or 483,600 ac-ft per year (or 78 percent) coming from ground water withdrawal (TWDB 2010c).

With the exception of the Edwards-Trinity (Plateau) Aquifer, ground water levels in the area are generally declining because the rate of withdrawal is greater than the rate of recharge. Springs in Ector, Crane, Midland, and some surrounding counties have stopped flowing as a result of water table drawdown (Brune 2002).

In addition, there have been reports of contamination of shallow aquifers from oil field activities (Brune 2002). A review of the *2008 Joint Groundwater Monitoring and Contamination Report* yielded 59 instances of ground water contamination in Ector County (Texas Groundwater Protection Committee 2008). However, a survey of TCEQ records found no cases of contaminated ground water within 10 mi (16 km) of the proposed polygen plant site (TCEQ 2006).

The following sections summarize the properties of the major and minor aquifers that are potentially affected by the TCEP. Edwards-Trinity (Plateau), Ogallala, and Pecos Valley are major aquifers (see Figure 3.5), whereas the Capitan Reef Complex, Dockum, Edwards-Trinity (High Plains), and Rustler are minor aquifers (see Figure 3.6).

3.6.4.1 EDWARDS-TRINITY (PLATEAU) AQUIFER

The Edwards-Trinity (Plateau) Aquifer is a major aquifer that spans from the Hill Country of central Texas to the Trans-Pecos region of West Texas and provides water to 38 counties. This aquifer is located immediately to the north and east of the polygen plant site (see Figure 3.5) and is the process water source for WL3 and WL4. The aquifer also underlies eight linear facilities in the project area ROI and several oil fields in the EOR ROI.

The maximum saturated thickness of the aquifer is greater than 800 ft (244 m). The chemical quality of water in the Edwards-Trinity (Plateau) Aquifer can range from fresh to slightly saline. Most of the Edwards-Trinity (Plateau) Aquifer lies beneath water-table conditions; however, where it is fully saturated and exhibits low permeability, artesian water conditions are present. Irrigation activities account for approximately 70 percent of the ground water usage from the aquifer, with municipal water use and livestock supplies accounting for the remainder. Water well yields can range from 50 gal (189 L) per minute where the saturated thickness is thin to greater than 1,000 gal (3,785 L) per minute. Water levels have remained relatively stable because recharge has normally maintained the relatively low volumes of pumping throughout the aquifer (TWDB 2001). Annual supply from the Edwards-Trinity (High Plains) Aquifer in Pecos County (source area for WL3 and WL4) is approximately 37 billion gal (142 billion L) or 114,849 ac-ft.

3.6.4.2 OGALLALA AQUIFER

The Ogallala Aquifer is a major aquifer in the High Plains of Texas, which provides water to all or parts of 46 counties. This aquifer is located approximately 12 mi (19 km) to the northeast of the polygen plant site (see Figure 3.5). Although it would not be used as a process water supply source for the TCEP, this aquifer underlies three linear facilities in the project area ROI and several oil fields in the EOR ROI.

The Ogallala has a saturated thickness of up to 600 ft (183 m). Although many communities use the Ogallala Aquifer as their sole source of drinking water, approximately 95 percent of the water is used for irrigation. This aquifer supplies water to wells with yields on average of approximately 500 gal (1,893 L) per minute and a maximum of approximately 2,000 gal (7,571 L) per minute. The chemical quality of the water in the aquifer is generally fresh; however, fluoride content is commonly high and selenium concentrations can locally exceed drinking water standards. Since the expansion of irrigated agriculture in the mid 1940s, a greater amount of water has been pumped from the aquifer than has been recharged. As a result, some areas have experienced water-level declines in excess of 100 ft (30 m) from predevelopment to 1990 (TWDB 2001). However, more recently reduced pumpage in some areas of the High Plains has resulted in a reduction in the rate of water-level decline.

3.6.4.3 PECOS VALLEY AQUIFER

The Pecos Valley Aquifer is a major aquifer located in the upper portion of the Pecos River Valley of West Texas and provides water to nine counties including Ector and Crane. Although it would not be a process water supply source for the TCEP, the Pecos Valley Aquifer lies beneath the polygen plant site, five linear facilities, and several oil fields in the EOR ROI (see Figure 3.5).

The Pecos Valley Aquifer has a saturated thickness of approximately 250 ft (76 m). Approximately 80 percent of the ground water pumped from this aquifer is used for irrigation, with the remainder used for municipal supplies, industrial use, and power generation. Moderate to large yields of ground water can generally be expected from wells utilizing this aquifer. Water from this aquifer is typically hard because sulfate and chloride are the predominant constituents. Naturally occurring arsenic and radionuclides exceed primary drinking water standards and some deterioration of quality has resulted from past petroleum industry and irrigation activities. Water level declines have historically occurred in excess of 200 ft (60 m) in south-central Reeves and northwest Pecos Counties, but have moderated since the mid 1970s due to a decrease in irrigation pumpage (TWDB 2001).

3.6.4.4 CAPITAN REEF COMPLEX AQUIFER

The Capitan Reef Complex is a minor aquifer in West Texas that is located approximately 25 mi (40 km) to the west of the polygen plant site (see Figure 3.6). This aquifer is the process water source for WL2.

The Capitan Reef Complex Aquifer is a slender, arc-shaped aquifer approximately 10–14 mi (16–23 km) wide that extends from two locations in Texas northward into New Mexico where it provides water to the city of Carlsbad. This aquifer generally contains poor quality water, and yields a wide range of quantities of moderately saline to brine water. The saturated thickness of this minor aquifer widely varies. Most of the ground water pumped from this aquifer in Texas is used for oil reservoir EOR water-flooding operations. A small amount is used for irrigation of salt-tolerant crops. Over the last 70 years, water levels have declined in some areas as a result of localized production (TWDB 2001).

3.6.4.5 DOCKUM AQUIFER

The Dockum Aquifer is a minor aquifer that is located in West Texas and the Texas panhandle. It underlies much of the Ogallala Aquifer, the northern extent of the Edwards-Trinity (Plateau) Aquifer, and the eastern extent of the Pecos Valley Aquifer. This aquifer would not be a source of TCEP process water but lies beneath the entire project area ROI and several oil fields in the EOR ROI (see Figure 3.6).

In 1947, ground water depth of the Dockum Aquifer was measured at 205.6 ft (62.7 m) at a well located immediately south of the proposed polygen plant site (Texas Board of Water Engineers 1937; TWDB 2006); however, recent estimations suggest the ground water depth has dropped to approximately 320 ft (98 m) (TWDB 2003). The quality of the Dockum water is generally poor and contains sodium levels that may be damaging to irrigated land (TWDB 2003). In Ector County, water quality of the Dockum Aquifer ranges from fresh to brackish (TWDB 2003). Irrigation and public supply use is limited. Recharge to the Dockum Aquifer occurs primarily by precipitation and stream flow across the outcropping strata and where permeable portions of the aquifer are overlain by other aquifers such as the Pecos Valley Aquifer.

3.6.4.6 EDWARDS-TRINITY (HIGH PLAINS) AQUIFER

The Edwards-Trinity (High Plains) Aquifer is a minor aquifer in northwest Texas that underlies the Ogallala Aquifer and is located approximately 65 mi (105 km) north of the polygen plant site (see Figure 3.6). This aquifer lies beneath several oil fields in the EOR ROI. Most of the water wells in this aquifer provide water for irrigation and have yields ranging from 50 to 200 gal (189–757 L) per minute (Ashworth and Hopkins 1995).

3.6.4.7 RUSTLER AQUIFER

The Rustler Aquifer is a minor aquifer in the Trans-Pecos region of West Texas and is located approximately 45 mi (72 km) to the west of the polygen plant site (see Figure 3.6). This aquifer lies beneath several oil fields in the EOR ROI. The aquifer is principally located in Loving, Pecos, Reeves, and Ward Counties where it yields water for irrigation, livestock, and EOR water-flooding operations in oil-producing areas of the Permian Basin. High dissolved-solids concentrations render the water unsuitable for human consumption (Ashworth and Hopkins 1995).

3.6.5 Environmental Impacts of Summit's Proposed Project

3.6.5.1 GROUND WATER QUANTITY

Polygen Plant Site

The polygen plant would require water during construction, process water during operation, and potable water during both construction and operation phases. The largest demand would be for process water, which is currently estimated to require an annual minimum of 3.5 million gal (13 million L) per day with a peak demand of 5.5 million gal (21 million L) per day. This demand could be minimized using the brine concentrator and filter press disposal technology and the dry cooling tower options. Four delivery options from the three sources of process water were evaluated for the TCEP. These water sources are

- treated domestic effluent from the GCA Odessa South facility (WL1);
- ground water from the Oxy Permian water supply (WL2); or
- ground water from the FSH water supply project (WL3 and WL4).

The water that comprises the treated effluent from the City of Midland Wastewater Treatment Plant and the GCA Odessa South Facility originates primarily from surface lakes and is supplemented periodically by ground water prior to municipal use. Because this water would be produced and used regardless of the TCEP, no direct impacts to ground water quantity would occur under WL1. The waste water effluent is currently disposed of through application to agricultural lands and a small percentage of the effluent that is not cycled into the atmosphere through evapotranspiration may recharge shallow ground water. The agricultural lands are owned by the City of Midland and the land application of the waste water is being used as an alternative to securing a discharge permit for the effluent. Agricultural irrigation would be reduced or terminated altogether if WL1 were to be implemented, which would have a small impact to the percentage of recharge to the underlying shallow aquifer.

Oxy Permian) is a network of pipelines that provides brackish ground water from the Capitan Reef formation for EOR water flood projects in the Permian Basin. The closest source of the Oxy Permian water to the polygen plant site is a group of ground water wells near the town of Kermit, Winkler County, Texas, which is located approximately 29 mi (47 km) northwest of the TCEP. The Oxy Permian system is not utilized at its full capacity and the demand for water for use in secondary oil recovery has been slowly declining. The oil wells are producing a higher ratio of water to oil as the level in the oil reservoirs drops. The greater amount of water being produced means the oil companies need less supplemental water so the demand from the Oxy Permian water system is declining. Current estimates are that the pumping rate may be as low as 50 percent of what it was at its highest level (Smith 2010). Because the amount of water pumped for the Oxy Permian Water Supply has steadily decreased, the impacts of additional pumping for use as TCEP process water under WL2 would be small.

Water from the FSH line would derive from Edwards-Trinity (Plateau) Aquifer ground water, which is currently permitted for agricultural use on FSH farms. This water has already been accounted for in the 2011 Texas Water Plan, and the pipeline project represents a potential change in the use for the water rather than a new demand on water (Brock 2011). FSH would scale back, and eventually eliminate, the agricultural operations in their present form as the water was converted from irrigation to municipal use. There is very little recharge of the water currently used for irrigation by FSH back into the aquifer due to impermeable strata below the farm (Thornhill Group, Inc. 2008). The pipeline would originate approximately 68 mi (109 km) southwest of the TCEP near the town of Fort Stockton. The primary users of water from this source would be the Cities of Midland and Odessa; the TCEP would use approximately 10 percent of the total volume of this proposed water source (FSH 2010). Because no additional ground water would be withdrawn from the aquifer and because there is very little recharge of the water currently used for irrigation, the TCEP's use of 10 percent of the total volume would have a negligible impact to the Edwards-Trinity (Plateau) Aquifer.

The construction and operation of the TCEP would result in the creation of up to 150 ac (60 ha) of impervious surface area. Although this additional impervious area could hinder recharge to the Pecos Valley Aquifer beneath the proposed polygen plant, intermediate layers of low permeability shale located below the polygen plant site currently hinder ground water recharge. Because of the size of the Pecos Valley Aquifer recharge area and the existing recharge conditions, the impact of the additional impervious surface area to ground water recharge would be negligible.

<u>Linear Facilities</u>

The proposed new access roads would result in approximately 23.6 ac (9.5 ha) of new impervious cover. As with the polygen plant site, this new impervious cover would hinder aquifer recharge, but that impact is expected to be minor due to the size of the surrounding aquifer recharge area. Vegetation along the areas disturbed during construction of the process water, natural gas, and CO_2 pipelines would be restored after construction and would result in little to no impervious cover.

3.6.5.2 GROUND WATER QUALITY

<u>Polygen Plant Site</u>

During construction and operation of the polygen plant, petroleum, oils, lubricants, and other materials could be spilled onto the ground surface and potentially impact ground water resources. However, required SPCC plans and spill prevention measures would be employed. These measures would help minimize the chance of fuel, oils, lubricants, and other potentially hazardous materials being released and would encourage proper disposal of waste materials. In the event of a spill, it is unlikely that these materials would reach ground water resources before cleanup due to the depth of the ground water table (estimated to be 320 ft [98 m] below ground). In addition, intermediate layers of low permeability shale located below the polygen plant site would impede liquids discharged at the surface from reaching the water table.

As discussed in Chapter 2, the TCEP would use a ZLD system that would reduce the overall need for raw process water through water reuse and prevent the discharge of process reject water to the land surface. This system would treat and reuse the process water wastes through multiple cycles of use, with salt from the brine water being disposed of through one of the proposed technologies in Chapter 2. Of the concentrated brine disposal option, the brine concentrator–filter press and solar evaporation ponds present a remote possibility that salt deposited in landfills could eventually leach into ground water.

Leakage of brine water to shallow ground water from solar evaporation ponds could occur from leaks in piping, valves, liners, or other components of the system. To minimize these risks, the systems would be built using required containment technology and would require monitoring. The required containment technology combined with the distance down to ground water and the presence of multiple layers of low permeability shale make it unlikely that the operation of the solar evaporation ponds would have significant impacts to ground water resources. If salt-laden brine water leaks downward into any potential water supply aquifers for drinking water, the contaminated portion of the underground aquifer would become more saline and likely would become unfit for drinking water. Clean-up would involve installation of one or more pumping wells into the contaminated area of the aquifer and pumping the contaminated water back to the surface where it would then require either proper disposal or re-introduction into the plant's ZLD system (after the leaking system has been repaired).

Brine water injection wells would be built to TCEQ Class I standards, which include tubing and packer designs with annular monitoring and complete annular cementing from the injection interval to land surface. Meeting these design, construction, and monitoring requirements would reduce the potential for leakage of the injected brine water and upward displacement of poor-quality ground water into overlying water-supply aquifers. Further, a thick sequence of rock strata between the formations that would receive the TCEP brine water and the potentially usable water supply would impede any upward movement of injected brine water. If either injected salt-laden water or native brine in a deep reservoir is displaced into any potential water supply aquifers for drinking water, the contaminated portion of the underground aquifer would become more saline and likely would become unfit for drinking water. Clean-up would involve installation of one or more pumping wells into the contaminated area of the aquifer and pumping the contaminated water back to the surface where it would then require proper disposal. Contaminated water that is recovered could be processed through the plant's ZLD system only after the problem with the injection well is corrected.

Linear Facilities

Impacts from the construction of the linear facilities would include the potential for fuel, oils, lubricants, and other potentially hazardous construction materials being released to the surface or subsurface (e.g., railcar maintenance area). As with the polygen plant site, it is not likely that such materials would seriously degrade ground water due to the implementation of the required SPCC plan and spill controls, the presence of multiple layers of low permeability shale, and the depth of the ground water below the surface.

The construction of process water, natural gas, and CO_2 pipelines would require hydrostatic testing to certify the material integrity of the pipeline before use. These tests consist of pressurizing the pipeline with water and checking for pressure losses from pipeline leakage. Contractors would perform hydrostatic testing in accordance with U.S. Department of Transportation pipeline safety regulations and all other applicable permits. The source and quantity of water for hydrostatic testing would be dependent on the available water sources. After the tests, the used hydrostatic test water would be analyzed and disposed of appropriately based on its chemical composition.

Operation and maintenance of the pipelines would comply with TPDES permit requirements and SPCC plans, if applicable. A release from a water pipeline carrying treated effluent would be rapidly detected and repaired. There could be a small localized area of discharge of the treated effluent. Because the use of this water for irrigation has been approved by the TCEQ, such effluent has been deemed safe and would not pose a threat to ground water. Releases from either the CO_2 pipeline or natural gas pipeline would not affect ground water resources. Minor oil spills associated with the operation and maintenance of the power transmission lines could also occur. As with the pipelines, ground water impacts associated with spills along the power transmission lines would not be likely due to the depth of the ground water, presence of low permeability shale layers, and compliance with the required SPCC plans and spill controls.

Traffic accidents on project roads could result in hazardous materials spills. The spill response measures developed for the polygen plant site would be executed to control runoff and to clean-up hazardous materials spills. As noted earlier, the depth to ground water and presence of low permeability shale layers would prevent such spills from reaching the ground water.

Sequestration Sites

Impacts of the injection of CO_2 in deep geologic reservoirs would be expected to be low. The potential for CO_2 to naturally leak from the geologic reservoir into overlying shallow aquifers is low due to the depth and geologic characteristics of the potential sequestration sites (Smyth et al. 2006). Further, the CO_2 captured from the TCEP would be injected into oil reservoirs in quantities that would not cause the fluid pressures in the reservoir to significantly exceed the original natural pressures in those reservoirs, so pressure to drive the CO_2 upward would be lacking. These formations have held oil over geologic time, showing a high degree of integrity for long-term storage.

Although the most likely pathway for upward migration of CO_2 is through improperly abandoned deep wells that penetrate the main seal over the reservoir where CO_2 would be injected, RRC requires that abandoned injection wells be identified and properly plugged, which significantly reduces the potential for CO_2 leakage. Pursuant to RRC requirements, purchasers of the CO_2 would test any wells in the receiving fields prior to injection for EOR.

The sequestration of CO_2 associated with the TCEP would be the result of the EOR process. Because CO_2 is a valuable commodity in the EOR process, the potential users of the TCEP CO_2 would actively manage their EOR processes as a closed-system and strive to prevent the loss of any CO_2 in the process. Additionally, after long-term monitoring of the Scurry Area Canyon Reef Operators Committee oil field in Snyder, Scurry County, Texas, the Bureau of Economic Geology found that no systematic impacts to ground water occurred as a result of CO_2 injection practices (Smyth et al. 2009). The Scurry Area Canyon Reef Operators Committee oil field is located in the Permian Basin (approximately 100 mi [161 km] northeast of the proposed polygen site) and is considered to be representative of other likely Permian Basin CO_2 EOR sites (Smyth et al. 2006), including those sites that would use TCEP CO_2. Based on the experience at Scurry Area Canyon Reef Operators Committee oil field and the other information presented above, DOE anticipates minimal ground water impacts to the Capitan Reef Complex, Dockum, Edwards-Trinity (High Plains), Edwards-Trinity (Plateau), Pecos Valley, Ogallala, and Rustler Aquifers would occur as a result of the injection of TCEP CO_2 for use in EOR processes.

3.6.6 Mitigation

Additional mitigation has not been identified beyond the required compliance with state and federal air quality regulations, as well as implementation of standard construction controls identified in Chapter 2, Table 2.8.

3.7 Surface Water Resources

3.7.1 Background

This section identifies and describes the surface water resources that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

Surface water resources include wetlands, water bodies, waterways, and floodplains. Each of these resources provides benefits related to water quality, wildlife and aquatic life habitat, and flood protection. A number of federal and state laws and regulations include thresholds for protection of surface water resources. These thresholds are described in Chapter 7, Permitting and Licensing Requirements.

Wetlands are areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands typical of this region of Texas include areas along intermittent and perennial waterways, temporarily flooded areas, marsh complexes in large basins, seeps and springs, desert playas, abandoned stream channels, fringe wetlands around water bodies, and natural ground surface depressions (U.S. Army Corps of Engineers 2008, 2010).
Water bodies are geographic depressions or impoundments that hold water. They can be shallow or deep. Water bodies typical of this region of Texas include natural ponds and playa lakes and impoundments along waterways, but can also include man-made ponds associated with ranching, oil and gas activities, industrial cooling facilities, and municipal waste water filtration systems. Water bodies in this region are generally ephemeral, and when not inundated with water, they either function as wetlands or are dry.
Waterways are linear geographic features that convey flowing water. Well-known waterway types are rivers, streams, and creeks, but can also include man-made features such as ditches, canals, swales, pipes, and aqueducts (U.S. Army Corps of Engineers 2007).
Waters of the U.S. are surface waters that are chemically, physically, and/or biologically connected to other water resources, as the definition applies to the jurisdictional limits of the U.S. Army Corps of Engineers under the Clean Water Act.
Floodplains are areas that can be inundated periodically due to rain fall events. Floodplains are designated by the Federal Emergency Management Agency.

3.7.2 Region of Influence

The ROI consists of the polygen plant site, areas where the linear facilities would intersect surface water resources, and areas downstream (300 ft [91 m) of each intersection. The downstream area is included because such areas could be affected by increases in surface water runoff and downstream movement of eroded soils.

3.7.3 Methodology and Indicators

To characterize the existing environment and analyze potential impacts to surface water, DOE reviewed the FutureGen EIS (DOE 2007), USFWS National Wetland Inventory maps (USFWS 1994), U.S. Geological Survey NHD geodatabases (U.S. Geological Survey 2010a), Federal Emergency Management Agency floodplain data (City of Midland 2010; Federal Emergency Management Agency 1991a, 1991b), U.S. Geological Survey topographic maps (TWDB 2010d), aerial photographs (TWDB 2010e), available water quality reports, and conducted a limited site reconnaissance.

The impacts analysis for surface water resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. The potential impacts to surface water resources and their indicators are shown in Table 3.14.

Table 3.14. Indicators of Potential Impacts to Surface Water Resources

Potential Impact	Impact Indicator
Filling of wetlands, waterways, or water bodies, or otherwise alter drainage patterns that would affect these resources, thus triggering a permitted or regulated activity	Acres of fill in wetlands, waterways, or water bodies
Conflict with applicable storm water or regional water quality management plans or goals, or contaminate public water supplies and other surface waters exceeding (i.e., degrading) water quality criteria or standards	Water quality conditions
Violation of any federal, state, or regional discharge limitations, which could affect drainage patterns, flooding, and erosion and sedimentation	Volume of discharge into surface waters
Affect the capacity of surface water resources	
Conflict with established water rights or regulations protecting surface water for future beneficial uses	Volume of surface water used
Conflict with applicable flood management plans or ordinances, or alter floodways, floodplains, flood hazard areas, or otherwise impede or redirect flows such that human health, the environment, or personal property is affected	Acres of impacts within mapped floodplains or flood hazard areas
Affect or modify federally and/or state-listed protected water bodies such as wild and scenic rivers	Acres of disturbance within protected water bodies

3.7.4 Affected Environment

Existing surface water conditions are described in this section. The project area spans 23 subwatersheds as identified in Figure 3.7. Data on water quality conditions for the ROI were derived from studies along Monahans Draw. These studies conclude that water quality is typical of an intermittent stream that receives storm water runoff from municipal and industrial sources and within which treated municipal effluent dominates stream flow (James 1988; Larson 1996). Overall, they found the water quality to be reasonably good with elevated concentrations of nutrients, certain metals, and organics for short distances downstream from municipal outfalls.

> **Watersheds** are the land area that drains water to a particular stream, river, or lake. It is a land feature identified by tracing a line along the highest elevations between two areas on a map, often a ridge (U.S. Geological Survey 2011).
> **Subwatersheds** are a smaller geographic section of a larger watershed unit with a drainage area between 2–15 square mi (mi^2) (5–39 square km [km^2]) and whose boundaries include all the land area draining to a point where two second order streams combine to form a third order stream (EPA

3.7.4.1 WETLANDS, WATERWAYS, WATER BODIES, AND WATER QUALITY

Polygen Plant Site

There are no surface waters on the polygen plant site (DOE 2007; SWCA 2010a). The nearest surface waters are ephemeral headwaters to Monahans Draw and Landreth Draw. Data from the NHD, U.S. Geological Survey maps, and aerial photography show the Monahans Draw headwaters to be approximately 4.2 mi (6.7 km) to the northeast and the Landreth Draw headwaters approximately 11.8 mi (19.0 km) to the southeast of the polygen plant site (Figure 3.8). The closest major water body is the upper Pecos River, located approximately 30 mi (48.3 km) south of the project area.

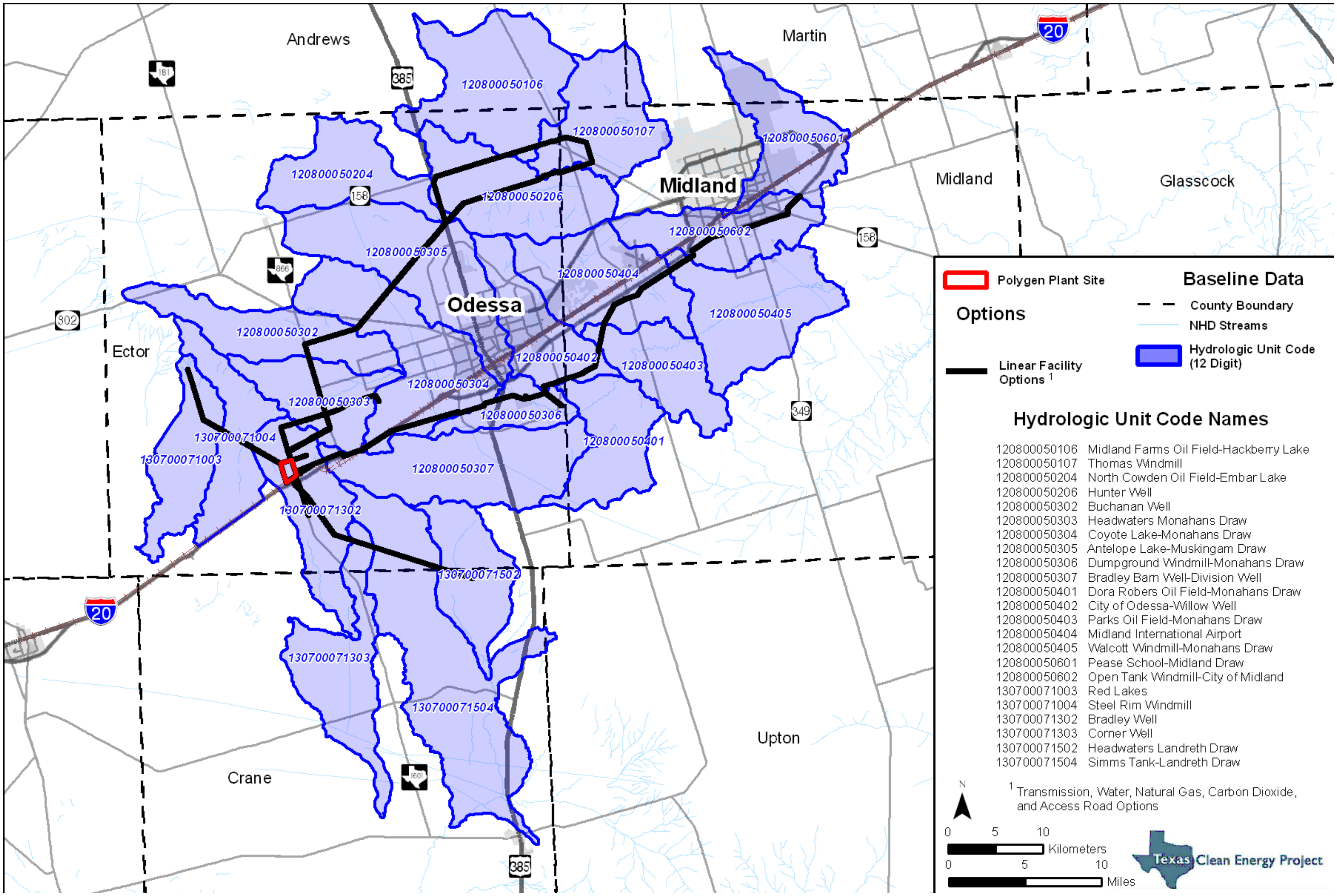

Figure 3.7. Subwatersheds in the project area.

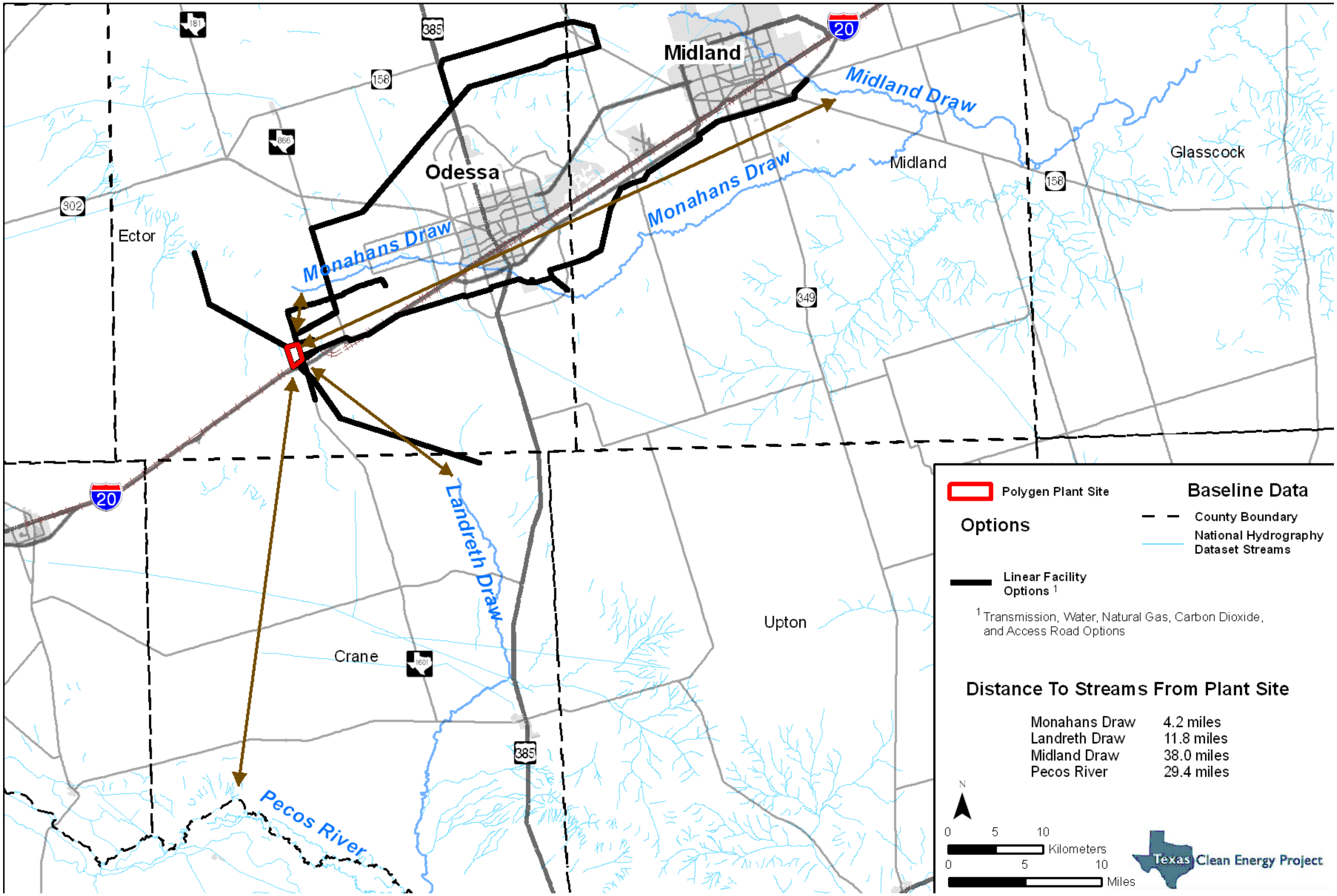

Figure 3.8. Proximity of major surface waters to the polygen plant site and linear facilities.

Linear Facilities

WL1 and WL3 are the only linear facilities with wetlands or water bodies within their proposed corridors (Table 3.15; Figure 3.9). The NHD, U.S. Geological Survey topographic maps, and/or aerial photographs suggest linear facility options potentially cross other surface waters, but an evaluation of these areas did not reveal surface water indicators. The total area of wetlands and water bodies within the combined corridors is approximately 2.16 ac (0.87 ha).

Table 3.15. Summary of Existing Wetland/Water Body Conditions for Specific Linear Facility Options

Linear Facility Option	Inset on Figure 3.9	Wetland/Water Body Type*	Area (ac [ha])†
WL1	B	PSS1K: Wetland Fringe to Monahans Draw Impoundment (artificial hydrology from effluent discharge)	0.20 (0.08)
WL1	B	R5AB3K: Monahans Draw Impoundment (artificial hydrology from effluent discharge)	0.54 (0.22)
WL1	C	PEM1Cxs: Ephemeral Borrow Pit (water body)	0.84 (0.34)
WL3	A	PEM2C: Ephemeral Playa‡	0.58 (0.23)
Total			**2.16 (0.87)**

* Wetland types follow Cowardin et al. (1979): PSS1K = palustrine scrub-shrub, persistent, artificially flooded; R5AB3K = riverine, unknown perennial, aquatic bed, rooted vascular, artificially flooded; PEM1Cxs = palustrine emergent, persistent, seasonally flooded, excavated, spoil; PEM2C = palustrine emergent, nonpersistent, seasonally flooded.
† Wetland acreages were derived from field reconnaissance, NHD data, National Wetland Inventory maps, and aerial photograph interpretation and not from field delineation.
‡ Wetland acreage was derived from GIS analysis of aerial photography only, as access to the surface water was unavailable.

From its headwaters 5 mi north of Penwell in Ector County, Texas, Monahans Draw runs east for approximately 45 mi (72 km) to its confluence with Midland Draw in Midland County, Texas. Monahans Draw is broad and shallow with a sandy substrate and over its course, transitions from a dry, ephemeral swale (upstream of the GCA Odessa South Facility) to a seasonally intermittent waterway. Effluent discharge from the GCA Odessa South Facility and rainfall runoff drive the intermittent nature of Monahans Draw as the historical springs and seeps have not flowed since the late 1930s (Brune 1981). Because it is not perennial, Monahans Draw is not a state-owned streambed. However, Monahans Draw is still an important drainage in the region; carrying flood flows and contributing to the overall dynamics of the local watershed and ultimately, the Colorado River.

Where Monahans Draw intersects WL1 (Insert B on Figure 3.9), it primarily functions as a wetland (Figure 3.10). This is due to the impounding of effluent discharge from the GCA Odessa South Facility (Figure 3.11). The overall nature and quality of this wetland is low because invasive and/or noxious species, such as broadleaf cattail (*Typha latifolia*), saltcedar (*Tamarix* sp.), and burningbush (*Bassia scoparia*) are dominant.

Additionally, the hydrologic regime is highly variable and driven primarily by the effluent discharge with rainfall events providing a secondary source of hydrology. Using the same observation point (South Dixie Boulevard upstream of the GCA discharge), DOE noted that Monahans Draw had high stream flow in June 2010, following a period of above-normal rainfall. Then shortly thereafter, in August 2010, Monahans Draw had no stream flow (Figure 3.12).

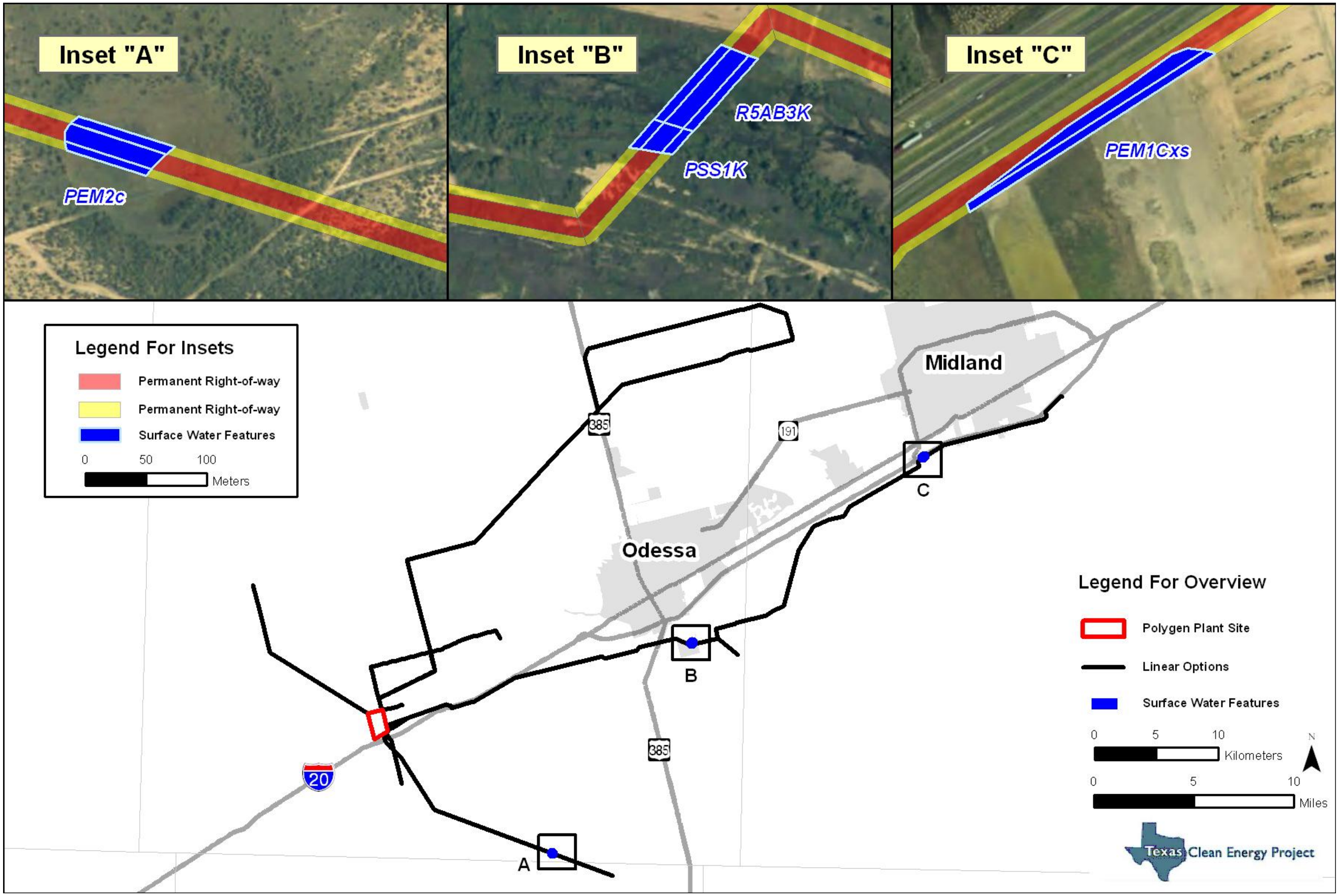

Figure 3.9. Existing surface water conditions along the TCEP linear facility options.

Figure 3.10. Monahans Draw Impoundment (dominated with broadleaf cattail), as viewed facing northwest toward the proposed waterline crossing.

Figure 3.11. Effluent discharge from Gulf Coast Waste Disposal Authority Odessa South Facility into Monahans Draw Impoundment.

Figure 3.12. Changes in Monahans Draw stream flow (above, as viewed from South Dixie Boulevard) and stages of wetland conditions (below, as viewed near the proposed WL1 crossing).

During this same period, the impoundment near the proposed WL1 crossing (also upstream of the GCA discharge) went from being inundated to only having pockets of saturation and inundation (see Figure 3.12). Therefore, in the absence of effluent discharge, periods of above normal rainfall may provide temporary, ephemeral wetland habitat for aquatic species. It is the artificial hydrology from GCA discharge that provides for a more consistent source of water that supports aquatic species habitat and attracts wildlife in this arid habitat.

All other surface waters, including the ephemeral playa lake and borrow pit (Insets A and C, respectively, on Figure 3.9), which could be crossed by the linear facilities are isolated and have evidence of past and current disturbances (e.g., excavation, livestock use, roads, etc.; see Figure 3.9; Figure 3.13).

Figure 3.13. Borrow pit with ephemeral water (PEM1Cxs Water Body, Inset C on Figure 3.9).

3.7.4.2 FLOODPLAINS

<u>Polygen Plant Site</u>

The polygen plant site is located outside of the 100-year floodplain. In fact, the entire subwatershed (Bradley Well) in which the plant site is located (see Figure 3.7) has limited floodplains with only a few closed topographic systems associated with ephemeral playas or ephemeral drainages. Based on topographic maps, the site has low relief—a difference of approximately 30 ft (9 m) across the site—with general surface drainage to the south-southwest.

<u>Linear Facilities</u>

Access roads would not be located in any known floodplains (City of Midland 2010; Federal Emergency Management Agency 1991a, 1991b). All of the proposed power transmission line alternatives and WL1 and WL2 would intersect mapped floodplains, but most of the floodplains are in closed topographic systems associated with ephemeral playas or depressional areas (i.e., they are not associated with waterways). The process water, natural gas, and CO_2 pipelines would be buried, thus no permanent aboveground structures would be placed within the 100-year floodplains, and construction would therefore not result in increases to the 100-year flood elevation or present barriers to floodway passage.

3.7.5 Environmental Impacts of Summit's Proposed Project

3.7.5.1 WETLANDS, WATER BODIES, WATERWAYS, AND WATER QUALITY

Polygen Plant Site

The absence of surface water resources in or adjacent to the polygen plant site eliminates the possibility of direct impacts and reduces the risk of indirect impacts. Indirect impacts to surface waters in the ROI during construction or operation of the polygen plant site would be unlikely for the following reasons:

- No discharge of storm water would occur. Storm water generated during construction and operation would be collected in on-site storm water retention basins, which would be located in the southwestern corner of the polygen plant site. Based on topographic maps, the southwestern corner is currently where all natural overland storm water drains. Additionally, the TCEP would comply with all existing regulatory requirements, such as storm water construction permits (maintaining and treating all storm water on-site).
- The TCEP would not discharge industrial waste water into surface waters. A ZLD system or deep well injection would treat all brine water and recycle it back into the polygen plant. Alternatively, brine water would be injected in deep geologic formations underneath the polygen plant site.

Impacts to surface waters in the ROI during operation of the plant site would be low. For any spilled materials such as coal or other by-products that were entering or leaving the polygen plant site, Summit would comply with existing regulatory requirements regarding remediation of spills and would follow guidelines outlined in a SPCC plan to reduce the potential for such materials to reach water bodies off-site. For windblown particulates such as those from coal and slag handling facilities and plant emissions, Summit would enclose coal and slag handling facilities and incorporate dust suppression sprayers and other dust collection systems. These measures would reduce the potential for deposition of PM on off-site water bodies.

The preferred water source for the TCEP is treated effluent from the GCA Odessa South Facility (WL1), but the Oxy Permian Process (WL2) or the FSH waterline (WL3 and WL4) could also supply process water to the TCEP. The current discharge volume (minimum monthly average discharge of 2.0 million gal [7.5 million L] per day) from the GCA Odessa South Facility to Monahans Draw would not be decreased as a result of the TCEP, because additional flow to the GCA Odessa South Facility would be provided from the City of Midland Wastewater Treatment Plant (Levine 2010). Thus, TCEP process water use would not affect Monahans Draw or any other surface water resource in the ROI.

Linear Facility Options

Impacts to surface waters or surface water quality from the construction or operation of the linear facility options would be unlikely. Once construction was complete, there would be no permanent aboveground structures in or adjacent to surface waters. Restoration procedures, such as soil stabilization and revegetation, would stabilize and restore the impacted area. The ROW adjacent to Monahans Draw would likely be maintained in a state that is cleared of woody vegetation, but considering the dominant species is saltcedar—a non-native, noxious, and invasive species—this could be considered a beneficial environmental consequence.

Construction of linear facilities could result in short-term impacts including increased turbidity and sedimentation, streambed disturbance, and removal of streambank vegetation. These impacts and their intensity would be minimal because:

- Construction would affect a maximum of 1.42 ac (0.57 ha) of wetlands (Table 3.16). This area excludes WL1, as construction across Monahans Draw (which is shown on Insert B on Figure 3.9) would occur in a manner to avoid potential adverse impacts to the 0.74 ac (0.30 ha) associated with Monahans Draw. Either traditional open-cut trenching methods or horizontal directional drilling would be used. Horizontal directional drilling methods would allow the construction activity to take place without obtaining a Clean Water Act Section 404 permit, whereas traditional trenching methods would require a permit. A permit is not required for the ephemeral playa lake and borrow pit (Insets A and C, respectively, on Figure 3.9) because they are isolated and nonjurisdictional.
- The construction activities affecting surface water resources would comply with existing regulatory requirements, such as storm water construction permits, that mandate runoff controls and erosion management. This would result in elimination or significant reduction of potential adverse impacts.

3.7.5.2 FLOODPLAINS

Analysis of impacts to floodplains showed that flooding has a low potential to occur due to the low frequency of local flood occurrences in Ector and Midland Counties (H20 Partners 2010). No permanent aboveground structures would be placed in the 100-year floodplains, and construction would therefore not result in increases to the 100-year flood elevation or present barriers to floodway passage. Floodplain impacts from linear facilities are limited because these facilities cross only minimal floodplain areas and the only aboveground structures would be temporary access roads during construction (transmission line structures would be placed outside of floodplains). Temporary access roads would be removed upon construction completion but designed to meet all applicable flood management requirements while in use during construction.

Table 3.16. Environmental Impacts to Surface Water Resources from Construction and Operation of Linear Facilities

Linear Facility Option	Inset on Figure 3.9	Temporary ROW*		Operational ROW†	
		Wetland Type‡	Area (ac [ha])§	Wetland Type‡	Area (ac [ha])§
WL1	B	PSS1K: Wetland Fringe to Monahans Draw Impoundment (artificial hydrology from effluent discharge)	0.10 (0.04)	PSS1K: Wetland Fringe to Monahans Draw Impoundment (artificial hydrology from effluent discharge)	0.10 (0.04)
WL1	B	R5AB3K: Monahans Draw Impoundment (artificial hydrology from effluent discharge)	0.26 (0.11)	R5AB3K: Monahans Draw Impoundment (artificial hydrology from effluent discharge)	0.28 (0.11)
WL1	C	PEM1Cxs: Ephemeral Borrow Pit (water body)	0.41 (0.17)	PEM1Cxs: Ephemeral Borrow Pit (Water Body)	0.43 (0.17)
WL3	A	PEM2C: Ephemeral Playa#	0.28 (0.11)	PEM2C: Ephemeral Playa¶	0.30 (0.12)
Total			**1.05 (0.42)**		**1.11 (0.45)**

* These include additional ROWs needed for construction only.
† These include maintained ROWs.
‡ Wetland types follow Cowardin et al. (1979): PSS1K = palustrine scrub-shrub, persistent, artificially flooded; R5AB3K = riverine, unknown perennial, aquatic bed, rooted vascular, artificially flooded; PEM1Cxs = palustrine emergent, persistent, seasonally flooded, excavated, spoil; PEM2C = palustrine emergent, nonpersistent, seasonally flooded.
§ Wetland acreages were derived from field reconnaissance, NHD data, National Wetland Inventory maps, and aerial photograph interpretation. DOE has not conducted a delineation of these resources.
¶ The perennial hydrology of these surface water features is due to the effluent discharge from the GCA Odessa South Facility.
# This wetland acreage was derived from GIS analysis of aerial photography only, as access to the surface water was unavailable.

3.7.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to surface water resources are:

Floodplain (TL1, TL2, TL5, and TL6):

- Designing the transmission line to span resource
- Coordinating with local floodplain administrators
- Conducting construction activities during dry or low flow conditions

Wetlands (WL1) and floodplain (WL3):

- Crossing wetland area at narrowest point to disturb the least amount of wetland vegetation.
- Using restoration and stabilization controls in affected areas to pre-construction conditions for open-cut methods or maintenance activities. In the case of WL1, TCEP representatives could coordinate with GCA to divert the effluent discharge around the construction area to

avoid downstream flow of sediment, and then return the discharge to normal conditions once the construction area is stabilized.

- Coordinating with local floodplain administrators.
- Conducting construction activities during dry or low flow conditions.
- Using erosion and siltation controls to minimize short-term impacts when maintenance activities requiring access to buried portions of pipelines occur in floodplains or wetlands.

3.8 Biological Resources

3.8.1 Background

This section identifies and describes the biological resources that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

Biological resources can be affected by the disturbance, injury, or death of individuals and by the destruction or disturbance, either temporarily or permanently, of habitat. In addition to addressing these possible impacts, this section addresses the potential for the introduction or spread of non-native or invasive species. Chapter 7, Permitting and Licensing Requirements, summarizes the federal and state laws, regulations, and executive orders applicable to biological resources.

3.8.2 Region of Influence

The ROI for biological resources is the area in which direct and indirect impacts have the potential to occur during TCEP construction and operation. It covers terrestrial and aquatic habitat, migratory birds, and federally and state-protected species. The ROI encompasses the total acreage of the polygen plant site and linear facility ROWs and a 0.5-mi (0.8-km) buffer zone around these areas to account for potential disturbance from project noise or vibration. In addition, the ROI for impacts to aquatic species includes areas where the linear facilities would intersect surface water resources, and areas downstream (at least 300 ft [91 m]) of each intersection. The downstream area is included because such areas could be affected by increases in surface water runoff and downstream movement of eroded soils which could adversely affect aquatic species.

3.8.3 Methodology and Indicators

3.8.3.1 METHODS OF ANALYSIS

Terrestrial Species

Terrestrial species and habitat were identified during various site visits noted in Section 3.2 to the proposed polygen plant site and accessible areas of the linear facilities. DOE recorded the wildlife and vegetative species present, the condition of the terrestrial community, and presence or absence of noxious or invasive species. In addition, a literature review was conducted to confirm wildlife species likely to occur in the ROI (Garrett and Barker 1987; Lockwood and Freeman 2004; Schmidly 2004). Bird species that commonly occur in the ROI were determined based on existing habitat types in the ROI and a literature review of the *Texas Ornithological Society Handbook of Texas Birds* (Lockwood and Freeman 2004).

Aquatic Species

DOE surveyed the proposed polygen plant site and accessible areas of the linear facilities for aquatic communities. There are no aquatic resources or communities on the proposed polygen plant site. However, for the accessible aquatic communities along the linear facilities, DOE documented wildlife and vegetative species, the condition of the aquatic community, and presence or absence of noxious or invasive species. See the surface water resources section (Section 3.7) for the methodology used for the assessment of wetlands, water bodies, and waterways. In addition, a literature review was conducted to confirm aquatic species likely to occur in the ROI (Garrett and Barker 1987; Lockwood and Freeman 2004; Schmidly 2004).

Migratory Birds

In three field investigations, DOE documented the potential for migratory bird species to occupy habitat in and adjacent to the project area.

Rare, Threatened, and Endangered Species

Federal- and state-listed threatened and endangered species with potential to occur in Ector, Midland, and Crane Counties, Texas, were identified through review of county-by-county lists of such species produced by USFWS (2010) and TPWD (2010). These USFWS and TPWD county lists provide baseline information to assess which threatened and endangered species have potential to occur in the ROI. DOE conducted three field investigations of the project area and reviewed aerial photographic and topographic maps to verify the presence of habitat for the identified species. DOE also reviewed the TPWD Natural Diversity Database to locate known occurrences of species that are considered rare, threatened, or endangered under Texas law. DOE gathered this information and developed a habitat evaluation to determine the potential for federal- and state-listed species to occur in the ROI (SWCA 2010b).

3.8.3.2 ASSESSMENT INDICATORS

The impacts analysis for biological resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their quantitative indicators are shown in Table 3.17.

Table 3.17. Indicators of Potential Impacts to Biological Resources

Potential Impact	Impact Indicator
Displacement of individuals (wildlife) or loss of habitat	Acres of surface disturbance
Loss of vegetation species or communities	
Direct removal of individuals; increased risk of direct mortality for some species	
Disturbance by project construction or operation resulting in changes to wildlife behavior	Acres within 0.5 mi (0.8 km) of project operations or construction zones
Increased risk of direct mortality (avian species) due to collisions with transmission lines	Linear feet and dimensions of new transmission lines
Increased risk of direct mortality (terrestrial wildlife species) from traffic	Linear feet of new roads Annual average daily traffic (AADT) numbers
Introduction of noxious or invasive species	Perimeter of surface disturbance and use (linear feet)

3.8.4 Affected Environment

The existing conditions for terrestrial and aquatic species, migratory birds, and rare, threatened, and endangered species are generally the same throughout the ROI; therefore, the following descriptions of existing biological resources apply to the project area in its entirety.

3.8.4.1 TERRESTRIAL SPECIES

The TCEP would be constructed and operated in the High Plains ecoregion of Texas (Griffith et al. 2007). This ecoregion is characterized by smooth and slightly irregular plains scattered with playa lakes, which are isolated wetlands in shallow depressions. Specifically, the ROI lies in the more arid subregions of the High Plains ecoregion, including both the Llano Estacado and Arid Llano Estacado subregions. Most of the project area is located in the Arid Llano Estacado subregion (Figure 3.14), which is drier than the Llano Estacado. The Llano Estacado subregion is located in northeast Midland County and includes the eastern extent of WL1 (Figure 3.14). DOE assumes that the terrestrial species occurring in these two subregions have the potential to occur the ROI.

Vegetation

The Llano Estacado and Arid Llano Estacado subregions are both described as a short-grass prairie vegetated primarily by buffalograss (*Bouteloua dactyloides*) and grama species (*Bouteloua* spp.). However, a significant portion of the two subregions has been altered by oil and gas production, ranching, and agricultural activities, in the past 100 years, which has caused fragmentation of the habitat and encroachment of shrub species such as mesquite (*Prosopis glandulosa*) and narrowleaf yucca (*Yucca angustissima*). This disturbance is evident throughout the ROI, which now fully supports the Mesquite Shrub-Grassland vegetation community known to occur in the two subregions. Invasive and noxious species (as defined under federal and state laws) are also present in the ROI, with cover ranging from 0 percent to approximately 70 percent, based on a visual estimate conducted during field investigations.

Observed invasive or noxious species in the project area include bermudagrass (*Cynodon dactylon*), burningbush, common sunflower (*Helianthus annuus*), Russian thistle (*Salsola tragus*), johnsongrass (*Sorghum halepense*), and saltcedar.

The dominant shrub species in the Mesquite Shrub-Grassland vegetation community observed in the ROI is mesquite, with fewer creosotebush (*Larrea divaricata*), four-winged saltbush (*Atriplex canescens*), broom snakeweed (*Gutierrezia sarothrae*), littleleaf sensitive-briar (*Schrankia uncinata*), lotebush (*Ziziphus obstusifolia*), sand sagebrush (*Artemisia filifolia*), and narrowleaf yucca. Shrubs in this dominant community range from 2 to 7 ft (0.6–2.1 m) in height, with densities ranging from 30 percent to 70 percent and interspersed with patches of bare ground (SWCA 2010b).

Common herbaceous vegetation in the Mesquite Shrub-Grassland vegetation community found in the ROI includes common sunflower, Russian thistle, silverleaf nightshade (*Solanum elaeagnifolium*), Texas croton (*Croton texensis*), and western ragweed (*Ambrosia psilostachya*). Dominant grass species include bermudagrass, little bluestem (*Schizacharium scoparium*), plains bristlegrass (*Setaria leucopila*), sand dropseed (*Sporobolus cryptandrus*), sideoats grama (*Bouteloua curtipendula*), silver bluestem (*Bothriochloa saccharoides*), and oldfield threeawn (*Aristida oligantha*).

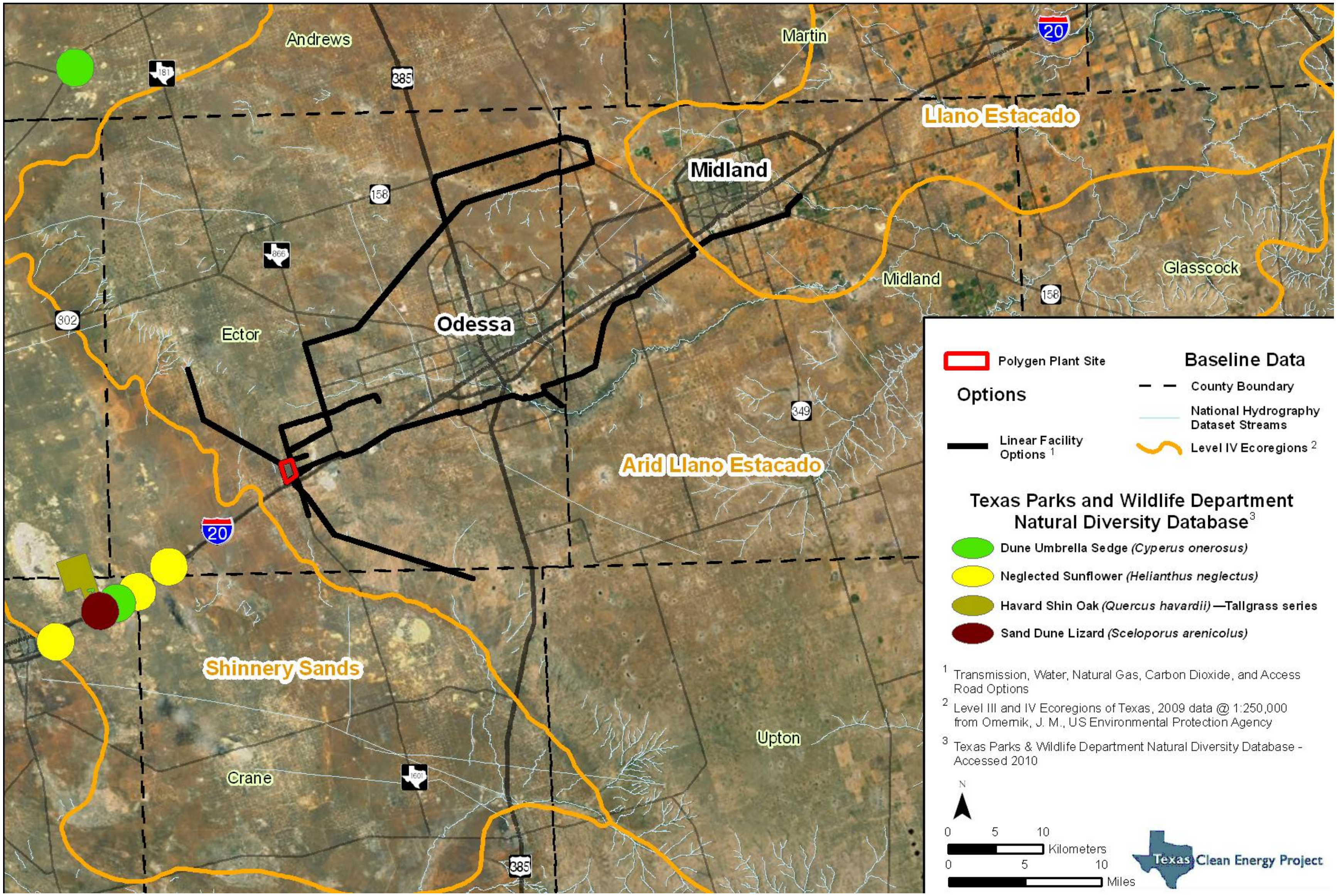

Figure 3.14. Ecoregions and Texas Parks and Wildlife Department Natural Diversity Database locations near the TCEP.

Wildlife

At least 55 species of mammals, 25 species of snakes, 11 species of lizards, 11 species of amphibians, and four species of turtles occur in the Arid Llano Estacado and Llano Estacado subregions (Garrett and Barker 1987; Schmidly 2004; Werler and Dixon 2000). More than 300 species of birds have been documented in the Arid Llano Estacado and Llano Estacado subregions (Hewetson et al. 2006; Midland Naturalists, Inc. 2010).). Because of the presence of suitable habitat in the ROI and the widespread occurrence of these wildlife species and their mobility, it is likely that they would be present in the ROI.

Common mammalian and reptilian species with potential to occur in the ROI include the nine-banded armadillo (*Daspypus novemcinctus*), coyote (*Canis latrans*), black-tailed jackrabbit (*Lepus californicus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), western diamond-backed rattlesnake (*Crotalus atrox*), Texas spotted whiptail lizard (*Aspidoscelis gularis*), and ornate box turtle (*Terrapene ornate*) (Garrett and Barker 1987; Schmidly 2004; Werler and Dixon 2000). Resident avian species potentially occurring year-round in the ROI include Bewick's wren (*Thryomanes bewickii*), European starling (*Sturnus vulgaris*), great-tailed grackle (*Quiscalus mexicanus*), horned lark (*Eremophila alpestris strigata*), house sparrow (*Passer domesticus*), killdeer (*Charadrius vociferous*), mourning dove (*Zenaida macroura*), northern bobwhite (*Colinus virginianus*), northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottos*), and western meadowlark (*Sturnella neglecta*) (Hewetson et al. 2006; Lockwood and Freeman 2004; Midland Naturalists, Inc. 2010).

Game mammals with potential to occur in the ROI include mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), and collared peccary (*Pecari tajacus*) (Schmidley 2004). Birds hunted as game include scaled quail (*Callipepla squamata*), Rio Grande turkey (*Meleagris gallopavo intermedia*), and white-winged dove (*Zenaida asiatica*). Feral hogs (*Sus scrofa*), a game species, occur in portions of Ector, Midland, and Crane Counties; this species is a non-native and invasive species that is a conservation threat to native vegetation and wildlife (Taylor 2003).

3.8.4.2 AQUATIC SPECIES

The proposed polygen plant site contains no wetlands, intermittent or perennial waterways, or water bodies that support aquatic species (DOE 2007; SWCA 2010b). The linear facility options intersect three water bodies/wetlands (see Table 3.15). These water features have varying quality of habitat for aquatic species (Table 3.18).

Table 3.18. Aquatic Habitat Characteristics

Water Feature	Linear Facility Option	Seasonality	Habitat Quality	Vegetation	Wildlife
Borrow Pit*	WL1	Ephemeral	Low	Unknown	Amphibians[‡] Brazilian free-tailed bats[‡] Swallows[‡]
Monahans Draw Impoundment	WL1	Perennial	Moderate	Broadleaf cattail[†] Saltcedar[†] Burningbush[†]	Amphibians[‡] Fish[‡] Northern raccoons (*Procyon lotor*) Red-winged blackbirds (*Agelaius phoeniceus*) Swallows Coyotes
Playa Lake*	WL3	Ephemeral	Low	Unknown	Amphibians[‡]

* Restricted access to property.
[†] Non-native, invasive, and/or noxious species.
[‡] Common wildlife not observed, but presumed to occur due to the habitat present.

WL1 crosses a portion of a borrow pit south of the I-20 frontage road. Two culverts interconnect the borrow pit with a wetland north of the I-20 frontage road; however, DOE observed water in the borrow pit only after rain events, which indicates that the borrow pit is ephemeral and receives runoff from roadways and developments, indicating low-quality habitat for wildlife. Although DOE was unable to access this property to identify plant species, based on observation and the surrounding area, it is likely that this feature provides minimal habitat for wildlife species.

The portion of Monahans Draw that traverses WL1 primarily functions as a wetland due to a downstream impoundment that retains effluent discharge from the GCA Odessa South Facility. The continual water supply attracts wildlife in this arid habitat. Several invasive and noxious plants such as saltcedar are also found in this water feature (see Table 3.18).

During the scoping process, TPWD provided recommendations to minimize impacts to playa lakes in the project area. Playa lakes can support a diversity of wildlife species (e.g., waterfowl), protect water quality, and recharge ground water (Fish et al. 2010; Haukos and Smith 1997). DOE determined that one feature along WL3 appears to have characteristics of a playa lake. Although DOE was unable to assess this water feature because of restricted access, based on review of aerial photography it was determined that this potential playa lake is highly ephemeral. Although the quality of habitat for wildlife is low due to the surrounding land use activities, this playa may provide suitable breeding habitat for some amphibians, such as Couch's spadefoot toad (*Scaphiopus couchii*).

3.8.4.3 MIGRATORY BIRDS

The ROI occurs in the Central Flyway, a major migratory route used by birds traveling between wintering and breeding grounds. This location creates potential for a great number of migratory bird species to pass through and utilize habitat in the ROI during the spring and fall migration periods.

Regular migrants traveling through the ROI typically include the greater yellowlegs (*Tringa melanoleuca*), Forster's tern (*Sterna forsteri*), yellow warbler (*Dendroica petechia*), chipping sparrow (*Spizella passerina*), and clay-colored sparrow (*Spizella pallida*). Common migratory birds with potential to winter in the ROI include the American widgeon (*Anas americana*), common snipe (*Gallinago gallinago*), northern harrier (*Circus cyaneus*), brewer's blackbird (*Euphagus cyanocephalus*), dark-eyed junco (*Junco hyemalis*), lark bunting (*Calamospiza melanocorys*), and vesper sparrow (*Pooecetes gramineus*) (Lockwood and Freeman 2004).

Common migratory birds expected to breed in scrubland habitats similar to those in the ROI include American goldfinch (*Spinus tristis*), brown thrasher (*Toxostoma rufum*), common yellowthroat (*Geothlypis trichas*), dickcissel (*Spiza americana*), grasshopper sparrow (*Ammodramus savannarum*), horned lark, lark sparrow (*Chondestes grammacus*), long-billed curlew (*Numenius americanus*), and western meadowlark.

3.8.4.4 RARE, THREATENED, AND ENDANGERED SPECIES

The USFWS (2010) and TPWD (2010) list 13 threatened and endangered species as occurring, formerly occurring, or having the potential to occur in Ector, Midland, and/or Crane Counties. TPWD lists an additional 13 species as rare.

Based on the results of the TPWD Natural Diversity Database review (see Figure 3.14) and the field reconnaissance conducted by DOE, it was determined that the ROI provides suitable habitat for one state-listed threatened species, the Texas horned lizard (*Phrynosoma cornutum*), and 11 rare species including mammals, reptiles, and migratory birds (Table 3.19). No federally protected species are known to occur or were observed by DOE on or near the proposed polygen plant site or linear facilities (DOE 2007; SWCA 2010b). No designated critical habitat occurs in or adjacent to the proposed polygen plant site or its linear facilities. After review of the *Federally-listed Species Habitat Evaluation for the Texas Clean Energy Project in Ector, Midland, and Crane Counties, Texas* (SWCA 2010b), the USFWS concurred with DOE's assessment that no federally listed species are likely to be adversely affected by the project (see Appendix A).

In its scoping comments, TPWD listed the dune umbrella sedge (*Cyperus onerosus*) as a species of concern, although this species is not listed as threatened or endangered under state or federal law (TPWD 2010). Habitat for this species was not observed in the ROI during field reconnaissance nor does its range extend into the ROI (only into Andrews, Winker, and Ward Counties); thus, this species would not be affected by the TCEP. TPWD also listed Havard Shin Oak (*Quercus havardii*)—Tallgrass series as a natural community that could be impacted by project activities; however, this community was not observed in the ROI during field reconnaissance, nor was it identified in aerial photography. Therefore, this natural community and associated protected species (i.e., the neglected sunflower [*Helianthus neglectus*] and sand dune lizard [*Sceloporus arenicolus*]) are not expected to occur in the ROI and would not be affected by the TCEP.

Table 3.19. State-listed Rare, Threatened, and Endangered Species with Potential to Occur in the Region of Influence

Common Name (scientific name)	Listing Status*	County	Habitat Description	Potential for Occurrence in ROI	Range
Birds					
Baird's sparrow *(Ammodramus bairdii)*[†]	R	Ector Midland Crane	Occurs in shortgrass prairie with scattered low bushes and matted vegetation	Suitable habitat in ROI; very rare or rare migrant that could occur in ROI on occasion	Breeds in northern Great Plains and winters in Trans-Pecos, Mexico, and possibly South Plains; very rare to rare migrant in western half of Texas; few records from High Plains
Ferruginous hawk (*Buteo regalis*)[†]	R	Ector Midland Crane	Occurs in open country, primarily prairie, plains, and grasslands, particularly in areas with prairie dogs	Suitable habitat in ROI	Uncommon to common winter resident in High Plains and Trans-Pecos
Mountain plover (*Charadrius montanus*)[†]	R	Ector Midland Crane	Occurs in shortgrass plains and bare/plowed fields	Suitable habitat in ROI for migrating individuals	Migrant through most of West Texas; localized areas in western two-thirds of Texas as very rare summer resident and winter resident
Prairie falcon (*Falco mexicanus*)[†]	R	Ector Midland Crane	Occurs in open, mountainous areas, plains, and prairies; nests in cliffs	Suitable habitat in ROI	Rare to uncommon migrants and winter residents in the High Plains
Snowy plover (*Charadrius alexandrines*)[†]	R	Ector Midland Crane	Subspecies (Western snowy plover [*C.A. nivosus*]) is also listed as rare; occurs in flat sandy beaches, salt flats, sandy areas with little vegetation, saline lakes, and major rivers	Suitable habitat in ROI for migrants and summer residents	Migrant throughout the High Plains; uncommon summer resident in portions of Midland County and surrounding counties to northeast
Western burrowing owl (*Athene cunicularia hypugaea*)[†]	R	Ector Midland Crane	Occurs in open grasslands, especially prairie, plains, and savanna, sometimes in vacant lots or airports, particularly in areas with prairie dogs	Suitable habitat in ROI, particularly in areas with prairie dogs	Uncommon to common summer resident and uncommon to rare winter resident in western half of state; rare to very rare migrant and winter visitor farther east and south to coastal prairies

Table 3.19. State-listed Rare, Threatened, and Endangered Species with Potential to Occur in the Region of Influence

Common Name (scientific name)	Listing Status*	County	Habitat Description	Potential for Occurrence in ROI	Range
Mammals					
Big free-tailed bat	R	Crane	Prefers roosting in cracks and crevices in high canyon walls, but also known to roost in buildings; rugged, rocky country in both lowlands and highland habitats	No suitable rocky cliffs for roosting, but suitable buildings are near ROI; individuals could fly over ROI, but are not expected to occur	West and South Texas
Black-tailed prairie dog (*Cynomys ludovicianus*)	R	Ector Midland Crane	Lives in large family groups in dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle	Suitable habitat in ROI	West and western-central Texas
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	R	Ector Midland Crane	Occurs in habitats ranging from desert scrub to piñon-juniper woodlands characterized by rocky, broken country; roosts in caves, mines, and occasionally buildings	No caves or mines located near ROI; could roost in buildings or fly over ROI	West Texas
Swift fox (*Vulpes velox*)	R	Ector Midland	Prefers shortgrass prairie, mesa country along borders of valleys, sparsely vegetated habitats on sloping plains, hilltops, and other well-drained areas; adapted to pasture, plowed fields, and fencerows	Potential to occur in ROI; closest record in TPWD Natural Diversity Database is approximately 11 mi (17.7 km) northeast of WL1	West Texas

Table 3.19. State-listed Rare, Threatened, and Endangered Species with Potential to Occur in the Region of Influence

Common Name (scientific name)	Listing Status*	County	Habitat Description	Potential for Occurrence in ROI	Range
Reptiles					
Spot-tailed earless lizard (*Holbrookia lacerata*)	R	Ector Midland Crane	Inhabits moderately open prairie-brushlands with fairly flat areas free of vegetation and other obstructions, including disturbed areas	Suitable habitat in ROI	Central (Edwards Plateau) and south-western Texas
Texas horned lizard	T	Ector Midland Crane	Open, arid and semiarid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rocks when inactive; breeds March to September	Suitable habitat in ROI; individuals observed at the polygen plant site and near WL1 along Monahans Draw	Currently restricted to the western third of Texas

Note: No federally listed species are known to occur in the ROI.
Sources: Bockstanz and Cannatella (2000); Lockwood and Freeman (2004); Poole et al. (2007); Schmidly (2004); TPWD (2010); USFWS (2010).
* TPWD listing designation: T =Threatened; R = Rare.
† Rare species that are also protected under the Migratory Bird Treaty Act.

3.8.5 Environmental Impacts of Summit's Proposed Project

3.8.5.1 TERRESTRIAL SPECIES

Polygen Plant Site

Construction and operation of the polygen plant would result in the permanent loss of up to 300 ac (121.4 ha) of the Mesquite Shrub-Grassland vegetation community and its associated habitat functions for terrestrial species. This habitat is neither rare nor unique in the ROI for the polygen plant. Construction activities could result in direct mortality of those terrestrial wildlife species that are not mobile enough to escape construction equipment. In addition, construction vehicles, equipment, and human traffic could unintentionally disperse seeds of invasive or noxious species, which could encroach into adjacent lands or natural areas. Both plant and wildlife invasive and noxious species can outcompete native species, lower biological diversity, and alter ecosystem function.

Scoping comments inquired about potential impacts to wildlife from the storage and use of coal at the polygen plant site. Inadequately mitigated air emissions and dust can inhibit plant function and growth (Zeiger 2006), which can indirectly impact wildlife through loss and/or degradation of food, shelter, and nesting areas used by wildlife, or result in bioaccumulation of Hg in insects, birds, and mammals (Colman 2007). As described in Chapter 2 and in the air quality section (Section 3.3), coal-handling facilities would be designed to minimize emissions of coal dust, and the TCEP would be designed to remove more than 95 percent of Hg emissions. In compliance with Texas House Bill 460, the TCEP would be required to meet stringent air pollutant emissions limits. Modeling of the air pollutant emissions indicate that ambient air quality for all priority pollutants would be less than the NAAQS primary and secondary standards, which have been developed to protect human health and the environment, and that there would be minimal effects to soils, water, crops, vegetation, and wildlife as a result of the TCEP. Thus, the TCEP would likely have minimal effects on wildlife from the storage and use of coal.

Noise from construction activities at the polygen plant site could result in physiological (e.g., loss of hearing) and behavioral (e.g., communication or nesting) disturbances that could displace or alter the behavior of wildlife. This displacement would be permanent on-site and temporary adjacent to the site until construction is complete or until wildlife could habituate to the noise. Most project construction noise would attenuate to near-background levels within approximately 0.5 mi (0.8 km) (see Section 3.19, Noise and Vibration), indicating that disturbance of wildlife could occur over a maximum of 2,388 ac (966 ha) surrounding the polygen plant site. Temporary interruptions in normal wildlife behavior from construction noise are likely to have minimal impacts on reproductive success, thus resulting in few overall population level effects (AMEC Americas Limited 2005; Richardson et al. 1995). In addition, wildlife in the polygen plant site ROI would not likely notice a substantial noise level increase during regular construction activities due to the existing ambient noise levels from vehicular traffic on I-20 and oil and gas activities (see Section 3.19). Although intermittent high noise-level activities (e.g., steam venting) during construction could have adverse impacts to wildlife, these increases from regular construction noise would be brief and infrequent, indicating that overall impacts from construction noise would be minor.

Although the most acute effects would result from construction noise, less-intense operational noise disturbances would persist for the life of the project. As previously noted, disturbances from I-20 and oil and gas activities currently exist, indicating that wildlife in the ROI are habituated to existing noise disturbances. In addition, wildlife such as deer, rabbits, raptors, and songbirds are known to be resilient and adaptable to the noise levels that would likely occur during TCEP operation (see Section 3.19), based on observations at airport sites (AMEC Americas Limited 2005; Busnel 1978; Ellis et al. 1991 in AMEC Americas Limited 2005). Therefore, most wildlife would not likely be adversely affected by either temporary acute noise from construction or less-intense, long-term noise from operation of the polygen plant.

Linear Facilities

The primary direct impacts to terrestrial species from construction and operation of the linear facilities would be the removal or disturbance of the Mesquite Shrub-Grassland vegetation community and the wildlife species that are associated with it. Vegetation could be permanently removed from 132 to 574 ac (53–232 ha), and could be temporarily removed from or disturbed on an additional 114 to 543 ac (46–220 ha) during construction. The range in vegetation removal is based on the smallest and largest acreage combinations of the linear facility options as identified in Table 3.20. These impact areas from both construction and operational activities are based on the conservative assumption that all areas are currently vegetated; however, there are several developed areas along the linear facilities where vegetation does not occur or where vegetation would not be impacted (e.g., portions of transmission lines).

Table 3.20. Impacts to Terrestrial Habitat from the Linear Facility Options

Linear Facility Option	Temporary/ Construction Impact Area (ac [ha])	Permanent/ Operational Impact Area (ac [ha])	Potential Noise Disturbance Area (ac [ha])*	Total Length (mi [km])
WL1	508.5 (205.8)	256.5 (103.8)	26,650 (10,784.9)	41.2 (66.3)
WL2	113.5 (45.9)	57.2 (23.1)	6,456 (2,612.7)	9.3 (15.0)
WL3	172.4 (69.8)	86.6 (35.0)	9,568 (3,872.0)	14.2 (22.8)
WL4	41.0 (16.6)	23.2 (9.4)	2,184 (883.8)	2.7 (4.3)
TL1	116.6 (47.2)	60.6 (24.5)	6,379 (2,581.5)	9.3 (15.0)
TL2	117.8 (47.7)	65.5 (26.5)	5,950 (2,407.9)	8.6 (13.8)
TL3	31.5 (12.7)	18.0 (7.3)	1,935 (783.1)	2.2 (3.5)
TL4	11.7 (4.7)	8.1 (3.3)	893 (361.4)	0.6 (1.0)
TL5	459.2 (185.8)	236.2 (95.6)	23,973 (9,701.5)	36.8 (59.2)
TL6	455.5 (184.3)	212.0 (85.8)	21,413 (8,665.5)	32.8 (52.8)
CO_2	12.2 (4.9)	6.1 (2.5)	1,151 (465.8)	1.0 (1.6)
NG1	32.9(13.3)	16.5 (6.7)	2,257 (913.4)	2.7 (4.3)
AR1	5.0 (2.0)	2.9 (1.2)	721 (291.8)	0.3 (0.5)
AR2	58.0 (23.5)	35.5 (14.4)	2,882 (1,166.3)	3.7 (6.0)
RR1	13.4 (5.4)	6.7 (2.7)	1,266 (512.3)	1.1 (1.8)

* Area based on 0.5-mi (0.8-km) buffer.

Transmission line construction would require vegetation clearing for installation of the transmission structures and for limited-access road construction. Native vegetation that would not interfere with the safe operation of the transmission lines would remain undisturbed between the transmission line structures. Process water, CO_2, and natural gas pipeline construction would require the clearing of most vegetation in the construction ROW. Following construction, both the construction and operational ROWs would be reseeded with native vegetation. However, because of the need for visual inspection of pipelines, it is likely that ROW maintenance activities along the pipeline ROWs would not include the establishment of woody species such as mesquite. Access road construction would require the clearing of most vegetation in the construction ROW and permanent removal in the operational roadway ROW.

Invasive and noxious plant species could invade disturbed areas during construction and operation of the linear facilities. The relative level of possible impact associated with each option is indicated by the length of the linear facility, as identified in Table 3.20.

Construction noise (e.g., vehicular traffic, construction activities) may temporarily displace wildlife during construction of the linear facilities. However, this impact is expected to be minimal because displaced wildlife would quickly return after construction activities ceased. Furthermore, a number of the linear facilities would be located in areas of existing commercial, industrial, and residential development where comparable noise impacts already occur routinely (see Table 3.27). Table 3.20 shows the maximum area of wildlife habitat anticipated to be affected by noise during construction of each linear option. The area affected is based on the assumption that construction noise would largely attenuate to background levels within 0.5 mi (0.8 km) of linear facilities.

Wildlife fatalities from traffic collisions could also occur during plant construction and operation. The number of wildlife fatalities would likely increase due to the introduction and use of approximately 4.0 mi (6.4 km) of new access roads (AR1 and AR2) as well as the increased use of existing roads. As discussed in Section 3.16, AADT would significantly increase on I-20, FM 866, and FM 1601 during peak construction (18 percent, 193 percent, and 750 percent of current traffic, respectively [see Table 3.48]). However, the increase in AADT on these roads would be more modest during operations (2 percent, 22 percent, and 75 percent of current traffic, respectively [see Table 3.49]). Vehicle speed has a greater impact to the number of wildlife fatalities than the volume of traffic (Case 1978), indicating that wildlife fatalities due to traffic collisions could be minimized with speed regulation.

Bird and bat mortalities from collisions with man-made structures such as transmission lines and towers could occur during operation of the TCEP. Approximately 14 percent of predicted annual avian mortality comes from collisions with transmission lines, which is low when compared to almost 60 percent mortality occurring from collisions with buildings or windows (Erickson et al. 2005). Although bat collisions with transmission lines are known to occur, little is known about the extent of these fatalities (Dedon et al. 1989 in WEST Inc. 2003). In general, any transmission line option would increase the risk of bird and bat mortality due to the introduction of a new hazard in the flyway. The potential for mortality increases with the length of the line, indicating the longest option (TL5) would pose the greatest risk, whereas the shortest transmission line (TL4) would pose the least. In areas where existing transmission lines would parallel TCEP's line (TL1, TL2, TL5, TL6), there would be a greater visual detection, which helps to reduce the potential for bird collisions (Avian Power Line Interaction Committee 2006). There would be anticipated collisions associated with newly constructed lines; however, bird collisions with transmission lines are not considered to be a substantial source of bird mortality (URS Corporation 2005). Furthermore, none of the transmission lines would occur near major flight or feeding corridors, natural drainages, riparian habitats, wetlands, or water bodies, which are considered to be high-risk areas for collisions of birds and bats with transmission lines (Faanes 1987). Thus, all transmission line options would have low impact to wildlife.

3.8.5.2 AQUATIC SPECIES

Polygen Plant Site

As described in the surface water resources section (Section 3.7), no intermittent or perennial waterways or aquatic habitat of any kind are present on the polygen plant site. There would be no off-site waste water discharges and storm water would be diverted to on-site retention ponds. Compliance with TPDES permit requirements and SPCC plans would minimize off-site discharge or erosion that could impact downstream aquatic habitat.

Linear Facilities

Only WL1 and WL3 would have the potential to impact aquatic species due to the removal and disturbance of vegetation and aquatic habitat. Table 3.21 presents the total impacts to aquatic habitat during construction and the permanent disturbance areas following the reclamation of temporary use areas for these linear facility options.

Table 3.21. Impacts to Aquatic Habitat from the Linear Facility Options

Linear Facility Option	Total Temporary/Construction Impacts (ac [ha])	Total Permanent/Operational Impacts (ac [ha])
WL1	1.58 (0.64)	0.81 (0.33)
WL3	0.58 (0.23)	0.30 (0.12)
Total	**2.16 (0.87)**	**1.11 (0.45)**

Indirect impacts from linear facilities would include an increased potential for downstream siltation, risk of fluid spills or leaks, and noise during construction. Adverse effects to the water quality of these features would be minimized as long as erosion and siltation controls are implemented in accordance with EPA and TCEQ requirements.

WL1 would be constructed underneath Monahans Draw and would be constructed using erosion and siltation controls to minimize potential impacts to water quality and aquatic organisms. However, during the two- to three-week construction period, there would be an increased potential for water-quality degradation and impacts to aquatic organisms including amphibians and macroinvertebrates. Because WL1 would be installed underneath Monahans Draw, there would be no operational impacts associated with this pipeline. WL3 is the only linear facility that would directly impact the potential playa lake identified in the ROI (see Table 3.18).

3.8.5.3 MIGRATORY BIRDS

Polygen Plant Site

Consultation with the USFWS and TPWD did not identify any migratory bird populations that would be affected by the project (DOE 2007; SWCA 2010b). Approximately 300 ac (141 ha) of potential migratory bird habitat, including shrubland nesting areas, would be permanently removed by development of the polygen plant site. In addition, introduced species commonly associated with development (e.g., European starlings, house sparrows) could encroach into the ROI and displace or outcompete native bird species (Elphick et al. 2001; Koenig 2003). Human activities such as maintained landscaping and open trash receptacles attract these bird species to the area.

Migratory birds would face similar indirect impacts as described in Section 3.8.5.1, including impacts from noise and other disturbances. Birds could also be attracted to the solar evaporative ponds, if that option is implemented, and suffer adverse impacts from the brine contained in those ponds. Netting placed over the ponds would mitigate that potential impact. However, no rare or unique habitats, water resources, or other features that would be a significant attractant to migratory birds were identified on the polygen plant site. For this reason, no adverse effects would be expected at the population or community level.

Linear Facilities

Habitat loss for migratory birds could occur from the construction and operation of some of the linear facility options. The total acreage of habitat loss would vary by linear facility option (see Table 3.20). In areas adjacent to the linear facilities, disturbance from construction and operational noise could displace migratory birds or negatively affect their reproductive success until they habituate. Aquatic features along the linear facilities, particularly Monahans Draw, are likely an attractant to migratory birds; however, impacts to these features would be temporary (completed within two to three weeks). Although there could be collisions associated with the addition of a transmission line, no rare or unique habitat or attractants (e.g., wetlands, water bodies, or major feeding flight lines) are present along any of the transmission line options. Therefore, construction and operation of the linear facilities would present only minor impacts to migratory birds.

3.8.5.4 RARE, THREATENED, AND ENDANGERED SPECIES

Polygen Plant Site

A permanent loss of 300 ac (121 ha) of Texas horned lizard habitat as well as potential habitat for 11 state-listed rare species would occur due to the construction and operation of the polygen plant site. In addition, fatalities of Texas horned lizards and their prey (red harvester ants [*Pogonomyrmex barbatus*]) and 11 state-listed rare species (see Table 3.19) could occur during construction and operational activities if these species are present on the proposed polygen plant site. These species could face similar indirect impacts as described in Section 3.8.5.1, including impacts from noise and other disturbances.

Impacts from construction and operation of the polygen plant would be more adverse for Texas horned lizards than for more mobile species such as ferruginous hawks or burrowing owls. Rare migrant and resident species that may be present on the polygen plant site have ranges that extend throughout the Arid Llano Estacado and Llano Estacado subregions (see Table 3.19), thus any impacts to these species attributable to the TCEP would have minimal adverse effects to population viability.

Linear Facilities

Habitat loss for the threatened Texas horned lizard and 11 state-listed rare species could occur from the construction and operation of some of the linear facility options. The total acreage of habitat loss would vary by linear facility option (see Table 3.20). Fatalities of Texas horned lizards, their prey (harvester ants), and state-listed rare species could occur during construction of the linear facilities. Impacts to these species during operation of the buried pipelines would be unlikely, and impacts associated with operation of transmission lines would be primarily limited to maintenance activities where vehicles and workers would be in the field, and to bird collisions with power lines. Transmission line options that parallel existing transmission lines are more visually apparent to birds (Avian Power Line Interaction Committee 2006). Furthermore, none of the transmission lines would occur near major flight or feeding corridors, natural drainages, riparian habitats, wetlands, or water bodies, which are considered to be high-risk areas for collisions of birds with transmission lines (Faanes 1987). Thus, the transmission lines would have minimal adverse effect on birds. Overall, potential impacts to Texas horned lizards would be greater than other listed wildlife species, because of their decreased mobility.

3.8.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Section 2.5. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to biological resources are:

- Planting or seeding areas disturbed by the construction or operation of the TCEP with native vegetation to provide habitat for wildlife.
- Developing a monitoring and control plan; inspecting and cleaning construction equipment; using invasive species–free mulches, topsoil, and seed mixes; planting native species after construction and as landscaping; and using chemical and mechanical eradication of non-native or invasive species if they develop in the ROI to reduce the potential for the introduction or spread of non-native or invasive species (Bureau of Land Management [BLM] 2009; Federal Highway Administration 1999).
- Performing construction activities outside the breeding season for migrating birds, including western burrowing owls and ferruginous hawks.
- Conducting threatened and endangered species surveys in the proposed polygen plant site and along the linear facility corridors to minimize or avoid impacts to these species. Summit will also consult further with TPWD regarding Texas horned lizards prior to construction. TPWD specifically recommends the following mitigation measures be implemented to protect Texas horned lizards:
    - A permitted biologist should conduct Texas horned lizard surveys at the polygen plant site and along the linear facility corridors prior to construction. If found, individual lizards should be relocated to areas outside the construction area.
    - During construction and operation of the linear facilities, Summit should take measures to eradicate the red imported fire ant (*Solenopsis invicta*), a species that outcompetes Texas horned lizard prey species (red harvester ants). Eradication techniques should include spot applications of pesticides rather than broadcast applications of pesticides, which can kill Texas horned lizards and their prey.
    - To the extent practicable, Summit should avoid construction activities within 10 ft (3 m) of red harvester ant colonies along the linear facilities.
- Avoiding playa lakes and other water resources, or restoring temporarily affected water resources to their original condition.
- Constructing new transmission lines or modifying existing transmission lines to recommended industry and federal standards to reduce avian mortality from transmission lines. These could include increasing the visibility of lines with marker balls or similar devices, removing overhead grounding wire, and providing a 60-in (152-cm) separation between energized conductors (Avian Power Line Interaction Committee and USFWS 2005).
- Directing TCEP workers and contractors to drive below certain speeds while driving along the access roads to reduce the risk of wildlife fatalities.

Placing netting over solar evaporation ponds, if Summit implements this option, to minimize the risk of birds landing in them and being exposed to the concentrated brine water.

3.9 Aesthetics

3.9.1 Background

This section identifies and describes the aesthetic resources of the viewed landscape that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

Aesthetic resources include scenic areas, such as state and municipal parks, and viewpoints. In this analysis, aesthetics refers to the pleasing visual characteristics or features of the landscape, and consists of 1) areas containing visual resources, and 2) scenic viewsheds. Landscapes managed by federal, state, and local governments and that have visual resources may be protected for their scenic quality. These areas have been identified as having higher natural aesthetic values. Viewsheds are the landforms, water bodies, man-made structures, and other landscape elements that are seen from a fixed viewpoint. Scenic viewsheds are those landscapes that may have aesthetic value to a community and to residents that view them, or to commuters and other travelers that pass through them.

The night sky is also a component of aesthetics. The quality of the night sky view relates to the quantity of artificial light in the viewshed. Outdoor lighting can affect the view and the enjoyment of a natural, dark night sky where stars, planets, and the moon can be best observed. Light pollution can be created by the upward spill of light from an unshielded light source. Dust, water vapor, and other particles scatter and reflect light directed upward into the atmosphere, creating a phenomenon called skyglow. This light that escapes directly upward into the night sky is a major contributor to the loss of the dark night sky.

3.9.2 Region of Influence

The ROI for aesthetics is the 743-mi^2 (1,924-km^2) viewshed around the polygen plant site (Figure 3.15). This is the area from which the 200-ft-tall (61-m-tall) emissions stack at the polygen plant site could be seen within a 50-mi (80-km) radius.

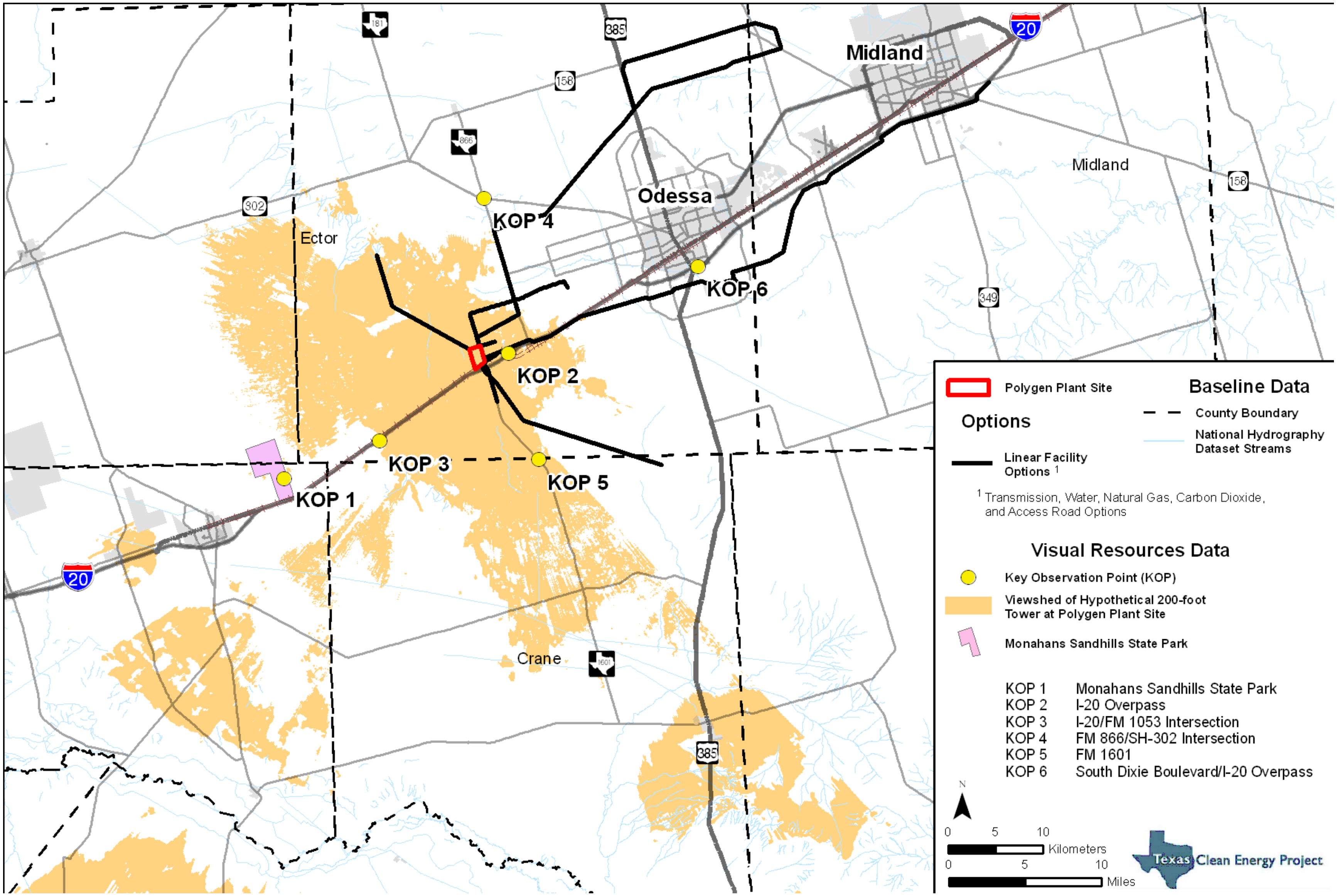

Figure 3.15. Key observation point locations.

3.9.3 Methodology and Indicators

The impacts analysis for aesthetic resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.22.

Table 3.22. Indicators of Potential Impacts to Aesthetic Resources

Potential Impact	Impact Indicator
Reduction in scenic quality from surface disturbances	Viewing distance to and angle of the project area Length of time project area is in view, as seen from the selected view points Expected viewer sensitivity to changes in the landscape
Reduction in scenic quality from fugitive dust production in disturbed areas	
Reduction in scenic quality from visually disruptive infrastructure (transmission lines) or equipment	
Reduction in night sky scenic quality from skyglow and visual intrusion from night lighting	

The analysis applied to aesthetics for the TCEP is based on the BLM Visual Management System. Using this system, the aesthetics of existing viewsheds and visual resources in and around the area that would be affected by the TCEP (the existing conditions) were compared to what those same viewsheds and resources would look like after TCEP construction. The comparison was conducted from fixed viewpoints known as key observation points (KOPs) (Table 3.23; see Figure 3.15). Typically, KOPs are located along hiking trails and roads or highways, at scenic viewing areas, in parks, and in communities where the project area would be in view.

Table 3.23. Key Observation Points Analyzed

KOP	Name	Location Relative to Proposed Polygen Plant Site (mi [km])	Basis for Selection
KOP 1	Monahans Sandhills State Park	14.8 (23.8) southwest	Is a popular sightseeing destination
KOP 2	I-20 overpass	1.6 (2.4) east	Is the boundary of a topographic break with unobstructed views of proposed polygen plant site
KOP 3	I-20/FM 1053 (Fort Stockton Road) intersection	7.8 (12.6) southwest	Is representative of highway corridor viewshed for eastbound motorists
KOP 4	FM 866/State Highway 302 intersection	9.6 (15.4) north	Has views of landscape along two secondary roads near Odessa
KOP 5	FM 1601	7.5 (12.1) southeast	Shows existing aesthetic conditions along proposed water pipeline ROW alternatives that parallel FM 1601
KOP 6	South Dixie Boulevard/ I-20 overpass	15.2 (24.5) northeast	Shows the viewshed within Odessa city limits

As shown in Table 3.23, DOE identified six KOPs to analyze the potential impacts to aesthetic resources near the proposed polygen plant site and linear facilities. The locations of these KOPs are shown in Figure 3.15. Note that the areas in the figure that depict the 200-ft (61-m) stack visibility area were computer-calculated, based on whether local topography would block a line-of-sight view of the stack. It does not account for Earth curvature, heat shimmer, or atmospheric haze. It also does not account for potential structural blocking of the stack by buildings, roadways, vegetation, or other site-specific features. The purpose of the visibility information is to approximately define where the proposed site might be regionally visible under ideal conditions.

These KOPs were selected as representative views of the affected area and surrounding landscape. They were selected on the basis of factors such as the number of viewers that would see the project area, the length of time that the project area would be in view, the angle of view, the viewing distance to the project area, and viewer sensitivity. Viewer sensitivity is the importance or concern that people place on any changes that might occur to a viewshed or an area with visual resources.

> The **Odessa Meteor Crater** is a national natural landmark located 6.5 mi (10.4 km) southeast of the proposed project area. The site includes a visitor center, picnic area, and a short walking path through the meteor crater. Though relatively close to the project area, this site was not used in the analysis of impacts to aesthetics because of its very small size and low visitor use and because the construction and operation of the TCEP would not affect its goal of preserving a unique geologic feature.

During the visual resource field survey, the viewshed to the northwest of the proposed project area was considered for potential analysis and identification of KOPs. However, based on the criteria or indicators used to establish the KOPs, none were identified because of the relative remoteness of the area, the distance from the project area, the few residences or communities in the area, and the relatively low traffic volume along State Highway 302.

Once the KOPs for the TCEP were selected, the scenic resources and existing conditions in and around the project area were described from those selected viewpoints. The descriptions included the landforms and water features, vegetation, landscape colors, roads, and structures that can be seen from each viewpoint. A panoramic series of photographs were taken from each KOP to document the scenic resources (such as parks) and scenic viewsheds that can be seen from each viewpoint.

Once the scenic resources and scenic viewsheds were described and documented at each KOP, a description of the proposed project was used to create a computer-generated visual simulation of what the project would look like from each KOP. This approach shows the scale of the project and the relative placement of potential aesthetics-disturbing project features. The image was then used to determine the degree to which impacts would affect the area's aesthetics, as seen from each KOP. The potential impacts of the project were described using the same terms used for describing the existing conditions: what the landforms, water features, roadways, and other existing structures, vegetation, and landscape colors would look like if the project was constructed. By comparing the aesthetic existing conditions to future conditions (through the use of the simulation), it is possible to gauge the level of scenic resource and scenic viewshed change.

3.9.4 Affected Environment

The **visual resource management system** consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones, which are divided into four classes that represent the relative value of the visual resources: Classes I and II are the most valued, Class III represents a moderate value, and Class IV is the lowest value.

Based on the level of existing development in the area, highly visible oil and natural gas extraction pumps, the visibility of roadways and railways, clearly visible surface disturbance along the highway corridor, and the flat landscape lacking obvious scenic contrasts in the KOP viewing areas, the scenic quality surrounding the polygen plant would be comparable to the BLM visual resource management Class IV. This classification applies to landscapes that have relatively low scenic quality, and are managed to allow high levels of change where management activities dominate the view and may be a major focus of viewer attention (BLM 1986). Figure 3.15 shows the locations of the KOPs selected for the TCEP.

3.9.4.1 SCENIC RESOURCES

Key Observation Point 1: Monahans Sandhills State Park

The Monahans Sandhills State Park is approximately 14.8 mi (23.8 km) southwest of the proposed polygen plant site. It consists of more than 3,800 ac (1,538 ha) of sand dunes. Some of the dunes are more than 70 ft (21 m) high, and park visitors who climb to the dune tops have an unobstructed view of the surrounding landscape (Figure 3.16). The park is a popular sightseeing destination, with outdoor activities that include dune surfing, self-guided nature trails, camping, and bird and wildlife viewing. The park topography is diverse, steep, and unstable, and typical of a windblown dune landscape. The park roadways, camping sites, and buildings lie at the base of the dunes, so the surrounding landscape is obscured by the height of the sand dunes.

Figure 3.16. Monahans Sandhills State Park, view facing northeast.

Views from the top of the dunes extend to the horizon and show the dune area continuing across the foreground (within 0.5 mi [0.8 km] of the KOP 1 viewpoint) and a flat landscape in the middle distance (from 0.5 mi [0.8 km] to 5.0 mi [8.0 km] from the viewpoint) and background (beyond 5.0 mi [8.0 km] from the viewpoint). The view in Figure 3.16 is to the northeast, toward the proposed polygen plant site. The predominant colors are tan and beige sand as well as dark and light green vegetation in the dune area and in the middle ground and background. Numerous but faintly visible power transmission lines are present to the northeast and southeast (see Figure 3.16).

The night sky conditions in and surrounding the park are generally unaffected by artificial light sources because of the lack of development in the immediate area. Vehicles parked or moving in the campground create some light, but there are no light poles or beacons along park roadways, nor are there lights in parking lots or visitor use areas to illuminate the roads, signs, access paths and trails, or parking areas.

3.9.4.2 SCENIC VIEWSHEDS

Key Observation Point 2: Interstate 20 Viewshed (west view)

The KOP 2 viewpoint lies along the I-20 shoulder approximately 1.6 mi (2.5 km) to the east of the proposed polygen plant site and the community of Penwell. The outskirts of the town lie just beyond the left edge of the photograph in Figure 3.17. The viewshed includes views of the topographic basin to the west and northwest (from this perspective the polygen plant would be located to the west), and views to the north, west, and south where motorists would see the landscape while travelling west on I-20. The viewpoint was selected because it lies at the boundary of a topographic break, where the landscape changes from flat in the east to a relatively lower elevation to the west. The shallow though rapid elevation change would quickly expose the proposed polygen plant site to unobstructed views by westbound motorists traveling along I-20. Foreground views are of access roads and railway lines, power lines, small commercial structures, and residences along the highway corridor. Middle ground and background views to the north and west show a homogeneous landscape with a sparse scattering of power lines, telecommunications towers, and indistinct structures. The landscape includes sparse lines of trees along secondary roadways in the foreground and middle ground, but views in all directions are unobstructed from this perspective. Landscape colors are various shades of green vegetation, brown areas of surface disturbances and exposed rock along unpaved roads and railroad beds, and miscellaneous bright colors on roadway signs, road shoulders, roadway support structures, and buildings.

Figure 3.17. Westbound viewshed along Interstate 20 near the proposed polygen plant site.[2]

Night sky conditions along the interstate travel corridor are presently affected by commercial and industrial lighting, highway lighting, and motor vehicles. The community of Penwell was not used as a KOP because it did not meet the criteria for KOP selection. Penwell is largely abandoned or vacant, with the exception of a few scattered residences within the community's limits and in proximity to I-20. KOP 2, however, is located very close to this community, is along the freeway, and provides a representative view of what Penwell residents would see. Note that one of the main criterion for selecting KOPs was number of potential viewers, which would be more heavily weighted toward freeway motorist viewers (with approximately 16,000 vehicles per day (vpd) traveling along this major transportation corridor) than the very small residential population in Penwell.

Key Observation Point 3: Interstate 20 Viewshed (East View)

The KOP 3 viewpoint is located at the junction of I-20 and FM 1053. The view is to the northeast toward the proposed project area. The topography is gently inclined but relatively flat, and similar to the surrounding landscape, as shown in Figure 3.18. This perspective is representative of the highway corridor viewshed for motorists traveling eastbound along I-20 toward Odessa and the proposed polygen plant site, and for motorists traveling north along FM 1053 as they approach the FM 1053/I-20 intersection. The viewpoint is approximately 7.8 mi (12.5 km) southwest of the project area, slightly elevated above the highway at the FM 1053 overpass. This point was selected because motorists traveling north along FM 1053 would have lengthy approaching views of the project area, as would eastbound motorists traveling along I-20, and the number of potential viewers along both highways would be large.

[2] The image is a cropped version of the simulation panorama shown in Figure 3.22, and the community of Penwell lies just outside the view, to the left of this photograph.

Figure 3.18. Eastbound viewshed along Interstate 20 at the junction with Farm-to-Market Road 1053.

Foreground and middle ground views are of the highway corridor, railroad embankments, high-voltage transmission lines, road signs, and road lighting poles. Surface disturbances and sparse vegetation growth along the highway corridor have exposed rock and soil. Lines of trees and clumps of shrubs are visible in the foreground. Viewshed colors range from buff and browns where soil and rock have been exposed, to shades of light to dark green where grasses, shrubs, and trees are visible. Background views are obscured by the slight depression of the highway at the viewpoint. No commercial or residential structures are visible.

Night sky conditions are presently affected in this locale by motor vehicles traveling along the interstate and along secondary roads. There are few other light sources.

Key Observation Point 4: Intersection of Farm-to-Market Road 866 and State Highway 302 Viewshed

This intersection lies approximately 9.6 mi (15.5 km) north of the proposed polygen plant site, and was selected because it provides representative views of the landscape along two secondary roadways near Odessa. The view is to the southwest toward the project area. As shown in Figure 3.19, the topography in this viewshed is uniformly flat, and the view is uninterrupted and extends to the horizon. The foreground to background view is of a rural landscape, with some evidence of surface disturbance and development: oil pump jacks are visible in the foreground, and high-voltage power lines, towers, and poles can be seen in the foreground, middle ground, and background. Lines of trees are visible in the middle ground. Landscape colors are limited to shades of green vegetation interspersed with tan and light brown where rock and soil have been exposed by surface disturbances.

Figure 3.19. Farm-to-Market Road 866 and State Highway 302 intersection viewshed.

Night sky conditions are affected by motor vehicles traveling along the road. The roadway is unlit, and there are few artificial light sources along the roadway corridor.

Key Observation Point 5: Farm-to-Market Road 1601 Viewshed

The KOP 5 viewpoint along FM 1601 was selected because it shows existing aesthetic conditions near a proposed waterline (WL3). This viewpoint is located approximately 7.5 mi (12 km) southeast of the proposed polygen plant site, and the view is east toward the proposed waterline routes. As shown in Figure 3.20, the topography is relatively flat to undulating in the foreground and middle ground, with very low ridges visible in the background. The view is uninterrupted and extends to the horizon. The predominant features in the viewshed are dense growths of scrubby trees and shrubs in the foreground and middle ground that, with the undulating landscape, tend to obscure the ground surface. Colors range from light to dark green vegetation with occasional patches and streaks of light brown where exposed soil is visible. Power transmission towers are visible in the background, as are indistinct views of buildings and other structures.

Figure 3.20. Farm-to-Market Road 1601 viewshed.

Night sky conditions are affected by motor vehicles traveling along the road. The roadway is unlit, and there are few artificial light sources along the roadway corridor.

Key Observation Point 6: South Dixie Boulevard and Interstate 20 Overpass Viewshed

The KOP 6 viewpoint, in the city of Odessa, lies approximately 15.2 mi (24.5 km) northeast of the proposed project area, and was selected to show the viewshed from within the city limits. The view is to the west, toward the proposed polygen plant site, along I-20. As shown in Figure 3.21, the view is dominated by typical residential, commercial, and industrial development along a major interstate travel corridor as it passes through a population center. The topography is flat, with views extending to the horizon. The viewshed foreground includes the interstate roadway and infrastructure, small commercial and business buildings, secondary roads, residences, power transmission lines, and urban landscaping. Middle ground views are partially obscured by the foreground structures but include communications antennae, power lines, and large commercial and industrial structures. Background views are obscured by the intervening structures in the middle and foreground. The landscape is highly developed, and form and color is extremely diverse.

Figure 3.21. Odessa viewshed.

Night sky conditions in this viewshed are presently affected by interstate and secondary roadway lighting and motor vehicle lighting. In Odessa, there are many light sources caused by dense commercial, industrial, and residential development.

3.9.5 Environmental Impacts of Summit's Proposed Project

Based on project design schematics and structural height information, DOE created a simulation of the polygen plant site, which is shown in Figure 3.22 (as seen from KOP 2). Based on preliminary polygen plant design schematics (Summit 2010a), the simulation depicts the emissions stack at 200 ft (61 m). The coal piles are estimated to be 105 ft (32 m) in height; the turbine enclosure and gasifier are 175 ft (53 m) and 165 ft (50 m), respectively. At present, the precise layout of smaller-scale polygen plant features (e.g., pipes, road alignments) are unknown and are not depicted in the simulation.

This simulation was used to analyze impacts to aesthetics from each of the KOPs described above. The proposed polygen plant site simulation was viewed from each of the KOPs (using GIS software to locate the point of view at each KOP). It was determined that KOP 2 and KOP 5 would be close enough or have unobstructed views of the polygen plant: from KOP 2 the polygen plant would be approximately 1.5 mi (2.4 km) distant; from KOP 5 the polygen plant would be approximately 7.5 mi (12 km) distant, but would have a clear line-of-sight (Figure 3.23). The other KOPs, representing the perspective of viewers traveling along the major regional roadways, residing in Odessa, or recreating at the state park, would lie at distances or have intervening topography, structures, or vegetation such that the polygen plant site would not be clearly discernible during the daytime.

Figure 3.22. Polygen plant site simulation viewed from Key Observation Point 2. The Interstate 20 shoulder and the community of Penwell are visible at the far left side of the panorama.

Figure 3.23. Polygen plant site simulation viewed from Key Observation Point 5. This view is a north-facing continuation of the view shown in Figure 3.20.

3.9.5.1 IMPACTS TO KEY OBSERVATION POINTS 1, 3, 4, AND 6

An analysis of the KOPs in relation to the polygen plant simulation show that viewing distances, intervening topography, or intervening structures would prevent the site from being clearly viewed by the public at KOPs 1, 3, 4, and 6. The simulation analyses show that under ideal conditions (i.e., very low atmospheric haze, a lack of heat shimmer, and dips in topography), the tops of the polygen plant stacks would be visible; however, these features would not be obviously visible to the casual viewer nor would they attract viewer attention because of the polygen plant's brief visibility and the small portion of the plant exposed to potential view. Thus, the impacts to daylight aesthetics from project construction would be either none or minor depending on local lighting conditions and atmospheric haze.

The proposed transmission line structures would have direct impacts to aesthetics because they would be visible from major travel routes and would create new vertical form contrasts on the landscape. However, the impacts would be reduced because 1) large, cross-country transmission lines are presently visible in the region and adjacent to the proposed project area, 2) constructing another transmission line would be consistent with the level of development in the Odessa area, and 3) existing power lines in the region would prevent the new lines from being a focus of viewer attention.

The impacts of constructing water pipelines would be adverse but minor in the short term because heavy construction equipment would be visible during ROW vegetation and soil removal, trenching, pipeline laying, and pipeline burial. There would be no long-term impacts to aesthetics because the pipeline would be buried, construction-disturbed areas in the ROW would be recontoured and revegetated, and intervening topography and vegetation would prevent casual view of the ROW, as seen from FM 1601.

3.9.5.2 IMPACTS TO KEY OBSERVATION POINT 2

An analysis of the simulated polygen plant in relation to the analysis KOPs show that KOP 2 is the only viewpoint location where the polygen plant would be clearly in view. As mentioned above, this KOP is located along I-20 at a point where the local topography dips down to form the shallow valley, within which the polygen plant would be constructed. From this perspective, the polygen plant would lie in the middle ground, approximately 1.5 mi (2.4 km) from the viewpoint. The tall polygen plant structures, coal piles, and cooling tower would create obvious form, line, and color contrasts with the surrounding, uniformly flat landscape. This level of visible development would be consistent with the BLM management Class IV described above. In the short term, visually intrusive heavy construction equipment and construction vehicles would create color and form contrasts. Exposed soil in construction areas, staging areas, parking lots, and construction materials storage yards would create line and color contrasts. Windblown dust (fugitive dust) from dry, exposed soil in the site would briefly create localized haze during periods of major earth working that would reduce long-distance viewing. The impacts to aesthetics would be moderate, direct, and adverse because the size of the site and its proximity to the observation point would attract viewer attention and be a focus of view, for both westbound and eastbound motorists.

Long-term impacts would be similar to short-term impacts but to a greater degree: strong form, color, and line contrasts would be created that would attract the attention of the casual viewer. The height and size of the polygen plant structures, cooling tower, and coal storage piles would create moderate adverse direct impacts to aesthetics because of the strong form, color, and line contrasts with the surrounding landscape. Building colors and piles of black coal would strongly contrast with the green landscape, and building heights would contrast with the flat landscape. During the operational phase of the polygen plant, water vapor emitted from the cooling tower would increase the degree of contrasts with the surrounding landscape by creating a form and color-contrasting plume.

3.9.5.3 IMPACTS TO KEY OBSERVATION POINT 5

From the perspective of this KOP, the analysis of the simulated polygen plant shows that the structure would be partially visible in the background to motorists traveling north on FM 1601, and would become increasingly visible in the middle ground and foreground as motorists approach the I-20 interchange and Penwell. In the short term, ground-level construction activities and vehicles would be obscured by viewing distance, topography, I-20, and vegetation and would have no direct impacts to aesthetics. Above ground-level, construction activities would become increasingly visible from this viewpoint as the taller polygen plant buildings and stacks reached maximum height and were enclosed. The visible, aboveground portions of the polygen plant would create bold, angular, and clearly defined form, color, and line contrasts with the surrounding landscape and background sky. From this perspective, the structure would appear as a silhouette, creating strong linear edges against a blue sky. These contrasts would create direct, moderately adverse impacts to aesthetics that would likely attract the attention of the casual viewer and be a focus of view at this distance. The viewer's focus of view would become sharper and would begin to be dominated by the visible, aboveground portions of the plant as motorists approached Penwell and I-20.

Operations impacts would be similar to construction impacts, except that water vapor plumes emitted from the cooling tower would create additional color and form contrasts with the surrounding landscape. The contrasts would create direct, moderately strong, adverse impacts to aesthetics because the polygen plant would increasingly attract the attention of motorists traveling north toward Penwell and I-20, become a focus of attention, and begin to dominate the view as travelers approached the polygen plant site.

3.9.5.4 IMPACTS TO NIGHT SKY CONDITIONS

The construction and operation of the polygen plant would have direct, adverse impacts to night sky conditions because of the installation of high-intensity lighting in and around the site, and from nighttime flaring. During construction, lighting would be installed at the site for safety, to protect against trespassing, and to enable night-time construction. Light reflected upward would create light pollution and skyglow, which would be visible regionally. Plant lighting would likely be visible to travelers and residents at distances of up to 8 mi (12.8 km) (DOE 2007), but the night lighting impacts would be greatest for residents nearest the proposed polygen plant.

During TCEP operation, high-intensity lighting to maintain security and safety and to provide sufficient lighting for nighttime operation of the polygen plant would have adverse impacts on night sky viewing conditions. Exhaust stack flaring would contribute to light pollution and skyglow because, though the flares would be enclosed in the stack, light produced by flaring combustion would be directed upward and out of the 200-ft-high (61-m-high) emissions stacks. Additionally, adverse night sky impacts would be caused by Federal Aviation Administration (FAA)-required strobe lighting on the stack tops. This lighting would ensure and maintain safe night flying conditions around the site, but would contribute to skyglow and light pollution because the lighting would be unshielded and outward-directed.

3.9.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to aesthetic landscape contrasts are as follows:

- Applying dust control in areas where construction exposes soils
- Minimizing vegetation removal and soil exposure to reduce color contrasts
- Painting the facilities an appropriate color to reduce form, color, and line contrasts with the surrounding landscape (colors should be approximately two shades darker than the surrounding landscape.

- Minimizing building heights to reduce form contrasts

Mitigation measures that Summit could implement to reduce potential light pollution and the adverse impacts on night sky viewing are as follows:

- Using outdoor security and site lighting that is low in height, shielded so that the light is not directed skyward, and of minimal brilliance to illuminate the intended area and meet the intended purpose at that location (e.g., parking lots, signs, walkways, and safety and work areas)
- Using lamps that minimize the potential for light pollution, such as yellow lights rather than white lights (yellow light scatters less in the atmosphere).
- Using red strobes rather than white ones for FAA lighting because they are less visually intrusive but still meet aviation safety standards.

3.10 Cultural Resources

3.10.1 Background

This section identifies and describes the cultural resources that could be affected by the construction and operation of the polygen plant and linear facilities. This section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

Cultural resources include historic, archeological, and paleontological resources. The term also includes Traditional Cultural Properties that have religious and cultural importance to a distinct cultural group, such as a Native American tribe or Native Hawaiian group. The National Historic Preservation Act of 1966 requires that federal agencies take into account the effect that a federal undertaking may have on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (NRHP) (16 U.S.C. § 470f). NRHP eligibility criteria include elements significant to American history, architecture, archaeology, and culture as found in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association (36 C.F.R. § 60.4(a–d)). Traditional Cultural Properties may be eligible for inclusion in the NRHP.

Paleontological resources are geological in nature but are generally included in an analysis of impacts to cultural resources.

3.10.2 Region of Influence

Any historic properties identified in the area of potential effects must be evaluated to determine if the resource is on the NRHP or if it possesses characteristics that would make it eligible for inclusion in the NRHP. The area of potential effects consists of the geographic area or areas within which the undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist (36 C.F.R. § 800.16(d)). For the TCEP, the area of potential effects consists of the total disturbance area in the polygen plant site property and along the length of the linear facilities and access roads. In addition, the area of potential effects incorporates any historic structures located within a 0.5-mi (0.8-km) radius of the proposed polygen plant site. The 0.5-mi (0.8-km) radius was selected for this project based on the project's scope and potential to affect significant resources, should they be located. For purposes of analysis in this EIS, the ROI is the same as the area of potential effects and the term ROI is used for consistency with the other sections in Chapter 3.

3.10.3 Methodology and Indicators

The impacts analysis for cultural resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.24.

Table 3.24. Indicators of Potential Impacts to Cultural Resources

Potential Impact	Impact Indicator
Physical disturbance that could affect known cultural resources that are eligible for the NRHP	Number of known cultural resources (NRHP-eligible and NRHP-ineligible sites)
Physical disturbance to previously undocumented cultural resources or human remains from construction activities	Acres of surface disturbance
Increase in access to areas previously not accessible by road could result in inadvertent damage, looting, or vandalism to cultural resources	Numbers of known cultural resources (NRHP-eligible sites) Identification of Traditional Cultural Properties through Native American consultation

A background study of cultural resources was conducted for the proposed polygen plant site in 2010 (Peyton 2010). As part of this study, archaeologists examined maps and site files at the Texas Archeological Research Laboratory and searched the Texas Historical Commission's Texas Archeological Sites Atlas. These sources provided information on the nature and location of previously conducted archaeological surveys, previously recorded cultural resource sites, locations of NRHP properties, sites designated as State Archeological Landmarks, Official Texas Historical Markers, Registered Texas Historic Landmarks, cemeteries, and local neighborhood surveys. Archaeologists also reviewed the studies conducted in 2006 by the FG Alliance for the polygen plant site (FG Alliance 2006). This FutureGen study included background and archival data for the area and recommendations for future survey work on the property.

Because any ground-disturbing construction activity for the TCEP could alter or disturb previously undocumented cultural resources, archaeologists conducted a sample survey within the 600-ac (243-ha) polygen plant site in July 2010, excavating shovel test pits every 328 ft (100 m) in a grid-like pattern to determine whether any cultural resources might be present in previously unsurveyed areas. The sample survey included a search for cultural resources visible on the ground surface and exposed soils. Land access to the linear facilities was not available at the time of survey. A survey was also conducted to inventory all historic-age structures in the ROI. Similar survey efforts were not extended to the linear facilities due primarily to land access restrictions and the preliminary nature of proposed route alignments. To help locate sites where historic-age structures (i.e., older than 1960) once existed and to evaluate the potential indirect impacts to existing historical structures, archaeologists used soil maps, topographic maps, and city survey maps, some of which date to the middle to late nineteenth century. Historical aerial photographs were also examined.

Information from the historical map and photograph research was used to create an inventory of historic-age structures in the ROI. The inventory list was then verified during field efforts. This study also investigated the extent to which the proposed plant might be visible from existing historical structures, and whether there was potential for a historic district in the area. All fieldwork was confined to public roads and/or specific areas where the survey team had permission to access the property. Local residents were also interviewed when encountered.

For the associated linear facilities, data from background research efforts, soil and geology research, and field reconnaissance efforts were used to help identify areas with the highest potential for undiscovered cultural resources, and to plan for future investigations accordingly. Although a field investigation was conducted along public roads, full sample surveys were not conducted along the linear facility options because most of the alignments have not been finalized and no land access was granted. Once the alignments have been identified, areas with high or medium archaeological potential would be surveyed before construction begins.

3.10.4 Affected Environment

The TCEP lies on the far southwestern edge of the Southern Plains archeological region (Hofman 1989:1–2), bordering the Trans-Pecos archeological region to the west. The four main eras of human chronology for the Southern Plains region are the Paleoindian (10,000+ to 6000 B.C), Archaic (6000 B.C. to 500 A.D.), Late Prehistoric (500 to late 1500s A.D.), and Historic (sixteenth century to present).

The cultural resources background archival research revealed that most of the previous archeological work consisted of linear surveys conducted on behalf of various state and federal agencies, including TxDOT, TWDB, BLM, EPA, and the U.S. Army Corps of Engineers. Although several of these previous surveys intersect with one or more of the proposed linear facilities, none provide a substantial amount of information about the prehistoric or historical context of the project area. Archival research conducted for the FutureGen EIS in 2006 produced similar results, indicating that little to no archaeological investigations had been conducted recently near the project area (FG Alliance 2006).

There are no documented Traditional Cultural Properties and no cemeteries in the ROI for the proposed TCEP. Additionally, there are no documented paleontological resources or National Natural Landmarks in the project area.

3.10.4.1 POLYGEN PLANT SITE

The archaeological survey of the proposed polygen plant site conducted as part of DOE's 2010 cultural resources study resulted in the documentation of one new archaeological site (referred to as 41EC21, shown in Figure 3.24). This site is a historic-era industrial site related to oil-drilling activity in the early to mid-twentieth century. The site is located in the southwestern portion of the proposed polygen plant site and consists of two concrete pump jack foundations and an associated historical debris scatter. Due to the poor structural integrity of the two pump-jack foundations and the amount of industrial development in and around the site that has altered the landscape's character, 41EC21 is not considered eligible for listing in the NRHP.

The historical structures survey noted the presence of 14 residences, industrial facilities, commercial businesses, and oil-and-gas-related features in the ROI. These structures are described in Table 3.25 and their locations are noted in Figure 3.24. All of the development in the ROI, both modern and historical, was directly tied to oil and gas exploration and production.

Table 3.25. Built Environment Inventory in the Region of Influence

Name	Inventory Number	Type	Age	Location	NRHP Status	Description
The Joker Coffee Shop	1	Building	circa 1955	North side of the I-20 service road; west of Avenue C	Ineligible	The café is constructed with concrete block, has a flat roof and sits on a concrete slab foundation. The overall styling of the building is typical of 1950s roadside architecture, with hints of high-style modernism mixed with more modest vernacular construction techniques.
Rhodes Welding Complex	2	Building	1928, 1950, and 1952	North side of the I-20 service road; east of Avenue C	Potentially Eligible	The Rhode Welding Complex consists of three buildings, built from 1928–1952.
Lubrication complex	3	Building	circa 1935	North side of I-20, on east side of Avenue C	Ineligible	The circa 1935 complex consists of three standing buildings and a collapsed building.
Industrial shop	4	Building	circa 1935	South of Avenue G; east of lubrication complex (Inventory No. 3)	Ineligible	The shop may have been part of a larger complex of buildings at the location but is now the only standing building on the lot. The small shop building is typical of early to mid-twentieth century industrial architecture.
Wooden-framed house	5	Building	circa 1940	Intersection of Avenue H and Avenue D	Ineligible	The circa 1940 minimal traditional house has an L-shaped layout and is located to the southeast of the Avenues D and H intersection.
Asbestos-clad house	6	Building	circa 1945	Avenue H; across from wooden-framed house (Inventory No. 5)	Ineligible	The circa 1945 house is in the minimal traditional style.
Service station	7	Building	circa 1958	I-20 service road, south side of highway	Ineligible	The small station dates from the late 1950s or the early 1960s and has subtle touches of Googie architectural styling that dominated roadside architecture during the mid-twentieth century.
Service station complex	8	Building	circa 1965	I-20 service road, south side of highway	Ineligible	The complex housed a restaurant, service station, and fuel pumps and was built with the clean lines of simple modernist styling, lacking any decorative features.

Table 3.25. Built Environment Inventory in the Region of Influence

Name	Inventory Number	Type	Age	Location	NRHP Status	Description
Small service building	9	Building	circa 1945	Avenue C (east side) on south side of I-20	Ineligible	The circa 1945 service building is small, wooden-framed, and has a front-gabled roof with exposed rafter tails.
Penwell Post Office	10	Building	circa 1965	Avenue C (east side) on south side of I-20	Ineligible	The post office is constructed from concrete block, sits on a concrete slab foundation, and has a front-gabled roof clad in composite shingles.
House	11	Building	circa 1950	Avenue C (east side) on south side of I-20	Ineligible	The circa 1950s house has a side-gabled roof clad in asphalt shingles. Construction is wooden-framed and the house appears to be clad in asbestos siding and brick. The house is located on the south side of I-20, along Avenue C.
Rhodes House	12	Building	circa 1951	Northwest corner of Penwell, Avenue A	Ineligible	The house, built in 1951, appears to be a combination of ranch and minimal traditional styling, with a low-pitched side-gabled roof, a dominant external brick chimney, and a gabled entry porch spanning much of the front façade.
Mid-century office building	13	Building	circa 1958	South side of I-20 along service road	Ineligible	The small pink concrete block building is located along the I-20 service road on the west side of Penwell and faces north toward the highway. The building dates from circa 1958 and has a flat roof with a small entry porch supported by square posts.
Tank storage yard	14	Site and structures	circa 1925 for tanks	South side of I-20 along service road	Ineligible	The storage yard is located south of I-20, along the service road and just east of the service station (Inventory No. 7). The yard appears to be a storage area for old oil derricks and tanks. The yard is littered with historic-age wooden tanks and other machinery. The wooden tanks are of varying sizes, are constructed of vertical wooden boards and bound by metal banding.

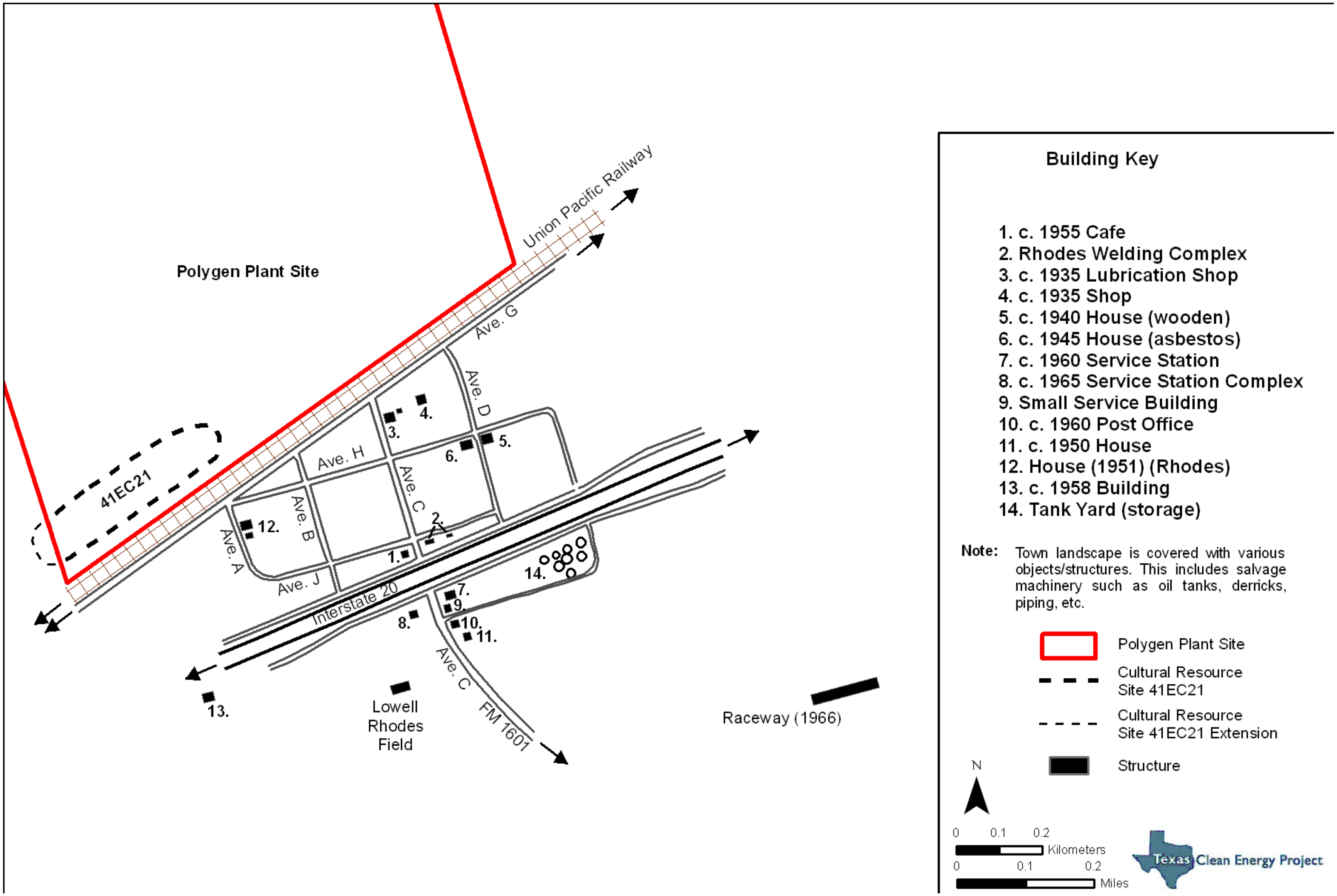

Figure 3.24. Location of historical structures documented in the region of influence.

Of the 14 historic structures in the ROI, 13 are ineligible for the NRHP. These 13 structures retain their integrity of location only. The integrity of design, materials, workmanship, and feeling have all been compromised by severe deterioration, changes in the surrounding environment due to widespread abandonment of the community, and the shift of land use from residential/commercial to an industrial storage yard and debris dump. Additionally, the construction of I-20 in the 1950s contributed to the disruption of the community's integrity by overlaying the highway corridor directly on the town's southernmost grid blocks.

One historical structure, the Rhodes Welding Complex, is potentially eligible for inclusion in the NRHP. The complex is located on the westbound frontage road of I-20 at the corner of Avenue C. It consists of two metal buildings, which are used as welding shops, and a concrete masonry unit building that functions as an office. The Rhodes Welding Company began operation before the community of Penwell was officially laid out in 1929. The original building (circa 1928) was located along the old highway/rail corridor on the north side of town. When that highway was decommissioned and the new interstate corridor moved automobile traffic to the southern side of Penwell in the 1950s, Rhodes Welding moved their shops to the I-20 frontage road and constructed two additional buildings (a larger metal shop building and an office). All three buildings can be seen on a 1963 aerial photograph of Penwell in their present configuration.

The complex as a whole retains all aspects of integrity. The individual buildings also retain all aspects of integrity, with the exception of the 1928 metal shop, which was moved from its original location and attached to the larger welding shop (structure No. 2, see Figure 3.24). Because the Rhodes Welding Complex represents a pattern of events that made a significant contribution to the development of a community, it is recommended as eligible for listing in the NRHP.

The Penwell historical marker is located west of the project area, approximately 0.9 mi (1.5 km) northwest of the intersection of I-20 and FM 1601. This marker was erected in 1965 and notes the birthplace of the Ector County oil boom following the construction of large oil wells on Robert Penn's land (Texas Archeological Sites Atlas 2010).

3.10.4.2 LINEAR FACILITIES

With the exception of WL1, there are no previously recorded NRHP-eligible sites along or within 1.0 mi (1.6 km) of the corridors for the proposed linear facilities. For WL1, there are four previously recorded archeological sites located along or within 1.0 mi (1.6 km) of the proposed corridor:

- A sparse prehistoric lithic scatter
- An Archaic-era seasonal campsite
- A possible Comanche open shelter/seasonal campsite with a hearth feature
- A prehistoric open campsite

None of these sites are recommended as eligible for the NRHP for a variety of reasons, including poorly preserved site deposits or lack of significant artifacts or features. In particular, the sparse prehistoric lithic scatter has been impacted by ROW construction and the field investigation conducted in July 2010 found no evidence of the site.

The Odessa Meteor Craters historical marker is located adjacent to the proposed WL1 corridor. These craters were created approximately 20,000 years ago from a shower of nickel-iron meteorites, and cover an area of approximately 2 mi^2 (5 km^2). None of the craters are located within the proposed corridors.

3.10.5 Environmental Impacts of Summit's Proposed Project

3.10.5.1 POLYGEN PLANT SITE

The construction and operation of the proposed TCEP would adversely affect the historic-era pump jack foundations and associated debris scatter that is located on and just outside of the proposed polygen plant site. However, as noted above, this site is not eligible for the NRHP because of its poor structural integrity and the amount of industrial development that has altered the character of the surrounding landscape. Although some local residents reported finding evidence of prehistoric sites affiliated with Native American culture as well as Anglo-American railroad settlement northeast of the project area, DOE's survey efforts determined that no Native American or historical railroad settlement sites are located on the polygen plant site.

For the historic-age structures in the ROI, only the Rhodes Welding Complex is potentially eligible for inclusion in the NRHP. The Rhodes Welding Complex viewshed was assessed to determine if the proposed TCEP would diminish the property's integrity as related to the NRHP. Overall, the viewshed around the complex has degraded as the town has changed from a thriving oil and gas community to a nearly abandoned and overgrown landscape dominated by dilapidated structures and industrial debris. Although the proposed plant could be seen from the Rhodes Welding Complex, the view to the north would be somewhat obscured by a row of large hardwood trees, the steep railroad grade, and various industrial debris including derricks, piping, and machinery. The interstate highway and overpass immediately south of the complex completely obstructs the view facing south. To the east and west are overgrown lots and several dilapidated structures.

The proposed plant, although different in scale, would be consistent with newer oil and gas industry structures in the area such that it would not present an entirely new element to the landscape. Although the proposed plant would be an imposing fixture in the viewshed of the Rhodes Welding Complex, the existing viewshed has already been considerably diminished as a result of the construction of the interstate highway, overpass, and railroad grade; the changes and degradation of the surrounding community; and shifts in local land use from community to an industrial debris dump. Thus, the proposed TCEP would not diminish the characteristics that make the Rhodes Welding Complex eligible for inclusion in the NRHP.

DOE's 2010 cultural resources report, including the archeological survey and historical structures survey, was submitted to the Texas Historical Commission (which serves as the SHPO for Texas) for review and comment. The report, submitted on September 3, 2010, detailed the results of the survey efforts and made recommendations for further work, which are summarized below. The Texas Historical Commission/SHPO provided a written response on October 14, 2010. In that response, the Commission concluded that no historic properties would be affected by the construction and operation of the TCEP and concurred with the recommendations in the cultural resources report.

3.10.5.2 LINEAR FACILITIES

As described above, the construction of WL1 could affect four previously recorded archaeological sites. None are eligible for inclusion in the NHRP because they are poorly preserved or lack of significant artifacts or features. One of the sites has been impacted by ROW construction and the field investigation conducted in July 2010 found no evidence of the site. No other cultural resources have been documented within the corridors of the other linear facilities associated with the proposed TCEP.

The field investigation determined that despite the absence of NRHP-eligible sites or other documented cultural resources, construction of any of the proposed linear facilities has the potential to affect previously undocumented cultural resources. Areas with the highest potential for intact prehistoric sites are those nearest Monahans Draw and its unnamed tributaries. Areas with low potential for harboring intact, significant cultural resources are those portions of the linear facilities that parallel existing roadways or pipeline and transmission line ROWs. These segments of the linear features are primarily located northeast of the proposed polygen plant site and along I-20. The remaining segments of the proposed linear features traverse open land, and have a moderate probability for harboring cultural resources. This is due primarily to the prevalence of oil and gas development throughout the region, which has taken a heavy toll on the landscape.

A cultural resources survey of the TCEP linear facilities would be conducted after the alignments had been finalized and prior to construction, in compliance with recommendations provided by the Texas Historical Commission on September 10, 2010. Although the probability is considered low, should any cultural resources or human remains be discovered during the pre-construction surveys for the linear facilities, the Texas Historical Commission/SHPO would be immediately contacted and consulted.

Operational impacts associated with ongoing maintenance and repair of the linear facilities could result in additional ground disturbance and physical impacts to presently unknown cultural resources. Increased access to areas previously not accessible by road could result in impacts to presently unknown cultural resources from inadvertent damage, looting, or vandalism.

3.10.5.3 NATIVE AMERICAN RESOURCES

There are no documented Traditional Cultural Properties in the proposed TCEP ROI. During the preparation of this EIS, requests for consultation letters were sent to representatives of federally recognized Native American tribes with potential interests in Crane, Ector, and Midland Counties to solicit information regarding the locations of any undocumented Traditional Cultural Properties or other culturally sensitive areas (see Appendix A for copies of the consultation letters).

The Ysleta Del Sur Pueblo of Texas responded to the consultation request letter, stating that they only wish to be contacted if human remains are discovered during the construction or operation of the TCEP. The Comanche Nation requested a copy of the draft EIS statement in order to officially comment on the proposed project.

The construction and operation of the TCEP could result in increased access to areas previously not accessible by roads. However, no known Traditional Cultural Properties are located in the proposed TCEP ROI, and impacts associated with TCEP construction and operation are not anticipated.

3.10.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Section 2.5. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to cultural resources are:

- Conducting pre-construction surveys and altering the site plot plan or linear corridors if undocumented cultural resources are found.
- Developing a discovery plan that would be implemented in the unlikely event that cultural resources (including human remains or burial features) are discovered at any point during construction, operation, or ongoing maintenance of the proposed TCEP. This plan should be developed in consultation with the Texas Historical Commission/SHPO and should include the immediate cessation of all ground-disturbing activities and further consultation with the Texas Historical Commission/SHPO to determine the appropriate course of action.

3.11 Land Use

3.11.1 Background

This section identifies and describes the existing land uses that could be affected by the construction and operation of the polygen plant and linear facilities. It describes existing land uses in the project area, potential impacts of the proposed project on land uses (particularly residential, industrial, and commercial) in and near the proposed polygen plant site and linear facilities, potential impacts from the proposed project on the ability to access nearby lands, and consistency with comprehensive land use plans and regulations. The section also presents the environmental impacts of the proposed project and the No Action Alternative. Additional mitigation measures that could be implemented to further reduce potential adverse consequences are presented.

A proposed project can result in new land uses that may conflict with existing land uses on lands near it. In some cases, land use plans and/or regulations define the types of land uses that are compatible and not compatible with other land uses. New land uses may have direct or indirect impacts on other existing land uses.

3.11.2 Region of Influence

The land use ROI for the TCEP consists of the 600-ac (243-ha) polygen plant site and the area within 2.0 mi (3.2 km) of the site's boundaries. This distance from the proposed site was chosen as the area in which existing land use could be affected by plant construction or operations and to account for potential indirect impacts from increased vehicle traffic, impediments to access, and impacts to existing land uses that would extend beyond the project area. The land use ROI for the linear facilities consists of the applicable linear facility and construction-footprint buffer areas, which are located 100 ft (30 m) from the centerline of each linear facility.

3.11.3 Methodology and Indicators

The impacts analysis for land use used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.26.

Table 3.26. Indicators of Potential Impacts on Land Uses

Potential Impact	Impact Indicator
Changes to existing and/or planned residential development/dwelling	Physical restrictions to existing and/or planned development as a result of construction or operation of the TCEP
Changes to existing commercial or industrial land use	
Changes to public and/or private land	Physical restrictions to public and/or private land as a result of fencing or other physical or legal barriers necessary for project construction or operation
Changes in land uses prescribed in existing land use plans	Conflicts with or limitations on land uses prescribed in existing land use plans
Impacts to air space	Conflicts with FAA regulations

DOE reviewed existing and future land use data collected from agency and local governmental land use plans and conducted a GIS overlay comparison of compatible and noncompatible uses to illustrate indicators of what land uses will be most affected by the TCEP. In addition, federal, state and county regulatory land use requirements were also reviewed.

3.11.4 Affected Environment

This section describes the land use conditions that could be affected by the construction and operation of the proposed polygen plant and associated linear facilities.

3.11.4.1 POLYGEN PLANT SITE

This section describes existing land uses, land ownership, land use plans, public access and recreation areas, and airspace designations that could be affected by the construction and operation of the proposed polygen plant.

Existing Land Uses

Prior to its current use for oil and gas production, the area in which the proposed polygen plant site is located was historically used for cattle ranching. Oil was discovered in this area in 1929 and, by the 1980s, oil and gas activities had replaced cattle grazing as the area's dominant land use. Over 200 permitted or developed oil and gas wells, three crude oil pipeline systems, one natural gas pipeline system, and one refined products pipeline system are found in the land use ROI. Many of the wells, however, are no longer in production. RRC records indicate that six permitted or developed natural gas and oil wells exist on the proposed polygen plant site (RRC 2010) (Figure 3.25). However, individuals familiar with the site indicated that only one oil well and one gas well remained active by 2006 (DOE 2007). Pipelines also cross the proposed polygen plant site, and although there are several existing pipelines, the only active pipelines include one crude oil pipeline system, one natural gas pipeline system, and one condensate pipeline system (Figure 3.25). Although there are no water wells on the proposed polygen plant site, TWDB records identified two documented water wells in the ROI (DOE 2007).

No residences or businesses are located in the proposed polygen plant site. The nearby community of Penwell (immediately south of the site) and the UPRR line that borders the polygen plant site were established after the discovery of oil. Seven occupied (and habitable) residences in Penwell remain (Figure 3.26). Three are located immediately north of I-20 and south of the proposed polygen plant site, and four are located south of I-20 along FM 1601. Several oil and gas extraction-related businesses still operate in and around Penwell outside of the proposed polygen plant site.

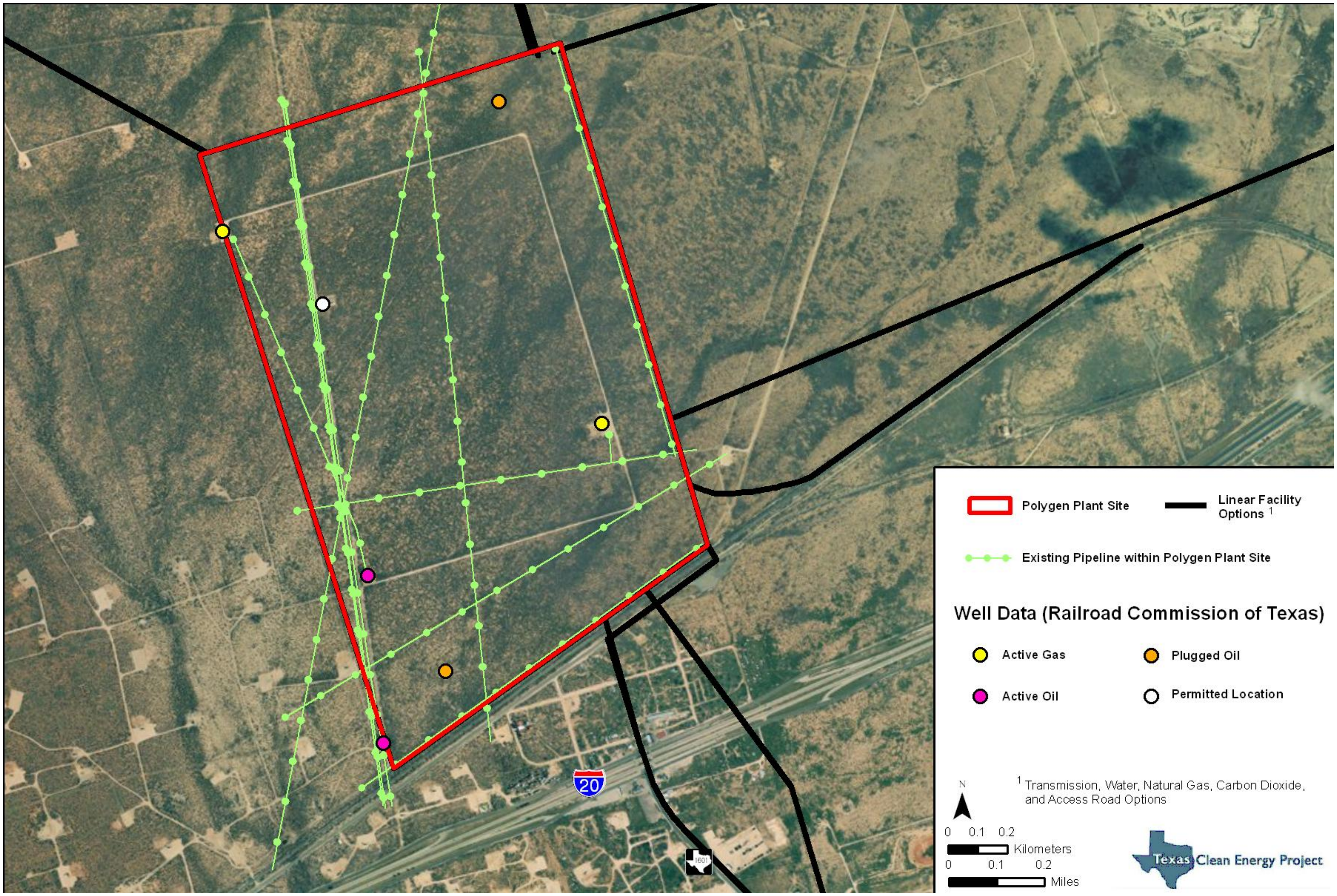

Figure 3.25. Existing wells and pipelines in the polygen plant site.

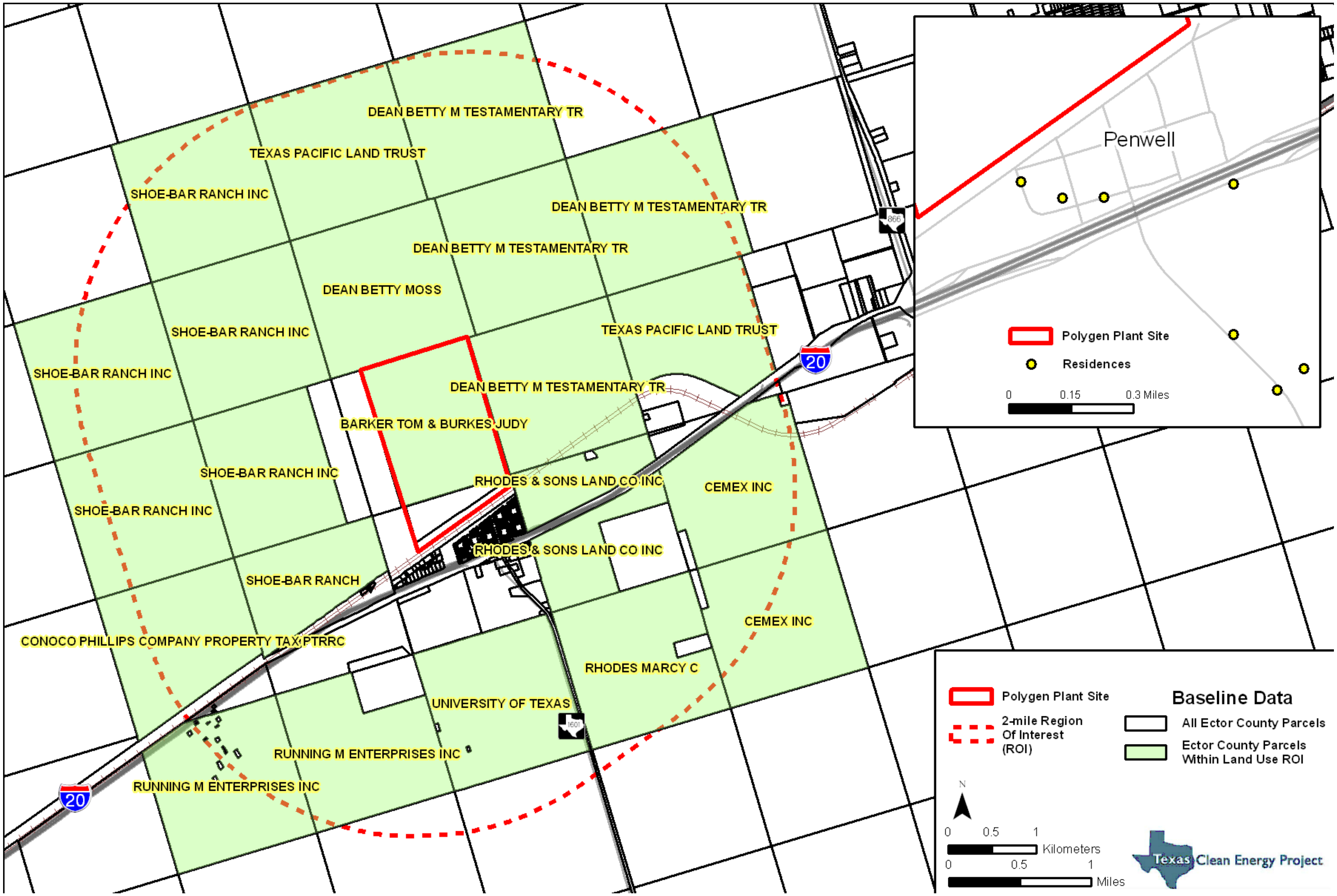

Figure 3.26. Large parcels in the polygen plant site region of influence.

Land Ownership

The proposed polygen plant site is owned by Summit. In the land use ROI, there are 22 large parcels of land owned by the Texas Pacific Land Trust, Ector County Sheriff's Department, Rhodes and Sons Land Company, Quell Petroleum Services, and the University of Texas, among others (see Figure 3.26). More than 200 other property owners have smaller holdings in the ROI, including private residences. Various utility and oil and gas companies have easements for access to subsurface oil and gas resources on the proposed plant site and surrounding lands.

Land Use Plans and Regulations

The proposed polygen plant site is located in unincorporated Ector County. The county has no land use plan, zoning, or development standards that are applicable to the proposed plant site.

Public Access Areas and Recreation

There are no recreational areas on the proposed plant site. The Penwell Knights Raceway, an active public drag strip, is located along FM 1601 on the south side of I-20, approximately 0.8 mi (1.3 km) southeast of the proposed plant site.

Airspace

There are no military airspaces designated above the ROI.

3.11.4.2 LINEAR FACILITIES

This section describes existing land uses, existing land use plans, and public access and recreation areas that could be affected by the construction and operation of the linear facilities associated with the TCEP.

Existing Land Uses

The corridors in which the TCEP linear facilities would be located generally pass through land that is rural and sparsely populated. Most of the land use in these areas is related to oil and gas extraction, and ranching. Other land uses include support services for the oil and gas industry (such as drilling and equipment storage, petrochemical manufacturing and storage) and some clusters of residences. Figure 3.27 identifies the locations of the residential areas along the linear facilities. Table 3.27 identifies the areas that contain residences as well as existing transportation and utility (electrical transmission and distribution lines and pipelines) ROWs that the linear facility options would cross.

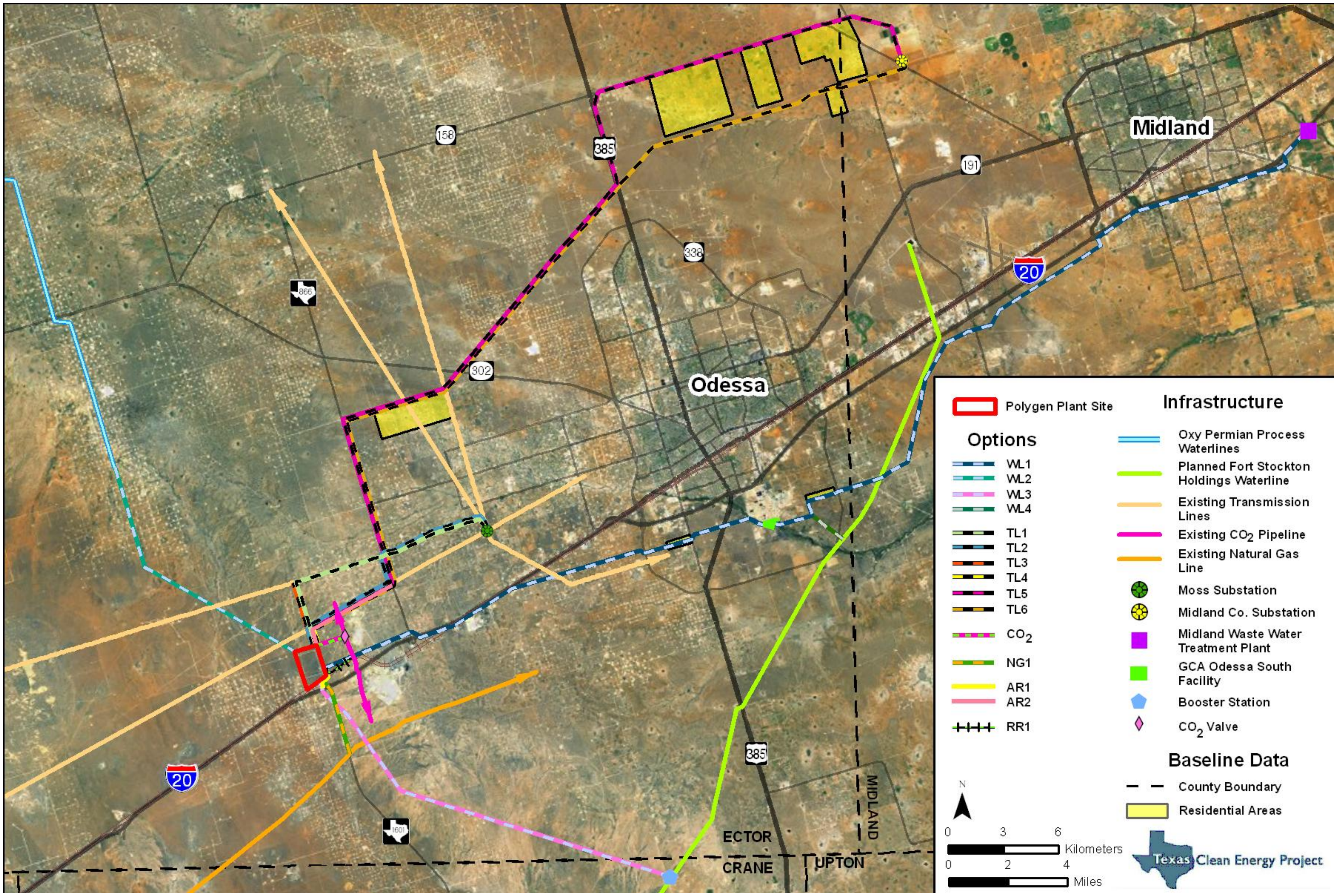

Figure 3.27. Residential areas along the linear facilities.

Table 3.27. Existing Land Uses, other than Oil and Gas Activity, along TCEP's Linear Facilities

Linear Facility Option	Type of Land Use Crossed	Distance and Direction from Polygen Plant Site (mi [km])	Total Length (mi [km])	ROW Use/Occupancy (if applicable)
WL1	Transportation ROW	3.0 (4.8) east	1.1 (1.8)	I-20 eastbound frontage road
	Transportation ROW	3.5 (5.6) east	2.4 (3.9)	UPRR
	Transportation ROW	12.0 (19.3)east	1.0 (1.6)	West Bell Street
	Residential area	12.0 (19.3) east	1.0 (1.6)	Scattered residences north and south of ROI
	Utility ROW	15.0 (24.1) east	1.9 (3.1)	Collector pipelines
	Utility ROW	16.0 (25.7) east	1.1 (1.8)	138-kV transmission line
	Transportation ROW	16.0 (25.7) east	0.5 (0.8)	FM 3503
	Residential area	17.0 (27.4) east	1.0 (1.6)	Clustered residences north of Hamett Drive
	Utility ROW	28.0 (45.1) east	4.3 (6.9)	138-kV transmission line
	Transportation ROW	30.0 (48.3) east	1.6 (2.6)	I-20 Eastbound Frontage Road
	Transportation ROW	33.0 (53.1) east	1.5 (2.4)	CR 110 and 111
	Transportation ROW	41.0 (66.0) east	1.1 (1.8)	I-20 eastbound frontage road
WL3	Transportation ROW	0.8 (1.3) south	0. 9 (1.4)	FM 1601
WL4*	Utility ROW	16.0 (25.7) east	1.1 (1.8)	138-kV transmission line
TL1	Utility ROW	2.2 (3.5) north	7.1 (11.4)	138-kV transmission line
TL2	Utility ROW	0.6 (1.0) north	3.1 (5.0)	138-kV transmission line
	Transportation ROW	3.5 (5.6) northeast	1.0 (1.6)	FM 866
	Transportation ROW	3.8 (6.1) northeast	3.9 (6.3)	138-kV transmission line
TL5†	Transportation ROW	7.5 (12.1) northeast	4.8 (7.7)	FM 866
	Transportation ROW	9.7 (15.6) northeast	2.4 (3.9)	West Yukon Road
	Residential area	9.7 (15.6) northeast	2.0 (3.2)	Scattered residences south of West Yukon Road
	Utility ROW	18.0 (29.0) northeast	8.9 (14.3)	345- and 138-kV transmission line
	Transportation ROW	20.6 (33.1) northeast	3.2 (5.1)	U.S. Highway 385
	Transportation ROW	22.0 (35.4) northeast	7.9 (12.7)	State Highway 158
	Residential area	27.0 (43.4) northeast	1.9 (3.1)	Scattered residences south of State Highway 158
TL6†	Transportation ROW	7.5 (12.1) northeast	4.9 (7.9)	FM 866
	Transportation ROW	9.7 (15.6) northeast	2.4 (3.9)	West Yukon Road
	Residential area	9.7 (15.6) northeast	2.0 (3.2)	South of West Yukon Road
	Utility ROW	16.0 (25.7) northeast	16.3 (26.2)	345- and 138-kV transmission line
	Transportation ROW	24.0 (38.6) northeast	1.0 (1.6)	East Cottonwood Road
	Residential area	25.0 (40.2) northeast	1.6 (2.6)	Scattered residences adjacent to CR 40
	Utility ROW	26.0 (41.8) northeast	2.2 (3.5)	345- and 138-kV transmission line
NG1	Transportation ROW	0.9 (1.4) south	1.7 (2.7)	FM 1601

Note: Only linear facilities that intersect with non–oil and gas land uses are discussed in this table.
* Includes WL1 from the polygen plant site to GCA Odessa South Facility.
† Also includes all of TL2.

Land Use Plans and Regulations

With the exceptions identified below, all of the TCEP linear facilities would be located in unincorporated Ector County. The county has no land use plan, zoning regulations, or development standards that would be applicable to the linear facilities. Portions of WL1 and WL4 would pass through areas in the city of Odessa that are zoned as Future Development and Heavy Industry and would need to comply with the Odessa Zoning Ordinance (City of Odessa 2006). WL1 would also cross through the city of Midland in areas zoned Single-family Dwelling, Business Park, Commercial, Local Retail, and Mobile Home and would need to be consistent with the *Midland Master Plan 2025* (City of Midland 2005).

Public Access and Recreation Areas

The Penwell Knights Raceway is the only public access and recreation area in the ROI. It is accessed from I-20 via the north I-20 frontage road and FM 1601. NG1 and WL3 would be located adjacent to the entrance to raceway.

3.11.5 Environmental Impacts of Summit's Proposed Project

This section describes the potential environmental impacts of the construction and operation of the proposed polygen plant and associated linear facilities on land use in the ROI.

3.11.5.1 POLYGEN PLANT SITE

This section describes the potential impacts of the proposed polygen plant on existing land uses and land ownership, the extent to which the plant would be consistent with existing land use plans, and the potential impacts of the proposed plant on public access and recreation areas and airspace.

Existing Land Uses

There are no existing residential dwellings or planned residential developments in the proposed polygen plant site. During construction, noise and visual impacts associated with construction-related activities (particularly traffic) would occur near several of the residences in Penwell that are south of the polygen plant. However, project construction would not affect the current use of these properties, and construction impacts would be similar to those currently experienced from nearby oil and gas activities and I-20 traffic. Access to some residences could be temporarily delayed by construction traffic, as discussed in Section 3.16, Transportation. Impacts during the operational phase of the TCEP to existing residents would be similar to those currently experienced from nearby oil and gas activities and I-20 traffic.

The primary use of the polygen plant site would change from oil and gas extraction to energy and chemical production. The TCEP would be an industrial type of energy-related use that would be consistent with the land uses in the ROI. Existing oil and gas extraction on the polygen plant site could continue, although access would need to be coordinated with Summit. Oil and gas exploration and production on lands in the ROI but outside of the polygen plant site would not be affected. There are no public lands in the land use ROI, and access to I-20 would not be compromised by the project.

Land Ownership

The ownership of land in the ROI would not change as a result of the construction or operation of the proposed TCEP.

Consistency with Comprehensive Land use Plans and Regulations

As previously mentioned, the proposed polygen site is located in unincorporated Ector County. The county does not have a land use plan and has not assigned land use zones to lands in its jurisdiction. Therefore, the polygen plant would not be inconsistent with any Ector County land use plans for the project area.

Public Access and Recreation Areas

No impacts to the majority of public access areas and recreation would result from the construction and operation of the plant. The Penwell Knights Raceway Park, the only public access and recreational area within the ROI, operates on Friday nights and Saturdays. Construction-related traffic using AR1 to access the polygen plant site could result in traffic delays for patrons accessing the raceway. These potential delays could be mitigated through scheduling and close coordination with the raceway operators.

Airspace

In accordance with FAA regulations, signal lights would be required atop the plant cooling towers and other structures that are higher than 200 ft (61 m). No other impacts to airspace would be expected.

3.11.5.2 LINEAR FACILITIES

This section describes the potential impacts of the proposed TCEP linear facilities on existing land uses, the extent to which those facilities would be consistent with existing land use plans, and the potential impacts of the proposed linear facilities on public access and recreation areas.

Existing Land Uses

Construction of the linear facilities would have temporary impacts on some adjacent lands. The construction ROW would be used for activities such as trenching, equipment movement, and materials laydown (see Table 2.2). Construction work would consist of activities such as land clearing, trenching, pipe installation, backfilling, compacting, and hydrostatic testing for leakage, cleanup, and restoration. Where appropriate, street and driveway pavements would be cut and temporarily covered during pipeline construction to maintain access. All regulated road and rail-line crossings would be accomplished using directional drilling technology, which allows for site-specific locations of the pipeline to be buried beneath lands without disturbing the surface directly above the pipeline. The ability to use some lands for their existing uses (oil and gas development, utility and road ROWs, and cattle grazing) would be temporarily affected during construction but would not be inhibited during operations.

Most of the lands that the process waterlines, natural gas pipeline, transmission lines, and CO_2 pipeline would pass through are primarily used for oil and gas extraction and ranching. The TCEP linear facilities would be located in existing ROWs where possible, which would reduce potential land use impacts. The linear facilities (except for the transmission lines) would be buried and would have little to no impact to the ability to use adjacent lands. The TCEP transmission line routes would follow existing transmission lines and other linear facilities and would be located in or next to existing ROWs when possible. Table 3.28 shows the acreage of land that would be required for the linear facilities ROWs.

Table 3.28. Linear Facility Rights-of-way Acreage Requirements

Linear Facility Option	Acreage Requirement (ac [ha])
WL1	252.4 (102.1)
WL2	56.3 (22.8)
WL3	86.6 (35.0)
WL4	18.1 (7.3)
TL1	60.6 (24.5)
TL2	65.5 (26.5)
TL3	18.0 (7.3)
TL4	8.1 (3.3)
TL5	236.2 (95.6)
TL6	212.0 (85.8)
CO_2	6.1 (2.5)
NG1	16.5 (6.7)
AR1	4.0 (1.6)
AR2	35.5 (14.4)
RR1	6.7 (2.7)

Note: Represents the permanent (operational) ROWs, not temporary (construction) ROWs.

No new residential developments are planned near the proposed TCEP linear facilities. However, several of the linear features would pass through or be adjacent to existing residential areas (see Figure 3.27). WL1 would pass within 400 ft (122 m) of two residential areas in unincorporated Ector County. One area is located approximately 12 mi (19 km) east of the proposed polygen plant site and the other is approximately 17 mi (27 km) east. The residences in both areas are along approximately 2 mi (3.2 km) of the proposed WL1 corridor. Because the waterline would be buried, the residences would not be impacted by the WL1 pipeline and ROW.

TL5 would also pass within 200 ft (61 m) of two residential areas. The areas begin approximately 9.7 mi (15.6 km) and 27 mi (43.5 km) northeast of the proposed plant site, and both areas have residences along approximately 2.0 mi (3.2 km) of the proposed TL5 corridor. TL5 would not impact the use of these residential areas, although the transmission line could be seen from these areas.

TL6 would also be routed within 200 ft (61 m) of two different residential areas. The residential area closest to the proposed polygen plant site (9.7 mi [15.6 km] northeast) is the same area near which TL5 would pass. The second area is approximately 25 mi (40 km) to the northeast of the proposed plant site and would be located along approximately 1.6 mi (2.5 km) of scattered residences. The presence of the transmission line under TL6 would not impact the use of these residences, although it could be seen from them.

Consistency with Comprehensive Land Use Plans and Regulations

WL1 and WL4 are the only linear facilities that would pass through lands that are subject to land use controls (zoning). WL1 and WL4 would travel through the city of Odessa in areas with zoning district designations of Future Development and Heavy Industry. Approximately 1,200 ft (366 m) of WL1 would travel through the Future Development zoning district, and its permanent ROW would total approximately 1.2 ac (0.5 ha). WL4 would pass through approximately 1,000 ft (305 m) of the Heavy Industry zoning district and would require approximately 1 ac (0.4 ha) for its permanent ROW. Permitted uses in these two zoning districts include local utility lines (such as waterlines), sewage pumping stations, natural gas lines, and high voltage electrical transmission lines. Thus, it is expected that WL1 and WL4 would be permitted uses.

WL1 would also pass through approximately 2.0 mi (3.2 km) of the city of Midland. Table 3.29 shows the number of miles this option would cross in each zoning district and the acreage required for permanent ROW.

Table 3.29. Waterline Option 1, Zoning District Crossings, and Acreage Required for Right-of-way

	Extent in Zoning District (mi [km])	ROW Area (ac [ha])
Business park	1.6 (2.5)	9.7 (3.4)
Commercial	0.5 (0.8)	3.0 (1.2)
Light industrial	0.8 (1.3)	4.8 (2.0)
Local retail	2.5 (4.0)	15.5 (6.3)
Mobile home	0.8 (1.3)	4.8 (1.9)
Single-family dwelling	0.7 (1.0)	4.2 (1.7)

The proposed corridor for WL1 contains an existing pipeline ROW that also could be used for the WL1 pipeline. The location, construction, and operation of water pipelines are not specifically covered in the *Midland Master Plan 2025* zoning classifications. It is assumed that water pipelines would be consistent with the six zoning districts that WL1 would pass through, because utilities and infrastructure are recognized in the master plan as necessary for businesses and residents.

Public Access and Recreation Areas

Access to the Penwell Knights Raceway Park could be affected by construction of NG1 and/or WL3. These options would not cross the drag strip, but would cross the public access to the park. However, because the park only operates on Friday nights and Saturdays, coordination of construction activities with the operators of the park could mitigate any potential impacts. There are no other public access or recreation areas along the linear corridors.

3.11.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Section 2.5. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to land use are:

- Using erosion and siltation controls to manage the effects of construction and ground-disturbing activities
- Implementing practices to reduce traffic volumes

Other mitigation measures noted in Sections 3.19, Noise and Vibration; 3.15, Utility Systems; and 3.16, Transportation would also assist in maintaining compatibility with existing land use designations.

3.12 Socioeconomics

3.12.1 Background

This section identifies and describes the existing socioeconomic conditions that could be affected by the construction and operation of the polygen plant and linear facilities. The potential impacts of the proposed TCEP on socioeconomic conditions such as population levels, housing requirements, and economic output in the region are addressed. This section also presents the environmental impacts of the proposed project and the No Action Alternative.

3.12.2 Region of Influence

The ROI for the socioeconomic analysis is Ector, Midland, Crane, and Ward Counties, which cover approximately 3,426 mi^2 (8,873 km^2) in West Texas. These are the counties in which the proposed polygen plant and associated linear facilities would be located and in which DOE expects almost all construction and operations workers would live. The prominent cities in the ROI are Odessa in Ector County and Midland in Midland County. Although Penwell is close to the proposed project area, socioeconomic data for the town are unavailable.

3.12.3 Methodology and Indicators

The socioeconomic analysis used the following federal, state, and local data sources:

- U.S. Census Bureau
- U.S. Department of Commerce, Bureau of Economic Analysis
- U.S. Department of Labor, Bureau of Labor Statistics (BLS)
- Texas State Data Center
- Texas Office of the State Demographer
- Real Estate Center at Texas A&M University
- IMPLAN data (created by the Minnesota IMPLAN Group)

To analyze potential economic impacts in the ROI, DOE used IMPLAN (Version 3.0). IMPLAN is an economic modeling tool that can create a detailed social accounting picture and a predictive multiplier model for a regional economy. The IMPLAN database contains county, state, and federal economic statistics that can be used to measure the effect on a regional or local economy of a given change or event in the economy's activity. Economic modeling considers a regional economy, which for the TCEP consists of Ector, Midland, Crane, and Ward Counties.

The impacts analysis for social and economic resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.30.

Table 3.30. Indicators of Potential Impacts to Social and Economic Conditions

Potential Impact	Impact Indicator
Demographic changes in population levels because additional construction and operations workers would be required for the project	Change in population from changes in employment
Housing availability changes for construction and operations workers	Change in demand on housing supply (substantial population increase leads to changes in housing supply needs [insufficient housing supply or increased vacancies])
Economic changes in employment, area income taxes, and economic output in the region	Change in revenue benefits from taxes (increase in employment leads to increase in housing demand, addition of plant leads to increased royalty tax revenue, or increase/decrease in economic output

3.12.4 Affected Environment

3.12.4.1 DEMOGRAPHICS

Population data were obtained from the U.S. Census Bureau and the Texas State Data Center and Office of the State Demographer. Table 3.31 summarizes historical and projected population values in the ROI with comparative figures for the state of Texas.

Table 3.31. Historical and Projected Population in the Region of Influence

Location	Population		Total Percent Change in Population	Projected Population				Increase (%)
	2000*	2009†	2000–2009	2010	2020†	2030†	2040†	2010–2040
Texas	20,851,820	24,538,335	17.7	25,373,947	28,005,740	31,830,575	35,761,165	40.9
Ector County	121,123	132,153	9.1	132,817	143,926	153,884	163,093	22.3
Odessa	90,943	99,507	9.4	132,817	143,926	153,884	163,093	22.8
Midland County	116,009	130,203	12.2	129,715	133,633	140,138	145,132	22.3
Midland	94,996	107,248	12.9	129,715	133,633	140,138	145,132	11.9
Crane County	3,996	4,084	2.2	4,299	4,723	4,757	4,710	9.6
Ward County	10,909	10,693	-2.0	9,914	12,083	12,174	12,100	22.0
ROI Total	**252,037**	**277,133**		**276,745**	**294,365**	**310,953**	**325,035**	**17.4**

*Data from U.S. Census Bureau (2000).

†Data from Texas State Data Center and Office of the State Demographer (2010).

These data indicate population growth of 17.7 percent in Texas from 2000 to 2009, and projections for the state between 2010 and 2040 show a population growth rate of 40.9 percent.

Between 2000 and 2009, Ector County grew by 9.1 percent and is anticipated to continue growing approximately 22.3 percent between 2010 and 2040. Odessa shows a similar pattern, having increased its population by 9.4 percent between 2000 and 2009. Anticipated growth for Odessa between 2010 and 2040 is 22.8 percent. Between 2000 and 2009, Midland experienced the most growth overall at 12.9 percent, and additional growth between 2010 and 2040 is expected to be approximately 11.9 percent. Crane County had the slowest population growth between 2000 and 2009 at 2.2 percent and is anticipated to increase by 9.6 percent between 2010 and 2040. Ward County had negative growth between 2000 and 2009 at -2.0 percent; however, population projections show steady growth between 2010 and 2040 at 22 percent.

3.12.4.2 HOUSING

According to 2005–2009 census data estimates, which are based on average estimates of data collected between January 2005 and December 2009, Ector and Midland Counties had an occupancy rate higher than the state at 90.4 percent and 93.0 percent, respectively (Table 3.32). The median home value was $109,600 in Midland County, $67,700 in Ector County, $48,200 in Crane County, and $41,300 in Ward County.

Table 3.32. Total Housing Units and Occupancy Rate, 2005–2009

Location	Total Housing Units	Occupied	Occupied (%)	Vacant	Vacant (%)	Median Home Value ($)
Texas	9,407,692	8,269,046	87.9	1,138,646	12.1	118,900
Ector County	51,519	46,561	90.4	4,958	9.6	67,700
Odessa	39,387	35,609	90.4	3,778	9.6	76,500
Midland County	50,142	46,629	93.0	3,513	7.0	109,600
Midland	41,523	38,931	93.8	2,592	6.2	113,700
Crane County	1,657	1,489	89.9	168	10.1	48,200
Ward County	4,909	3,897	79.4	1,012	20.6	41,300

Source: U.S. Census Bureau (2010).

According to the Real Estate Center at Texas A&M University, in 2009 the average occupancy rate for apartment units was 96.7 percent in Midland and 97.1 percent in Odessa. There were approximately 2,600 hotel rooms in the Midland metropolitan area with an occupancy rate of 54.4 percent. For the same year, Odessa had approximately 2,100 hotel rooms with an occupancy rate of 50.4 percent (Texas A&M University 2010a, 2010b).

3.12.4.3 ECONOMICS

Economic factors discussed below are gross domestic product (GDP), industry employment, and taxes and revenues.

Gross Domestic Product for the Region of Influence

Table 3.33 summarizes existing GDP by industry in the ROI, which was used to compare changes in GDP in the ROI as a result of the project. GDP is the contribution of each private industry and government to the ROI's output. GDP, or value added, is equal to the gross output (which consists of sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (which consist of energy, raw materials, semifinished goods, and services that are purchased from domestic industries or from foreign sources). It can also be measured as the sum of incomes related to production, such as wages and salary accruals and gross operating surplus (IMPLAN 2008). GDP is presented in undiscounted 2008 dollar terms, rounded to the nearest thousand.

As shown in Table 3.33, total GDP for the ROI in 2008 was $17.73 billion. The top industries were dominated by the oil and gas sectors, with extraction of oil and natural gas accounting for 30.7 percent of GDP for the ROI, followed by support activities for oil and gas operations (10.7 percent) and drilling oil and gas wells (10.6 percent).

Table 3.33. Gross Domestic Product by County for the Region of Influence: Top Ten Industries

Sector	Ector	Midland	Crane	Ward	ROI Total
Food services and drinking places	$145,628,392	$150,139,319	$2,101,086	$4,927,858	$302,795,655
Rental activity for owner-occupied dwellings	$314,652,400	$546,245,752	$8,213,391	$24,751,434	$893,862,977
Motor vehicle parts manufacturing	$9,967,138	$2,829,420	$2,217,558	$5,049,028	$20,063,144
Drilling oil and gas wells	$503,392,374	$885,284,063	$53,724,099	$46,893,299	$1,489,293,835
Extraction of oil and natural gas	$441,22,832	$3,757,353,280	$79,245,936	457,850,887	$4,294,450,103
Support activities for oil and gas operations	$561,628,696	$786,419,038	$38,223,060	$108,643,881	$1,494,914,675
Transport by pipeline	$29,373,331	$79,724,038	$3,985,746	$3,010,985	$116,094,100
Transport by truck	$96,693,910	$84,189,794	$2,703,205	$15,427,528	$199,014,437
Offices of physicians, dentists, and other health practitioners	$140,345,838	$135,751,702	$554,204	$2,936,943	$279,588,687
Construction of other new nonresidential commercial and health care structures	$174,040,085	$81,916,423	$759,210	$5,825,042	$262,540,760
Commercial and industrial machinery, and equipment rental and leasing	$182,603,440	$95,042,707	$553,615	$12,194,445	$290,394,207
Real estate establishments	$80,308,156	$168,268,051	$42,634	$2,178,470	$250,797,311
Architectural, engineering, and related services	$47,945,641	$180,304,355	$141,407	$7,665,059	$236,056,462
Wholesale trade business	$656,838,225	$579,170,252	$4,142,961	$12,615,413	$1,252,766,851
Employment and payroll only (state and local government, education)	$342,643,444	$216,515,222	$10,315,503	$29,907,600	$599,381,769
Employment and payroll only (state and local government, noneducation)	$136,216,728	$206,088,732	$6,719,528	$16,175,402	$365,200,390
Electric power generation, transmission, and distribution	$30,210,582	$32,353,358	$0	$18,365,378	$80,929,318
Total County GDP	**$3,452,488,380**	**$7,987,595,506**	**$213,643,143**	**$774,418,652**	**$12,428,144,681**

Source: IMPLAN (2008).
Note: Total county GDP includes other sectors not described in the table. Shaded sectors rank in the top ten industries for each county

Industry Employment

To determine how the TCEP could alter existing employment numbers, DOE considered current industry employment in prominent industries in the ROI. Industry employment is based on the BLS Covered Employment and Wages, as reported by IMPLAN (IMPLAN 2008). Generally these data include jobs for people who worked during, or received pay for, the reporting period. Excluded from employment data are self-employed, sole proprietors, domestic workers, and unpaid family workers. Table 3.34 lists employment by industry in the ROI in 2008; shaded cells indicate the top five employment sectors for each county. Food services and drinking place jobs dominate the ROI, representing 7.2 percent of ROI employment. State and local government (education) (6.5 percent) and support activities for oil and gas activities are in the top five for every county in the ROI (6.3 percent).

Table 3.34. Region of Influence Employment, By Industry (number of jobs)

Sector	County				ROI Total
	Ector	Midland	Crane	Ward	
Total full and part-time employment	72,595.51	82,835.01	1,689.82	4,278.80	161,399.14
State and local government (education)	5,876.82	3,869.05	182.23	584	10,512.1
State and local government (noneducation)	2,423.62	3,638.71	159.49	333.2	6,555.02
Food services and drinking places	5,839.22	5,424.82	84.03	227.4	11,575.47
Wholesale trade business	5,133.92	4,227.02	38.58	99	9,498.52
Support activities for oil and gas operations	4,079.06	5,169.98	219.02	728.5	10,196.56
Drilling oil and gas wells	1,411.91	2,220.61	99.81	101.9	3,834.23
Extraction of oil and gas	966.17	5,929.53	200.34	163.3	7,259.34
Retail stores (food and beverage)	1,069.84	1,050.97	53.4	100.6	2,274.81
Architectural, engineering, and related services	598.5	2,872.7	1.9	142.9	3,616
Transport by truck	1,262.2	989.6	38.5	137	2,427.3
Motor vehicle parts manufacturing	145.8	86.2	27	106.3	365.3

Source: IMPLAN (2008).
Note: Shaded sectors rank in the top five employment sectors for each county.

According to the BLS, in October 2010 the unemployment rate was 8.1 percent in the state of Texas, 7.4 percent in the city of Odessa, and 5.1 percent in the city of Midland (BLS 2010a). In May 2009, the state average hourly wage was $19.76 with an average annual wage of $41,100 (BLS 2010b). In the construction industry, the average hourly wage of workers was $17.12 with an average annual wage of $35,610 (BLS 2010b).

Taxes and Revenues

There is no individual income tax in Texas; the state does levy sales, luxury, estate, and corporate income taxes. Only those revenues that are reported by the state or federal government (e.g., income and sales taxes.) were considered for this analysis. Revenue information was gathered at the county level.

Sales taxes apply to the retail sale of personal property or services in the state. Texas levies a 6.25 percent general sales (transaction privilege) tax on consumers, which is just above the national average of 5.4 percent.

Property taxes are levied by school districts, cities, counties, and special districts in Texas. Table 3.35 illustrates the total property tax rate for each county and revenues received for the 2009 calendar year. Total revenue collected from property taxes in 2009 for the ROI was $78.99 million.

Table 3.35. 2009 County Property Tax Rates and Revenues

Jurisdiction	Total 2009 Tax Rate	Revenue ($)
Ector County	0.358000	34,108,383
Midland County	0.211805	24,620,026
Crane County	0.312580	6,646,236
Ward County	0.789900	13,618,287
ROI Total		**78,992,932**

Source: Texas Comptroller of Public Accounts (2009a).

According to the State Comptroller's Office, property taxes in the region are paid into one of three county government general funds: the general fund, the farm-to-market roads and flood control fund, and the road and bridge fund. Table 3.36 shows the tax rates and revenue paid into the three funds in 2008 for each county.

Table 3.36. 2008 County General Fund, Farm-to-Market Roads and Flood, and Bridge Revenues

Jurisdiction	General Fund Tax Rate (%)	General Fund Revenue ($)	Farm-to-Market Tax Rate (%)	Farm-to-Market Control Revenue ($)	Road and Bridge Tax Rate (%)	Road and Bridge Revenue ($)	Total ($)
Ector County	3.5	34,267,631	0.0	0	0.0	0.0	34,267,631
Midland County	2.1	23,489,746	0.0	0	0.0	0.0	23,489,746
Crane County	2.8	6,537,898	0.3	719,126	0.0	0.0	7,257,024
Ward County	6.3	12,043,109	0.3	566,225	0.0	0.0	12,609,334
ROI Total		**76,338,384**		**1,285,351**		**0.0**	**77,623,735**

Source: Texas Comptroller of Public Accounts (2008).

As shown in Table 3.36, Ector County collected $34.26 million in property taxes in 2008, Midland County collected $23.49 million, Crane County collected $7.26 million, and Ward County collected $12.61 million.

3.12.5 Environmental Impacts of Summit's Proposed Project

3.12.5.1 DEMOGRAPHICS

During the construction phase of the project (2011–2013), an annual average of 200 workers would be needed in 2011, with a peak of 300 workers; an annual average of 700 in 2012, with a peak of 1,050 workers; and an annual average of 1,000 in 2013, with a peak of 1,500 workers. According to the IMPLAN model used to estimate economic impacts to the ROI from construction of the TCEP, almost all of the workers needed for construction would currently live in the ROI. Therefore, during the construction phase, there would be no impacts to existing population levels.

During the operations phase (with a lifespan of at least 30 years and possibly up to 50 years), 150 workers would be needed on an annual basis. For the purpose of this analysis, it is assumed that TCEP workers would be equally distributed throughout three primary industries: 50 workers in electricity production, 50 workers in urea manufacturing, and 50 workers in CO_2 manufacturing. According to the IMPLAN model used to estimate economic impacts to the ROI from the operation of the TCEP, approximately 26.8 percent (13 workers) of the electricity production workforce would live in the ROI. The remaining 73.2 percent of workers (37 workers) would be highly skilled workers who were not necessarily available from the workforce in the ROI. These workers would likely commute or relocate to the ROI from areas outside the ROI. Assuming that all 37 workers relocated to the ROI with an average family size of four, this would result in a 0.05 percent increase in overall population. The IMPLAN model also estimated that all of the workers needed for the urea manufacturing and CO_2 manufacturing processes would live in the ROI, resulting in no impacts to existing population levels.

3.12.5.2 HOUSING

During the construction phase, it is expected that all workers would live in the ROI and continue residing in their existing homes. For this reason, no impacts to housing would be expected during construction.

During the operations phase, 37 new workers from outside the ROI would be expected to fill highly skilled positions. These workers would either commute from their current residences (assumed to be outside the ROI) or relocate to the area. Assuming that all of the workers relocated to the ROI, the existing housing supply shown in Table 3.32 would be adequate to support this increase. Because housing is expected to be available, impacts to existing home prices as a result of potential relocations would be negligible.

3.12.5.3 ECONOMICS

Impacts to economic factors, which include GDP, industry employment, and taxes and revenues, are discussed below. To remain consistent with data presented in 3.12.3.3, IMPLAN estimates using 2008 dollars were calculated.

Gross Domestic Product for the Region of Influence

GDP is the measure of economic contribution of an industry to the regional economy, or the net of the intermediate goods and services used. Indirect GDP consists of value added by other industries that would be used to support the TCEP, such as construction materials to build the polygen plant. Induced value added would occur through the respending of income received by the TCEP into the local and regional economies (IMPLAN 2008).

As shown in Table 3.37, total GDP for the construction of the project in 2011 would be $24.15 million, representing a 0.1 percent increase in GDP for the ROI in 2008. In 2012, total GDP would be $84.53 million, increasing the GDP for the ROI by 0.5 percent. In the final year of construction in 2013, total GDP would be $120.75 million, representing a 0.7 percent increase in the ROI.

Table 3.37. Total TCEP Gross Domestic Product per Year

Year	Direct GDP ($)	Indirect GDP ($)	Induced GDP ($)	Total GDP ($)
2011 construction	15,098,475	4,356,725	4,696,404	24,151,604
2012 construction	52,844,665	15,248,538	16,437,411	84,530,614
2013 construction	75,492,378	21,783,626	23,482,017	120,758,021
Annual operation	15,529,632	20,848,191	5,406,630	41,784,453

Source: IMPLAN (2008).

During the operations phase, the total GDP per year would be $41.78 million (an increase of 0.2 percent to the ROI). Because the life of the project would be between 30 and 50 years, total GDP from the TCEP would be long term and beneficial for the region.

Given the proximity of Penwell to the polygen plant, it is possible that the project could have a favorable impact to the town's economy. However, this is largely dependent on the location of the main operational entrance and whether it will run through the town (Crutcher 2010). If the entrance is through Penwell, it is possible that a convenience store or restaurant may be constructed (Crutcher 2010).

Industry Employment

Total employment would vary by year. In 2011, an annual average of 200 workers would be needed, 700 in 2012, and 1,000 in 2013. For the purpose of this analysis, the annual average number of annual workers from the ROI was used to run an IMPLAN model to assess economic impacts during construction.

As previously stated, the IMPLAN model estimated that all construction workers would reside in the ROI. During the operations phase, the IMPLAN model estimated that, of the 150 workers needed for TCEP operations, 37 electrical production workers would need to be highly skilled. The model also predicted that these highly skilled workers would not be available from the workforce in the ROI. Thus, it is assumed that these highly skilled workers would reside outside the ROI and would have no positive economic impact in the ROI. The other 113 workers needed for electricity production and urea and CO_2 production would live in the ROI and thus would have a positive economic impact in the ROI (Table 3.38).

Table 3.38. Total Employment per Year

Year	Number of Workers	Indirect Employment	Induced Employment	Total Employment
2011 construction	200.0	43.6	64.2	307.8
2012 construction	700.0	152.7	224.9	1,077.6
2013 construction	1,000	218.1	321.2	1,539.3
Annual operation	113.4	132.1	74.0	319.5

Source: IMPLAN (2008).

Although the overall impacts would be beneficial, total employment from each phase of construction and the operation phase would have a negligible effect on total employment in the ROI. During the operations phase, additional employment would account for less than a 0.07 percent increase in employment. The construction and operation phases of the TCEP would have a negligible effect on income levels in the ROI.

Taxes and Revenues

Numbers presented below include estimated household tax and corporation tax by year and phase. Household tax is associated with the estimated sales tax paid by households (IMPLAN 2008). Corporation tax is associated with the production of the goods and services, the generation of incomes by production, the subsequent distribution and redistribution of incomes among institutional units, and the use of incomes for purposes of consumption or saving (IMPLAN 2008). As shown in Table 3.39, total revenue from state and local taxes for the construction phase would be \$0.19 million in 2011, \$0.68 million in 2012, \$0.97 million in 2013, and \$0.36 million during the operations phase. For 30 years of operation, total revenue from taxes could be \$10.8 million. This would have beneficial and long-term impacts to the region as revenue would be redistributed to counties, which in turn would allocate and redistribute revenue to local communities.

In 2009, House Bill 469 was enacted to provide an annual exemption for state franchise tax (up to a cumulative limit of \$100 million) for the first three projects that qualify as “clean energy projects,” primarily by using coal for fuel, capturing 70 percent or more of carbon emissions, and using the captured CO_2 for EOR if the EOR operation is certified by the Texas Bureau of Economic Geology as meeting requirements for CO_2 MVA. If a project proponent elects to receive this franchise tax exemption and qualifies for it, it must pay the Texas Bureau of Economic Geology a total of \$8 million or some agreed other amount to devise, implement, and monitor compliance with the MVA program. The franchise tax would otherwise equal 0.5 percent of the gross receipts of sales of products by the clean energy project. The same legislation exempts from sales tax any equipment used for the capture, compression, and transportation of equipment used for CO_2/EOR.

The proposed TCEP may be eligible for the state franchise exemption. In addition, the proposed project includes some equipment that would be included in the sales tax exemption. Further, the TCEP would be eligible for accelerated depreciation under normal tax law principles to the extent it is considered primarily a chemical plant by virtue of its production of urea and captured CO_2.

In terms of local taxes, Summit would apply for customary local property and other tax exemptions, which, if granted by local authorities, would be temporary in nature (typically limited by statute to 10 years of abatement).

Table 3.39. State and Local Taxes

Phase	Households ($)	Corporation ($)	Total ($)
2011 construction	128,270	66,525	194,795
2012 construction	448,945	232,838	681,783
2013 construction	641,350	332,626	973,976
Annual operation	147,673	212,301	359,974

Source: IMPLAN (2008).

As shown in Table 3.40, a total of $0.99 million in indirect state and local business taxes would be generated in the TCEP construction phase in 2011, a 0.07 percent overall increase in indirect regional taxes. In 2012, revenue generated through indirect business tax would be $3.46 million (0.2 percent increase in overall indirect regional taxes), $4.94 million in 2013 (0.3 percent increase), and $3.53 million for each year of operations (0.2 percent increase).

Table 3.40. State and Local Indirect Business Taxes

Phase	State and Local ($)
2011 construction	989,234
2012 construction	3,462,318
2013 construction	4,946,169
Annual operation	3,532,786

Source: IMPLAN (2008).

3.12.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. Impacts to socioeconomic resources as a result of the proposed TCEP would be minor and, in general, beneficial. For that reason, additional mitigation measures for socioeconomic resources not were developed.

3.13 Environmental Justice

3.13.1 Background

This section identifies and describes the potential for environmental justice impacts to result from the construction and operation of the polygen plant and linear facilities. Environmental justice is defined as the fair treatment and meaningful involvement of all people—regardless of race, ethnicity, or income level—in environmental decision making. Environmental justice programs promote the protection of human health and the environment, empowerment by means of public participation, and the dissemination of relevant information to inform and educate affected communities. The section also presents the environmental impacts of the proposed project and the No Action Alternative.

Executive Order 12898 (February 11, 1994) and its accompanying memorandum require that "each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Council on Environmental Quality 1997).

3.13.2 Region of Influence

The ROI for the environmental justice analysis is Ector, Midland, Crane, and Ward Counties. These are the counties in which the proposed polygen plant and associated linear facilities would be located and in which DOE expects almost all construction and operations workers would live. The same ROI was used for the socioeconomic impacts analysis.

3.13.3 Methodology and Indicators

The methodology for this analysis included assessing the presence and percentage of minority populations and/or low-income populations in the ROI and determining whether those communities would experience disproportionately high and adverse impacts as a result of the TCEP. U.S. Census Bureau data for 2000 at the census tract level were used to determine presence of these populations in the ROI. Once available, 2010 U.S. Census Bureau data will be used to determine potential impacts to environmental justice populations. Figure 3.28 shows the areas and census tracts used in the analysis.

Environmental justice populations may exist in definable communities, or they may be dispersed among other populations but in higher concentrations than in either the county or state as a whole. When assessing whether a proposed action would have disproportionately high and adverse impacts, one part of the analysis focuses on whether the project's impacts would be greater in areas having higher concentrations of minority members or low-income people. Criteria to assess environmental justice issues are outlined below.

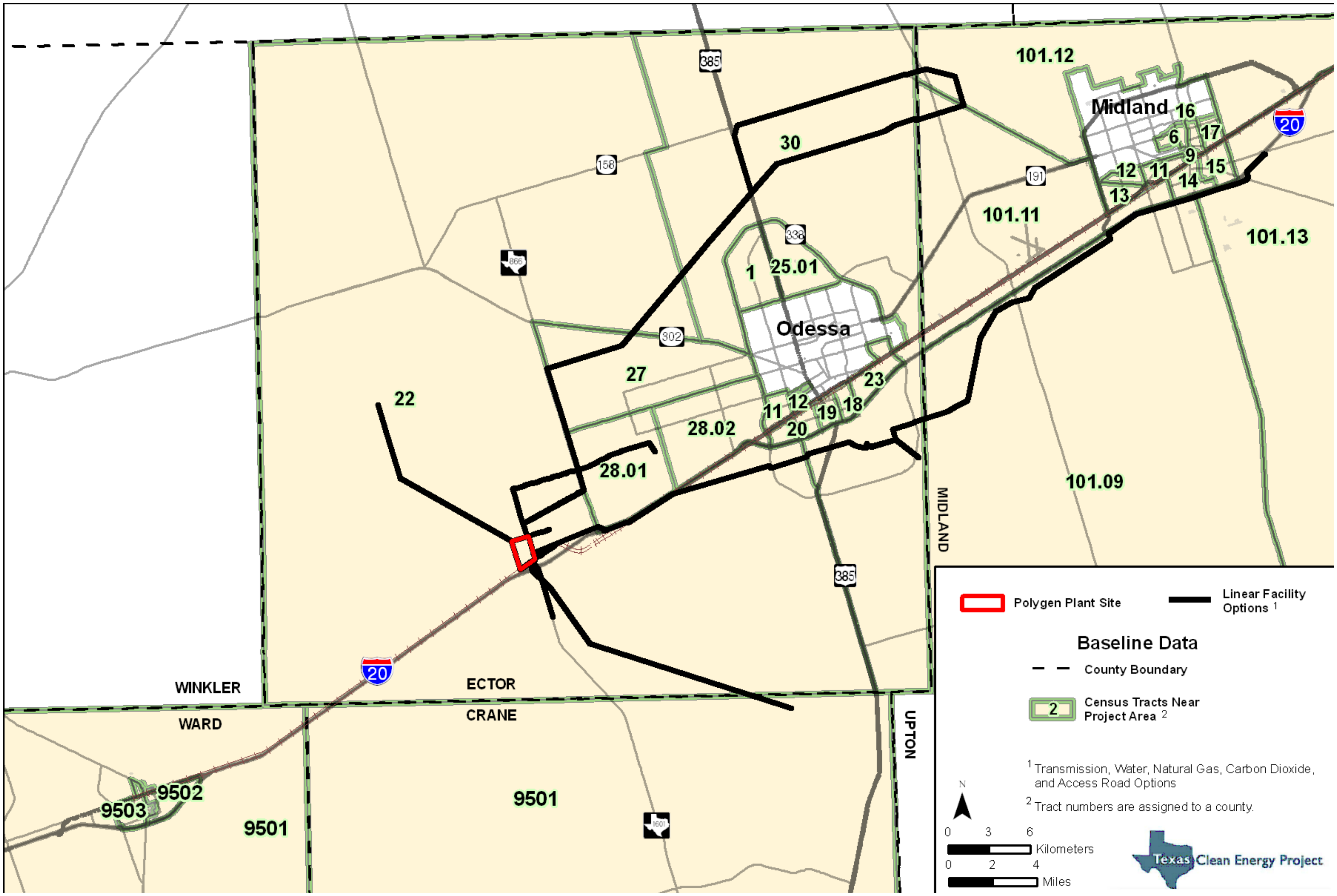

Figure 3.28. Census tracts in the region of influence.

Definition of Minority Populations

Minority populations are defined as follows:

- Minority: Individual(s) classified by Office of Management and Budget Directive No. 15 as Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other nonwhite persons.
- A minority population exists where either
  - the minority population of the affected area exceeds 50 percent; or
  - the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

Definition of Low-income Population

Low-income populations in an affected area are populations below the annual, statistical poverty thresholds from the U.S. Census Bureau's current population reports on income and poverty. Families and persons are classified by the U.S. Census Bureau as "below poverty level" if their total family income or unrelated individual income is less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under 18 that are present. A low-income population exists where either

- the low-income population of the affected area exceeds 50 percent; or
- the low-income population percentage of the affected area is meaningfully greater than the low-income population percentage in the general population or other appropriate unit of geographic analysis.

Disproportionately High and Adverse Human Health and Environmental Effects

Under Executive Order 12898, when determining whether human health effects are disproportionately high and adverse, agencies must consider the following three factors to the extent practicable:

- Whether the health effects, which may be measured in risks and rates, are significant, unacceptable, or above generally accepted norms (adverse health effects may include bodily impairment, infirmity, illness, or death).
- Whether the risk or rate of hazard exposure by a minority population or low-income population to an environmental hazard is significant and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group.
- Whether health effects occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Similarly, when determining whether environmental effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practicable:

- Whether there is or would be an impact to the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment;
- Whether environmental effects are significant and are or may have an adverse impact to minority populations, low-income populations, or Indian tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and
- Whether the environmental effects occur or would occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

The impacts analysis for environmental justice used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Indicators for the environmental justice analysis are summarized in Table 3.41.

Table 3.41. Indicators of Potential Environmental Justice Impacts

Potential Impact	Impact Indicator
Disproportionate impacts to low-income or minority populations (federal agencies are required to address environmental justice when implementing their respective programs).	Identification of populations considered low income and/or minority in the ROI and that would be adversely affected by the proposed TCEP. Distribution of adverse effects on the above populations.

3.13.4 Affected Environment

3.13.4.1 MINORITY AND/OR LOW-INCOME POPULATIONS IN THE REGION OF INFLUENCE

Minority Communities

There are six census tracts in Ector County (census tracts 11, 12, 19, 20, 22, and 28.01), three census tracts in Midland County (14, 16, and 17), and one census tract in Ward County (9503) in which the minority population exceeds 50 percent. In addition to those census tracts, there are four census tracts in Ector County, six census tracts in Midland County, one census tract in Crane County, and two census tracts in Ward County in which the minority populations exceed the state's minority population of 32 percent. The minority populations are primarily Hispanic or Latino.

Low-income Populations

According to the Current Population Report of 2000, the national poverty rate in 2000 was 11.3 percent (U.S. Census Bureau 2000). In the ROI, all of the census tracts in Ector County, seven census tracts in Midland County (9, 11, 14, 15, 16, 17, and 101.09), one census tract in Crane County (9501), and all of the census tracts in Ward County had at least 50 percent of the population identified as individuals or families living below the national poverty level.

3.13.5 Environmental Impacts of Summit's Proposed Project

This section discusses the potential for disproportionately high and adverse impacts on minority or low-income populations as a result of the construction or operation of the TCEP. Twenty-three of the 26 census tracts in the ROI are minority and/or low-income communities. Eleven of those are located in Ector County (1, 11, 12, 18, 19, 20, 22, 27, 28.01, 28.02, and 30), nine in Midland County (9, 11, 12, 13, 14, 15, 16, 17, and 101.9), one in Crane County (9501), and all three in Ward County (9501, 9502, and 9503).

In terms of air quality, project emissions during construction and operation would not contribute to exceedances of NAAQS and would not be expected to cause significant air quality or human health impacts (Section 3.3.6). No long-term impacts to surface water or ground water from the construction or operation of the TCEP would occur, as discussed in Chapters 3.6 and 3.7, respectively. Construction activities would cause a temporary decrease in the level of service (LOS) on FM 866 because construction activities would use this road for access to the project area (see Section 3.16). Although some decrease in LOS would likely occur as a result of construction of the polygen plant, this decrease would not constitute a disproportionately high and adverse impact. Construction activities would produce increased noise levels from commuter and construction-vehicle traffic, construction-equipment operation, and steam-venting during polygen plant startup (see Section 3.19.4); however, these increased noise levels would not have disproportionately high and adverse effects on minority or low-income communities.

No disproportionately high and adverse impacts as a result of the TCEP's operations would occur to low-income or minority populations. Short-term beneficial impacts could include an increase in employment opportunities and potentially higher wages or supplemental income through jobs created during plant construction.

Both the construction and operation phases of the TCEP would disproportionately affect minority and or low-income communities in regard to housing availability and cost, utility rates, or safety issues associated with increased traffic.

3.13.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. No additional mitigation measures specific to environmental justice would be necessary for the proposed project.

3.14 Community Services

3.14.1 Background

This section describes the existing community services (law enforcement, emergency response, health services, schools, and recreation) and anticipated impacts to those services as a result of construction and operation of the TCEP.

3.14.2 Region of Influence

The ROI for community services is Ector, Midland, Crane, and Ward Counties. These are the counties in which the proposed polygen plant and associated linear facilities would be located and in which DOE expects almost all construction and operations workers would live. The same ROI was used for the socioeconomic impacts analysis.

3.14.3 Methodology and Indicators

DOE used data from county websites and the TPWD website to analyze the potential impacts of the proposed TCEP on local community resources. The impacts analysis for community services used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.42.

Table 3.42. Indicators of Potential Impacts to Community Services

Potential Impact	Impact Indicator
Demands on or effective access to law enforcement, local and regional emergency response entities, and health services; conflict with local and regional plans for law enforcement, emergency response services, and health services	Increase in population as measured against calculated population that existing infrastructure and workforce resources could support
Enrollment in local school system, or conflict with local and regional plans for school system capacity and enrollment	Increase or decrease in school enrollment as measured against calculated capacity of local school system
Impacts to existing recreational areas and facilities such as trail networks or local and regional recreational areas and facilities	Increase or decrease of miles of trail or number of acres in recreational areas Changes in recreational experiences due to noise, light, or air pollution impacts Changes in recreational experience due to visual impacts.
Population changes due to TCEP construction or operation could affect local and regional recreational areas, facilities, and/or trails, such as the Monahans Sandhills State Park	Increase or decrease in visitor use days for recreational areas, facilities, and/or trails

3.14.4 Affected Environment

3.14.4.1 LAW ENFORCEMENT

The Ector County Sheriff's Department, Odessa Police Department, and Midland Police Department provide law enforcement in Ector County. The Sheriff's Department has 201 employees, of which 90 are sworn peace officers (Ector County Sheriff's Office 2010). The Odessa Police Department consists of 170 sworn personnel and 59 civilian personnel. The City of Midland's Police Department has 172 law enforcement officers. Based on 2009 population data, there are approximately 0.5 law enforcement officers per thousand Ector County residents.

The Midland County Sheriff's Department provides law enforcement in Midland County. The Sheriff's Department has 15 patrol deputies (Midland County Sheriff's Office 2010). There are approximately 0.1 officers per thousand Midland County residents.

The Crane County Sheriff's Department and the Crane Police Department provide law enforcement in Crane County. The Sheriff's Department has nine law enforcement officers (Crane County Sheriff's Office 2010), and the Crane Police Department has five law enforcement officers (Crane Police Department 2010). There are approximately 2.2 officers per thousand Crane County residents.

The Ward County Sheriff's Department and the Monahans Police Department provide law enforcement for Ward County. The Sheriff's Department has 17 law enforcement officers, three of whom are reserves (Ward County Sheriff's Office 2010). The Monahans Police Department has 11 officers (City of Monahans 2010). There are approximately 0.001 law enforcement officers per thousand Ward County residents.

3.14.4.2 EMERGENCY RESPONSE SERVICES

In Texas, the Councils of Government are associations of local county governments that work together to solve regional issues and planning needs. Emergency response and fire protection, in particular, are managed by the Councils of Government. All counties in the ROI are members of the Permian Basin Regional Planning Commission's 9-1-1 Program, which also serves 10 other member counties. The 9-1-1 Program is responsible for 911 emergency management throughout the commission's boundaries. The program is used to dispatch ambulances and fire, rescue, and emergency medical personnel from various locations throughout its member counties. There are numerous emergency medical and ambulance services in the ROI, mostly located in Ector and Midland Counties where there are larger and more concentrated populations.

3.14.4.3 FIRE PROTECTION

The Odessa Fire Department provides emergency response support to the city of Odessa and Ector County. The Odessa Fire Department has 165 employees, of which 150 are full-time firefighters. Fire services are provided to Midland County through the Midland Fire Department, which consists of 187 personnel. The Greenwood and Northeast Midland County volunteer departments also serve the area (Fire Department Directory 2010). There is one fire station in Crane County, which is used by the Crane Volunteer Fire Department (Fire Department Directory 2010).

3.14.4.4 HAZARDOUS MATERIALS EMERGENCY RESPONSE

All of the counties in the ROI have hazardous materials units. These units respond and perform functions to handle and control actual or potential leaks or spills of hazardous substances (OSHA 2010).

3.14.4.5 HEALTH SERVICES

There are seven hospitals in the ROI. Three hospitals are in Ector County: Odessa Regional Medical Hospital, Odessa Memorial Hospital, and Medical Center Hospital. Odessa Regional Medical Hospital has 230 beds, Odessa Memorial Hospital has 44, and the Medical Center Hospital has 277 (HealthGrades 2010; Hospital-Data 2010a; Odessa Regional Medical Center 2010). The Midland County Hospital District operates the Midland Memorial Hospital, which has 321 beds (Hospital-Data 2010b). The Crane County Hospital District and Crane County Rural Health Clinic serve the residents of Crane County with 28 beds (Hospital-Data 2010c). Lastly, Ward County has one hospital, the Ward Memorial Hospital, which has 49 beds (Hospital-Data 2010d).

3.14.4.6 SCHOOLS

School districts in the ROI are the Ector County Independent School District (ISD) in Ector County, the Greenwood ISD and Midland ISD in Midland County, the Crane ISD in Crane County, and the Monahans-Wickett-Pyote ISD, Pyote ISD, Grandfalls-Royalty ISD, and Pecos-Barstow-Toyah ISD in Ward County. Table 3.43 provides a summary of each district's educational statistics.

Table 3.43. 2009–2010 School Enrollment

County	District	Enrollment in 2009	Number of Schools
Ector	Ector County ISD	27,435	2 early education centers 25 elementary schools 6 junior high schools 2 high schools **Total: 35 schools**
	Private schools	n/a	0 schools
Midland	Greenwood ISD	1,652	1 primary school 1 intermediate school 1 middle school 1 high school **Total: 4 schools**
	Midland ISD	21,466	26 elementary schools 12 secondary schools **Total: 38 schools**
	Private schools	n/a	7 schools
Crane	Crane ISD	1,006	1 elementary school 1 middle school 1 high school **Total: 3 schools**

Table 3.43. 2009–2010 School Enrollment

County	District	Enrollment in 2009	Number of Schools
	Private schools	n/a	n/a
Ward	Monahans-Wickett-Pyote ISD	1,983	2 elementary schools 2 middle schools 2 high schools **Total: 6 schools**
	Grandfalls-Royalty ISD	123	Prekindergarten to grade 12 **Total: 1 school**
	Pecos-Barstow-Toyah ISD	2,198	1 kindergarten 2 elementary schools 1 middle school 1 high school **Total: 4 schools**

Source: Texas Education Agency (2010).
Note: n/a = not available.

As shown in Table 3.43, Ector County ISD has the highest enrollment in the ROI at 27,435 students followed by Midland ISD with 21,466 students, and Grandfalls-Royalty ISD in Ward County has the lowest at 123 (Texas Education Agency 2010).

3.14.4.7 RECREATION

In the ROI, there are 80 county and city parks that offer recreational opportunities to nearby residents. In Ector County, there are 30 parks that are located in Odessa and one located in Douro. There are 49 county parks in Midland County and one county park in Crane County.

The closest recreation area to the proposed polygen plant site is the Penwell Knights Raceway, an active public drag strip located along FM 1601 on the south side of I-20, approximately 0.8 mi (1.3 km) southeast of the proposed plant site in Ector County. The 3,840-ac (1,554-ha) Monahans Sandhills State Park is located approximately 15 mi (24 km) from the proposed polygen plant site in Ward and Winkler Counties. Recreational activities in the park include camping, hiking, and sand surfing. Monahans Sandhills State Park hosts approximately 25,000 visitors per year and provides recreational infrastructure such as developed campsites, a mile-long hiking trail, shaded picnic areas, and an interpretive visitor's center.

3.14.5 Environmental Impacts of Summit's Proposed Project

3.14.5.1 LAW ENFORCEMENT

DOE assumes that all workers for the construction phase of the TCEP would already reside in the ROI. For the operations phase, DOE assumes that most of the workers would be from the ROI and those who were not would commute or relocate to the ROI. Thus, construction and operation of the

TCEP would result in a very small increase in population (0.05 percent) over current levels; for this reason, no impacts to the capacity of local law enforcement would occur.

3.14.5.2 EMERGENCY RESPONSE SERVICES

It is estimated that during the three-year construction period of the TCEP, there would be 91.65 recordable nonfatal incidents and no (0.19) fatalities (see Section 3.18). During operations, it is estimated that there would be 5.25 nonfatal recordable incidents occurring annually and no (0.01) fatalities. Based on the number of emergency response agencies throughout the ROI, and in particular in Ector County, the proposed polygen plant and linear facilities would be adequately served in an emergency during the construction and operations phases of the project. In addition, a very small increase in the existing population as a result of potential workers relocating to the ROI for the TCEP operation phase would have a negligible impact to demand for these services.

As a result of the TCEP, there would be an increase in traffic to and from the proposed site due to commuters for both the construction and operation phases, as well as the transport of potable water and construction materials during the construction phase. There would be an increase in traffic volume, and as a result, potential delays in emergency response time could occur ranging from three to five minutes (see Section 3.18).

3.14.5.3 FIRE PROTECTION

Although incidents that require fire protection services could occur during the construction or operation of the proposed polygen plant, the TCEP would have its own on-site fire protection capability. Any of the local fire departments would also be able to assist in a fire emergency if needed. The very small potential increase in population due to worker relocation to the ROI for the TCEP operation phase would have a negligible impact to demand for fire protection services.

3.14.5.4 HAZARDOUS MATERIALS EMERGENCY RESPONSE

The TCEP would also have its own on-site hazardous materials emergency response capability. Any incidents that may occur at the proposed polygen site would not increase the demand of existing hazardous materials units in the area. Hazardous materials units from counties in the ROI would be able to assist in an emergency if needed.

3.14.5.5 HEALTH SERVICES

Hospitals close to the proposed polygen site include Odessa Regional Medical Hospital, Odessa Memorial Hospital, Medical Center Hospital, and Midland Memorial Hospital. Should injuries occur as a result of the TCEP during the construction or operation phases, there would be enough beds and availability of medical facilities to assist in an emergency. The very small increase in population expected as a result of TCEP operations would not affect the capacity of health services in the ROI.

3.14.5.6 SCHOOLS

As noted above, all construction workers would reside in the ROI. DOE also assumes that most operations workers would reside in the ROI and that a few would commute from areas outside the ROI or relocate to an area in the ROI. However, any increases to the existing population resulting from TCEP operations would be negligible. For this reason, only a very small increase in school enrollment would be expected in the ROI, and no increased burden on the school systems is anticipated.

3.14.5.7 RECREATION

Any increase in the population of the ROI as a result of the TCEP would be negligible; therefore, population-related impacts to recreation (including nearby city, county, and state parks, as well as the Penwell Knights Raceway) are not anticipated. Due to the distance of Monahans Sandhills State Park from the polygen plant site and the expectation of no project-induced changes in local or ROI population, the recreational experience is not expected to be affected.

3.14.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. Because no impacts would occur, no additional mitigation measures specific to community services would be necessary.

3.15 Utility Systems

3.15.1 Background

This section identifies utility systems that may be affected by construction and operation of the proposed polygen plant and related linear facilities. It addresses the ability of the existing utility infrastructure to meet the needs of the proposed TCEP without interrupting services provided to existing users. The section also addresses the potential for construction-related impacts to existing utility infrastructure.

3.15.2 Region of Influence

The ROI for utility systems consists of 1) the existing infrastructure that provides process and potable water, sanitary waste water treatment, electricity, CO_2, and natural gas to nearby existing users and that would provide service to the proposed project; and 2) the pipelines, transmission lines, and other utility lines that lie within or cross the proposed polygen plant site or linear facilities. This existing infrastructure is or would be located in Ector, Midland, Crane and Ward Counties.

Utility systems for potable water are not addressed because potable water would be supplied by truck. Similarly, utility systems for fire suppression are not addressed because such requirements would be met by process water stored on-site, and industrial and sanitary waste water systems are not addressed because such wastes would be managed on-site.

3.15.3 Methodology and Indicators

DOE compared the expected TCEP utility needs to the existing utility infrastructure capacity to determine if the proposed project would strain any of the existing systems. DOE also identified the presence of utility infrastructure that could be affected by project construction using aerial photography, pre-existing studies, Public Utility Commission of Texas regulations and data, and TCEP conceptual design reports. The pre-existing studies include the Environmental Information Volume and EIS documents prepared for the FutureGen EIS (DOE 2007).

The impacts analysis for utility systems used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.44.

Table 3.44. Indicators of Potential Impacts to Utility Systems

Potential Impact	Impact Indicator
Potential uses that could exceed current capacity of utility systems, that would require system upgrades, or that would affect other utility users	Capacity quantities
Temporary failure/impacts to utilities due to direct contact with existing infrastructure during construction	Acreage areas associated with construction only

All routing options for the process water and transmission line linear facilities and the natural gas and CO_2 pipelines were considered.

3.15.4 Affected Environment

The proposed project area is located in a rural area where land use has historically been and currently is dominated by oil and gas activities and cattle ranching. Some existing utility systems in the ROI have been in place for many years. More recently, newer systems have been constructed in response to continued development in the region. Combined, these utility systems serve the needs of the Odessa–Midland area, as well as oil and gas operations throughout West Texas.

3.15.4.1 PROCESS WATER

Existing water sources in West Texas are used for a variety of activities related to oil and gas activities and agriculture and livestock use. No water pipelines are currently located on the proposed polygen plant site.

Process water required for the TCEP, as illustrated on Figure 2.7 in Chapter 2, could come from the following three potential sources:

- The primary water source would be treated effluent from the GCA Odessa South facility. Much of the water provided by GCA would be made up of waste water received at the GCA Odessa South Facility from the City of Midland Wastewater Treatment Plant. This water source, which would be used by WL1, would make beneficial use of treated effluent and would not use any other surface or ground water sources.
- WL2 would receive brackish ground water from the existing Oxy Permian company.
- WL3 and WL4 would receive slightly brackish ground water from the proposed FSH water mainline, which is proposed to be built from Fort Stockton to the Odessa–Midland area.

Existing conditions for each water supply system are described below.

The City of Midland Wastewater Treatment Plant currently provides primary treatment to the city's effluent prior to land application on agricultural fields. The treatment plant treats approximately 10 million gal (37.8 million L) per day on average (Womack 2010). The current maximum capacity of the waste water treatment plant is 21 million gal (79 million L) per day (City of Midland 2011). Treated effluent is currently pumped to city-owned agricultural lands approximately 15 mi (24 km) away and is applied through several center-pivot irrigation systems to hayfields on two farms, the Plant Farm and the Spraberry Farm. The city pays for the fields to be cultivated and the hay to be harvested (Summit 2010c). The effluent farm is currently permitted to handle up to 20 million gal (75 million L) per day of waste water (City of Midland 2011).

The GCA Odessa South Facility uses an activated sludge treatment process to treat both municipal sewage from the city of Odessa (approximately 2.0 million gal [7.5 million L] per day) and industrial waste water (GCA 2010). GCA's current capacity (as limited by its discharge permit) is 7.0 million gal (26.5 million L) per day; on average, the plant treats 2.0 million gal (7.5 million L) per day (Summit 2010c). GCA has a minimum required discharge rate of approximately 2.0 million gal (7.5 million L) per day into Monahans Draw. GCA currently has no water reuse customers; all treated effluent is currently discharged into Monahans Draw. The Oxy Permian water supply system is a network of pipelines providing ground water from a well field near the town of Kermit, Texas, for EOR water flood projects in the Permian Basin. Ground water from this source, the Capitan Reef Complex Aquifer, is brackish and would require additional treatment prior to use for the TCEP. In the 1960s, this aquifer was capable of producing at a rate of 25.2 million gal (95.4 million L) per day; however, with the significant reduction in demand for water flood make-up water in the oilfields of West Texas, heavy demand no longer exists (Smith 2010).

Currently in the developmental stage, the main FSH waterline project has been proposed to provide drinking water to the cities of Midland and Odessa. The TCEP could use approximately 10 percent of the total water that would be available through the FSH water mainline, if it were built. The FSH water source would be ground water from the Edwards-Trinity (High Plains) Aquifer located near the city of Fort Stockton, which is approximately 66 mi (106 km) southwest of the proposed TCEP area. FSH is permitted to pump up to 14 billion gal (54 billion L) or 44,100 ac-ft per year (Thornhill Group, Inc. 2008). The water that would be used by the TCEP is currently used for irrigation and would come from the water that is already being used for irrigation. This source would also require additional treatment prior to use for the TCEP.

3.15.4.2 TRANSMISSION LINES

There are no transmission lines located on the proposed polygen plant site. Power produced by the TCEP could go to the following two potential market sources:

- ERCOT, which manages the flow of electric power to 22 million Texas customers, including the Odessa–Midland area. ERCOT is one of nine regional electric reliability councils under North American Electric Reliability Corporation authority.
- SPP, which is a regional transmission organization that provides service to more than 370,000 mi^2 (595,457 km^2), including portions of Texas. SPP is also one of nine regional electric reliability councils under North American Electric Reliability Corporation authority.

The need for upgrades to the existing transmission grid to handle the additional power from the TCEP will be determined by interconnection studies currently be conducted.

Information regarding the capacity of the existing transmission systems to carry the power from the TCEP is not currently available and is the subject of ongoing transmission line routing and compatibility studies.

Oncor is the primary transmission and utility distribution company in the ERCOT market. TL1 through TL4 would interconnect with existing Oncor transmission lines located 9.3 mi (15.0 km), 8.6 mi (13.8 km), 2.2 mi (3.5 km), or 0.6 mi (1.1 km) away from the proposed polygen plant site, respectively. Competitive Renewable Energy Zones for the development of wind power have been designated in areas of Texas's ERCOT system. Under TL4, the proposed TCEP would interconnect with a 138-kV line located approximately 0.6 mi (1.1 km) north of the proposed plant site. Because this existing transmission line has been designated as a Competitive Renewable Energy Zones support transmission line (Public Utility Commission of Texas 2010), the compatibility of TL4 with Competitive Renewable Energy Zones–supported transmission lines is currently being evaluated as part of the transmission line routing and compatibility studies being conducted by Oncor.

Transmission lines maintained by Southwestern Public Service Company (a subsidiary of Xcel Energy) that offer connection to the SPP market are located 36.8 mi (59.2 km) and 32.8 mi (52.8 km), respectively, from the proposed polygen plant site (TL5 and TL6, respectively).

3.15.4.3 NATURAL GAS PIPELINE

No natural gas pipelines are currently located on the proposed polygen plant site (only connector and spur are present [oil pipelines occur on the proposed polygen plant site]). An existing 24-in (60-cm) natural gas pipeline owned and operated by ONEOK WesTex is located approximately 2.7 mi (4.3 km) south of the proposed polygen plant site; it would be the tie-in point for a natural gas lateral to supply the polygen plant.

The ONEOK WesTex system consists of approximately 2,380 mi (3,830 km) of pipeline of various sizes up to 24 in (60 cm) in diameter. The system operates at pressures up to 1,200 lbs (544 kg) per in^2 gauge and has a peak day capacity of 750 million ft^3 (70 million m^3) per day. The pipeline is connected to major natural gas–producing areas in the Texas Panhandle, Waha Hub, and Permian Basin (ONEOK 2010). The existing ONEOK pipeline has the capacity to supply the needed volume of natural gas required for the project (Randall 2010).

3.15.4.4 CARBON DIOXIDE PIPELINE

No CO_2 pipelines are currently located on the proposed polygen plant site. An existing 24-in (60-cm) CO_2 pipeline owned by Kinder Morgan runs north–south approximately 1.0 mi (1.6 km) east of the proposed polygen plant site. The pipeline is currently operating at a pressure of approximately 2,000 lbs (907 kg) per in^2 with a maximum operating pressure for this section of the pipeline at 2,300 lbs (1,043 kg) per in^2 (Hattenbach 2011). This pipeline begins in northeast New Mexico at Bravo Dome, where there are more than 300 CO_2 wells, and travels south to Texas to support various oil and gas operations throughout the Permian Basin (Kinder Morgan 2010b). As the largest transporter and marketer of CO_2, Kinder Morgan owns interests in CO_2 pipelines that deliver more than 1.5 billion ft^3 (139 million m^3) per day to the Permian Basin, Utah, and Oklahoma (Kinder Morgan 2010b). As part of the TCEP, a CO_2 connector pipeline would be constructed between the polygen plant site and the existing Kinder Morgan CO_2 pipeline. The existing Kinder Morgan CO_2 pipeline has the capacity to accept all of the CO_2 produced by the project (Hattenbach 2011), although injection of additional CO_2 would require Kinder Morgan to balance the inputs and outtakes along the system (Hattenbach 2011).

3.15.5 Environmental Impacts of Summit's Proposed Project

3.15.5.1 CONSTRUCTION

Existing utilities would not be adversely impacted by construction activities at the polygen plant site. No known transmission lines, natural gas transmission pipelines, cables, or sanitary sewer lines or waterlines occur on the proposed polygen plant site; however, several oil and gas collector pipelines and two active wells are present on-site. Summit would work with the owners of the active collector pipelines and active wells to relocate these facilities, as necessary, to avoid interference with the construction and operation of the proposed project.

Existing utilities infrastructure could inadvertently be damaged or have service disrupted during construction of the linear facilities. The ROWs for the linear facilities would include intersections with existing potable water and sewer lines, overhead or buried transmission lines, gas utility lines, fiber optic cables, and other utility system facilities. The potential for inadvertent damage or service disruption during construction would vary based on proposed construction methods and proximity of the proposed linear facility to existing utility systems, but would be greatest during trenching activities.

All linear facility ROWs would be of sufficient width and access to allow for the safe construction of project-related transmission lines and pipelines without interfering with existing utilities. Construction would include controls and prudent construction procedures (e.g., the identification and marking of all existing utility infrastructure in the work areas) to further reduce impacts to existing utilities. Prior to construction, the construction contractor would perform reconnaissance surveys and would record, delineate, and flag the locations of all utility lines in the proposed linear facility ROWs. During construction, controls such as hand digging of trenches in select areas would decrease the potential for construction equipment, particularly trenching equipment, to sever or damage existing underground lines.

Table 3.45 provides a summary of the construction method for each proposed linear facility option, as well as its estimated length and the number of pipelines and transportation ROWs that could be intersected.

Table 3.45. Proposed TCEP Linear Facilities Intersections to Existing Utility Systems

TCEP Linear Facility	Construction Method	Distance (mi [km])	Number of Known Pipeline ROW Crossings*	Number of Transportation ROW Crossings
Process waterline options	Machine trenching would be used in areas that do not intersect existing utility lines.	WL1: 41.2 (66.3)	WL1: 40	WL1: 9
		WL2: 9.3 (15.0)	WL2: 11	WL2: 9
		WL3: 14.2 (22.8)	WL3: 13	WL3: 2
		WL4: 2.7 (4.3)	WL4: 2	WL4: 2
Transmission lines options	No trenching would be required for the overhead power lines. Individual support towers would require small excavations for the foundations of towers.	TL1: 9.3 (15.1)	TL1: 15	TL1: 3
		TL2: 8.6 (13.8)	TL2: 13	TL2: 3
		TL3: 2.2 (3.5)	TL3: 4	TL3: 0
		TL4: 0.6 (1.0)	TL4: 2	TL4: 0
		TL5: 36.8 (59.2)	TL5: 44	TL5: 12
		TL6: 32.8 (52.8)	TL6: 41	TL6: 14
CO_2 pipeline	Same as process water supply pipeline.	1.02 (1.6)	4	3
Natural gas pipeline	Same as process water supply pipeline.	2.7 (4.3)	5	0

Table 3.45. Proposed TCEP Linear Facilities Intersections to Existing Utility Systems

TCEP Linear Facility	Construction Method	Distance (mi [km])	Number of Known Pipeline ROW Crossings*	Number of Transportation ROW Crossings
Access road/rail spur	Entirely in proposed ROW. AR1 follows an existing transportation ROW; AR2 and RR1 would require new ROWs. Roads would be constructed per county standards and would be paved. Construction would include cut and fill.	AR1: 0.03 (0.05) AR2: 3.7 (6.0)	AR1: 3 AR2: 14	AR1: 0 AR2: 1

*Based on proposed linear facility temporary ROW width of 100 ft (30 m).

Because electric power transmission lines are suspended over the land surface, there would be fewer impacts to existing utility systems, even with the required construction for the support towers. Existing utility systems would be taken into account during planning of the alignments.

3.15.5.2 OPERATIONS

Polygen Plant Site

Existing utilities would not be adversely impacted by operation activities at the polygen plant site. The brine concentrator and filter press option may require the greatest use of electricity, depending on the choice of equipment, as waste heat from the power plant could be used to crystallize the salts. The solar evaporation ponds would require the least use of electricity. The wet cooling tower option would have a lower electricity demand than the dry cooling tower option. Additionally, the wet cooling tower option may potentially require a larger water supply pipeline than currently proposed under the various waterline options.

Process Water Options

Waterline Option 1

Under this option, treated sanitary effluent from the City of Midland Wastewater Treatment Plant would be piped to the GCA Odessa South Facility and ultimately to the polygen plant.

Impacts to the City of Midland Wastewater Treatment Plant

Discussions with the City of Midland indicate that there is an adequate available volume of effluent to supply the total process water needs for the proposed project without impacting the City of Midland Wastewater Treatment Plant (CH2M Hill 2010). The city currently disposes of treated effluent through application on city-owned effluent farms. It is currently unclear if the city would continue to reserve a portion of treated effluent for this practice, although both the treatment plant and the two effluent farms have considerable more capacity than is currently being used (see Section 3.15.4.1). Providing Midland's treated effluent to the TCEP would permit the city to continue to operate without a discharge permit and potentially reduce or eliminate the costs of maintaining the agricultural activities associated with current effluent disposal.

Impacts to the GCA Odessa South Facility

The GCA Odessa South Facility has a treatment capacity of 7.0 million gal (26.5 million L) per day and is currently treating 2.0 million gal (7.5 million L) per day, which includes a required discharge of 2.0 million gal (7.5 million L) per day into Monahans Draw. The specific quantity of effluent to be transferred from Midland to the GCA is currently being negotiated by those two entities. The City of Midland has expressed an intention to provide at least an amount that would allow GCA to fully supply the TCEP while not decreasing the current discharge rates into Monahans Draw (Ganze 2011). The process water would come from one of two approaches: 1) a combination of treated effluent from the GCA Odessa South Facility and untreated effluent from the City of Midland Wastewater Treatment Plant, which would be piped to and treated at the GCA Odessa South Facility; or 2) entirely from the City of Midland Wastewater Treatment Plant, which also would be piped to and treated at the GCA Odessa South Facility before being piped to the polygen plant site. Either approach would provide an adequate volume of treated effluent to supply the maximum TCEP water usage demand of 5.5 million gal (20.8 million L) per day while maintaining the current discharge to Monahans Draw of 2.0 million gal (7.5 million L) per day including during drought conditions (Ganze 2011).

Under WL1, all of the process water demands for the TCEP would be supplied by municipal reuse water; no other surface or ground water sources would be used. The GCA Odessa South Facility would be able to make use of more of its full treatment capacity at the Odessa South Facility.

Waterline Option 2

Under this option, water would be piped to the polygen plant from the existing Oxy Permian pipeline system where it would be treated on-site. This option would have no impacts on existing water treatment utility systems.

Oxy Permian has determined it can meet its current water needs while supplying 5.0 million gal (18.9 million L) per day of water to the TCEP with no significant upgrades to their system (Smith 2010). Therefore, there would be no impacts to the system under average or maximum TCEP water usage conditions.

Waterline Option 3

Under this option, water would be supplied from the proposed FSH water mainline. The TCEP would require approximately 10 percent of the expected capacity of the FSH waterline (Brock 2011). Under this option, FSH water would be treated on-site; therefore, this option would have no impacts on existing water treatment utility systems.

Waterline Option 4

Under this option, water from FSH would be piped to the GCA Odessa South Facility for treatment and then piped to the polygen plant. Supplementing GCA process water supply with only enough FSH water to meet the TCEP's needs would result in the same impacts to the GCA Odessa South Facility described for WL1.

Transmission Line Options

TCEP operations would result in approximately 213 MW of electricity entering the power grid, which would provide needed electricity supply to the existing utility system.

Electric Reliability Council of Texas Grid

Summit is working with Oncor to develop an interconnection agreement for the TCEP. A detailed interconnection study is being prepared by Oncor, which will identify any required system improvements necessary to support the interconnection of the TCEP with the existing electric transmission grid (preferred TL4 option). TL4 would require the construction of approximately 0.6 mi (0.9 km) of a 138-kV transmission line and a switching station at the intersection with the existing transmission line. Power provided by the TCEP would help ERCOT's projected load growth. Although the interconnection study has not been finalized, some improvements to the grid may be necessary. The extent of the grid improvements would be refined when the interconnection study is complete.

The interconnection study will provide a preliminary identification of any thermal or voltage limit violations resulting from the interconnection, a preliminary identification of network upgrades required to deliver the proposed generation to ERCOT loads. The interconnection study will assess the current and projected future power flow dynamics of the ERCOT system both with and without the TCEP. The interconnection study will include the most recent information for load, generation additions, transmission additions, interchange, and other pertinent data necessary for analysis.

As part of the interconnection study, ERCOT will determine what upgrades would be required to deliver the output of the project to SPP load customers. Potential infrastructure upgrades may include new and/or upgraded switch stations, upgraded substation at the point of interconnection, upgrading conductors and/or structures on existing transmission lines, and other system infrastructure.

The use of Oncor's transmission line could have indirect impacts to Competitive Renewable Energy Zones projects if the Oncor line does not have additional capacity. Additionally, transmission line projects currently in planning phases could be completed by the time the proposed TCEP is constructed, which would improve the utility system's ability to efficiently move wind and solar-generated electric power to market even further (Oncor 2010). If the planned improvements are completed, no impacts to Competitive Renewable Energy Zones would be expected.

Southwest Power Pool Grid

SPP is currently conducting a similar interconnection study to determine what impacts interconnecting the TCEP under TL5 and TL6 would have on the existing SPP transmission system infrastructure. The interconnection study will evaluate impacts of the TCEP on the overall stability of the existing SPP grid and what system upgrades may be required as a result.

The purpose of the interconnection study is to identify solutions to resolve power flow, stability, and short circuit impacts potentially resulting from the interconnection of the TCEP. In addition, the interconnection study will identify the necessary facilities required to interconnect the new generating plant to the SPP transmission system. The interconnection will also provide estimates of the cost and in-service schedules for these items. The identification of limitations or required network upgrades and an assessment of current and future power flow dynamics would also occur similar to the ONCOR interconnection study.

Natural Gas Pipeline

The TCEP requirement of 2 trillion Btu annually represents approximately 1 percent of the current annual available capacity of the ONEOK WesTex system; thus, no impacts would occur to this system for the operation. If the TCEP were to use natural gas for full electricity dispatch, it would require 17.5 trillion Btu annually. This represents approximately 7 percent of the available current ONEOK WesTex system capacity.

Carbon Dioxide Pipeline

The existing Kinder Morgan CO_2 pipeline has sufficient capacity and line distribution to accept and transport the TCEP's CO_2 to potential customers while simultaneously meeting the needs of existing users (Hattenbach 2011). Therefore, no impacts to the existing CO_2 system would occur.

3.15.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP, including various controls and measures, are described in Table 2.8 in Chapter 2. Because no impacts to existing utility systems would occur, no additional mitigation measures have been developed.

3.16 Transportation

3.16.1 Background

This section discusses the existing roadway and railway infrastructure that would be used during construction and operation of the polygen plant and associated linear facilities. This analysis focuses on the potential short- and long-term impacts that may occur along existing interstate highways, maintained state and county roadways, municipal roadways, and railway lines in the ROI. Based on a traffic analysis conducted as part of the FutureGen EIS (a similar energy project that would have used the polygen plant site and the FM 1601 access route), DOE expects that traffic impacts as a result of the TCEP would be minor. For this reason, a full traffic analysis was not conducted as part of transportation analysis contained in this EIS.

3.16.2 Region of Influence

The ROI for the transportation analysis consists of the primary roads most likely to be used for worker commute and delivery of materials; that is, I-20, FM 866 and FM 1601, as well their exit ramps, frontage roads, or any cross streets that would be used or modified to facilitate that transport.

3.16.3 Methodology and Indicators

The impacts analysis for transportation used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.46.

Table 3.46. Indicators of Potential Impacts to Transportation

Potential Impact	Impact Indicator
Change in daily traffic volume and LOS	Volume of roadway traffic and LOS rating along existing travel ways during construction and operation of the TCEP
Change in daily railroad car volume	Volume of railway traffic along existing travel ways during construction and operation of the TCEP

Roadway LOS is a measure of the capacity road segments and intersections to manage existing vehicle traffic volume. It is determined by consideration of a variety of factors, including the average speed of all vehicles and percent time spent following slower vehicles (that is, the time that vehicles spend in platoons behind slow vehicles due to inability to pass) (TxDOT 2009a).

There are six LOS categories, designated with letters ranging from A to F, with A representing the best driving conditions (free flow, little delay) and F as the worst (congestion, long delays) (Transportation Research Board 2000). LOS A, B, or C are typically considered good operating conditions in which minor or tolerable delays of service are experienced by motorists (Transportation Research Board 2000). An adverse impact would be created if traffic generated by a proposed project increased road traffic enough to degrade the LOS to levels below good operating conditions (i.e., LOS D or worse) or cause increased traffic delays and congestion.

The number of vehicles that travel along a route in a 24-hour period is the average daily traffic, which is not adjusted for trucks or seasonal variations. The AADT includes adjustments for seasonal, weekly, daily, and hourly variations and is calculated as the number of vehicles traveling along a roadway in a year, divided by 365 days.

To assess potential TCEP impacts to the local railways, the change in daily railroad car volume during both construction and operation of the polygen plant was compared to existing conditions. The ability of the existing rail infrastructure to accommodate the increased railroad car volume was assessed. An adverse impact to railroad traffic would be created by any changes to railroad traffic that would cause delays or exceed capacity along the existing railways in region or affect traffic in the region.

3.16.4 Affected Environment

3.16.4.1 ROADWAY SYSTEM

Existing Operating Conditions

Highways and roadways in the ROI would be used to transport materials and workers involved in TCEP construction and operations. Based on TxDOT criteria, these roads are classified as principal arterials, minor arterials, collector roads, and local roads and streets. Principal arterials include federal interstate highways and major state highways whose function is high traffic movement and mobility with limited access. Minor arterials are roadways that connect to or interconnect principal arterials. These roads provide moderate mobility with limited access. Collectors are roads that connect local roads to arterials. They have moderate mobility and moderate access. Local roads and streets are roads that permit access to property and have high access, but limited mobility (TxDOT 2009a).

The primary access roadway to the polygen plant site would be the I-20 corridor, which runs east–west. I-20 has four travel lanes, two in each direction, a posted speed limit of 70 mi (113 km) per hour, and is designated as a Class 1 rural freeway (a principal arterial) by the U.S. Department of Transportation.

FM 1601 and FM 866 would serve as access roads connecting the polygen plant site to I-20. FM 1601 is a two-lane collector road with a posted speed limit of 55 mi (89 km) per hour. This road transects the community of Penwell in a north–south direction. North of I-20, FM 1601 terminates at CR 1216 (Avenue G), located at the southern boundary of the polygen plant site, less than 0.5 mi (0.8 km) from I-20. The intersection is controlled with a stop sign for FM 1601 traffic. To the south, FM 1601 runs under the interstate and continues southward for approximately 25 mi (40 km) until it intersects with State Highway 329. Two-way frontage roads, located on the north and south sides of I-20, allow access to Penwell and FM 1601 from the interstate using two entrance and two exit ramps, with the two exit ramps labeled Exit 101 (Figure 3.29). Traffic is controlled with four-way stop signs where the frontage roads intersect FM 1601.

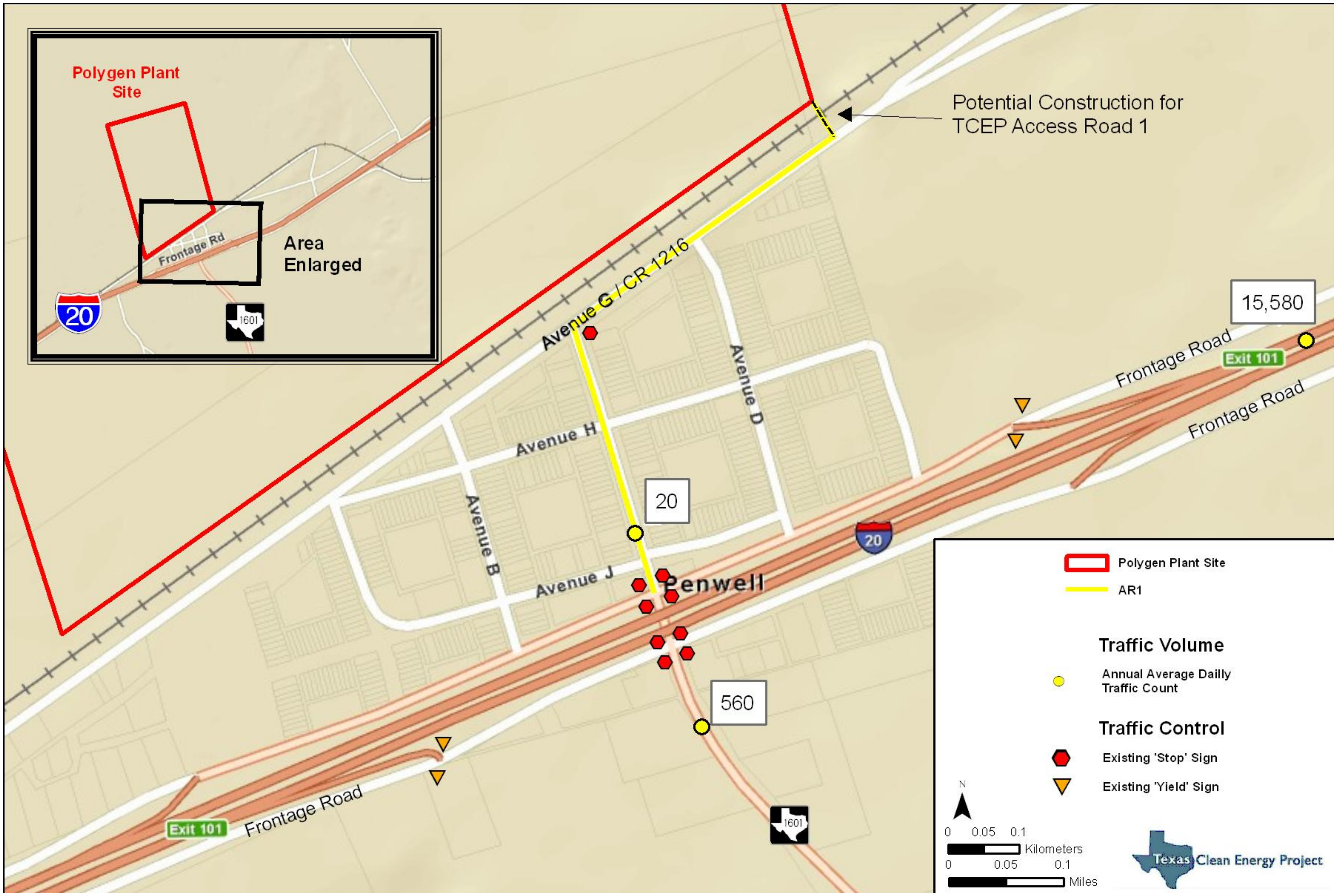

Figure 3.29. Interstate 20 exit, frontage roads, and intersection with Farm-to-Market 1601.

FM 866 is a two-lane collector road with a posted speed limit of 70 mi (113 km) per hour and is located approximately 3.0 mi (4.8 km) to the east of Penwell. FM 866 also runs in a north–south direction. North of I-20, FM 866 terminates at State Highway 158, approximately 16 mi (25 km) from the interstate and near the town of Goldsmith. To the south, FM 866 passes under I-20 and terminates in less than 1.9 mi (1.6 km) at West Murphy Street. Two-way frontage roads, located on the north and south sides of I-20, allow access to FM 866 using two entrance and two exit ramps, with the two exit ramps labeled Exit 104 (Figure 3.30). Frontage road traffic is controlled with two-way stop signs where the frontage roads intersect FM 866.

Traffic Volumes

In 2008, the AADT along I-20 was 16,100 vpd just east of the I-20 and FM 1601 interchange, and 16,700 vpd just east of the I-20 and FM 866 interchange (TxDOT 2009b). Unpublished data provided by TxDOT indicate that the AADT at the Penwell site has since dropped to 15,580 vpd (Carr 2010).

Urban traffic maps published in 2008 report an AADT of 20 vpd on FM 1601 just north of I-20 and 560 vpd south of I-20. An AADT of 200 vpd was reported on CR 1216 (Avenue G) just east of Penwell (TxDOT 2008).

The 2007 published AADT on FM 866 was 1,300 vpd, just north of both I-20 and the north side frontage road and exit ramp (TxDOT 2008). To the south of I-20 and the south side exits and frontage roads, the AADT decreases to 630 vpd. Unpublished data provided by TxDOT indicate that the AADT at northern site has since increased to 1,500 vpd (Carr 2010).

Based on the most current available traffic data, I-20, FM 1601, and FM 866 all operate at LOS A. LOS A describes traffic flow as free-flow traffic when motorists can travel at or above the posted speed limit and they have maneuverability between lanes.

Table 3.47 depicts total traffic volume and LOS for four sites closest to the TCEP proposed access roads.

Table 3.47. Annual Average Daily Traffic Volumes and Level of Service

Roadway	AADT (vpd)	LOS
I-20 east, at Penwell	15,580	A
I-20, east of FM 866 exit	16,700	A
FM 1601 north	20	A
FM 866 north	1,500	A

Sources: TxDOT (2008) and Carr (2010).

3.16.4.2 RAIL SYSTEM

The UPRR would serve the TCEP. The UPRR ROW borders the southern boundary of the polygen plant site and also forms the northern boundary of Penwell. In general, the UPRR line links major West Coast and Gulf Coast ports, as well as serving Mexico, Canada, and the U.S. East Coast through Chicago, St. Louis, Memphis, and New Orleans (Union Pacific Corporation 2010a).

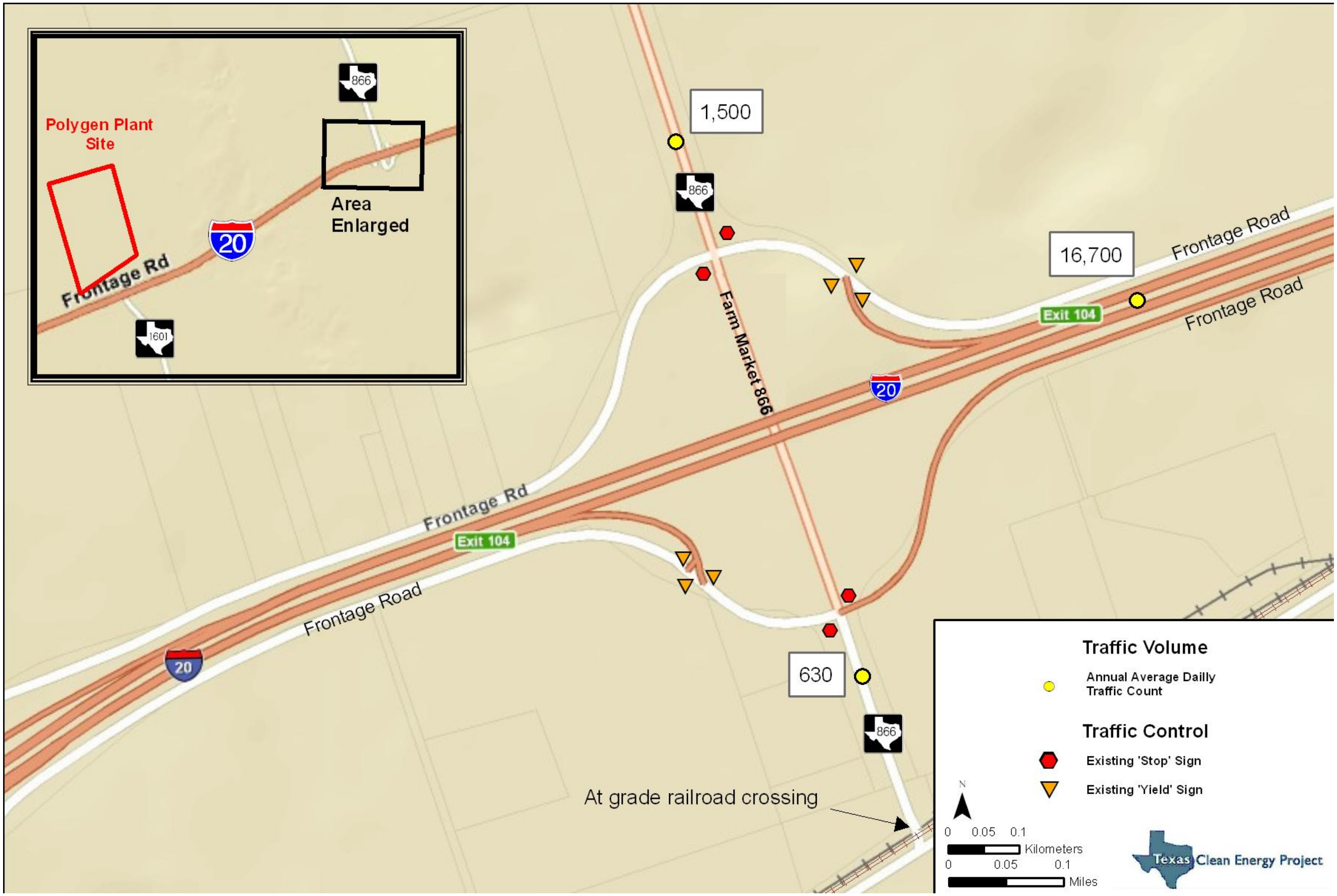

Figure 3.30. Interstate 20 exit, frontage roads, and intersection with Farm-to-Market 866.

Annually, UPRR transports over 200 million tn (181 t) in coal from the Powder River Basin in Wyoming and from other coal fields in Utah, Colorado, and southern Illinois to electric power plants across the nation, West Coast and Gulf Coast ports, and facilities on the Mississippi and Ohio Rivers and Great Lakes (Union Pacific Corporation 2010b). Powder River Basin coal is currently used in power plants located in La Grange, Sudan, Amarillo, Mount Pleasant, Fort Ben County, and Jewitt, Texas. UPRR trains of Powder River Basin coal bound for Texas destinations typically travel on rail lines passing through Wyoming, Nebraska, Kansas, and Oklahoma before reaching Fort Worth, Texas, after which trains are routed to their respective destinations (UPC 2009).

Approximately 1.5 million freight rail tn (1.3 million t) were moved through the Odessa District (a 12-county area covering Andrews, Crane, Ector, Loving, Martin, Midland, Pecos, Reeves, Terrell, Upton, Ward and Winkler Counties) in 2004, with a projected increase of 177 percent by 2025 (HNTB Corporation and TxDOT 2008). The UPRR line is the only Class I railroad (defined as one that carries large freight) and track service providing long distance and interstate fright shipments in the Odessa District, and owns approximately half of the mainline tracks in the district (HNTB Corporation and TxDOT 2008). UPRR is aware of the rail transport needs of TCEP and has included them in its company forecasts (Union Pacific Corporation 2009).

UPRR operates trains through the Odessa area 24 hours per day for the entire year (FG Alliance 2006). Near the polygen plant site, the UPRR rail line operates as a single-track mainline with 17 trains per day, seven days a week (i.e., 119 trains per week) all year (Schelbitzki 2010). There is no scheduled passenger train operation in the Odessa District (HNTB Corporation and TxDOT 2008). On the portion of the UPRR line between the polygen plant and the city of Odessa, there are 25 at-grade crossings. At-grade rail-highway crossings represent a traffic risk and can cause motor traffic delays or contribute to motor traffic bottlenecks depending on location.

3.16.5 Environmental Impacts of the Proposed Project

3.16.5.1 IMPACTS TO ROADWAY TRANSPORTATION

For purposes of this analysis, it was assumed that I-20, connecting to FM 866 at Exit 104, would function as the primary roadway access to the polygen plant (AR2) and that most workers and materials would be coming from the Odessa–Midland area. FM 1601 would function as an alternative route for emergency access (AR1); entrance to the polygen plant site by this route would be regulated by a locked gate. Summit has indicated that the maximum daily vehicular use of the FM 1601 access gate is expected to be approximately 5 percent of total TCEP traffic during construction and operations. All truck traffic would use FM 866.

Construction

Summit estimates that the project would require 26 trucks per day for construction materials during peak construction periods. Table 3.48 shows the maximum traffic increases that could be expected to result from the two-way commute of construction workers and truck traffic during construction of the TCEP. These figures include the estimated truck traffic and are based on an estimated peak yearly employment figures of 300 construction workers during year one, 1,050 construction workers during year two, and 1,500 construction workers during year three. These estimated traffic increases do not take into account carpools, shuttles, or other measures that could be taken by Summit or workers to reduce traffic, and as such, these values represent conservative estimates. For the purposes of this analysis, it is also assumed that most of the construction workers would be present on-site between approximately 7:00 a.m. and 5:30 p.m.

Table 3.48. Potential Traffic Increases During TCEP Construction

Roadway	Current AADT	Projected AADT during Year One Construction (increase [%])	Projected AADT during Year Two Construction (increase [%])	Projected AADT during Year Three Construction (increase [%])
I-20 at Penwell	15,580	15,660 (1)	15,685 (1)	15,730 (1)
I-20, east of FM 866 exit	16,700	17,350 (4)	18,840 (13)	19,750 (18)
FM 866	1,500	2,120 (41)	3,535 (136)	4,400 (193)
FM 1601	20	50 (150)	125 (525)	170 (750)

During TCEP construction, there would be increased traffic volume along I-20, FM 866, and FM 1601 caused by daily construction worker commuting, and trucking of construction materials and waste products into and out of the polygen plant site. Daily traffic volume along I-20 from Odessa to the FM 866 exit would experience a 4–18 percent increase in average daily traffic during the three-year construction period. The increase in the daily traffic volume along I-20 from FM 866 to FM 1601 during the construction period would be approximately 1 percent.

Projected use of FM 866 for 95 percent of total TCEP construction traffic would represent a 41-, 136-, and 193-percent increase over current traffic for Years One, Two and Three, respectively. During periods of higher construction employment, using FM 866 as the primary access route to the polygen plant could result in traffic delays along the exit ramp of I-20 (Exit 104), as traffic slowed to the 30 mi (48 km) per hour exit ramp speed. Upon exiting I-20, ramp traffic would need to merge with the existing traffic on the frontage road (controlled by a yield sign for existing frontage road traffic) but would come to a complete stop at the intersection with FM 866 before turning north. Because this is a two-way stop for frontage road traffic only, existing traffic on FM 866 would not stop to facilitate entry of TCEP traffic onto FM 866. TCEP commuters and truck traffic would also have to turn across opposing FM 866 traffic to enter the polygen plant site access road. Each of these slowing/stopping points could result in an increase in percent time spent following slow vehicles, a key indicator in determining LOS. The traffic route would be reversed as workers left the polygen plant site at the end of the workday. However, workers would not cross opposing FM 866 traffic and would have no stopping points along the route, other than yielding to opposing traffic before turning onto the eastbound I-20 entrance ramp.

The use of FM 866 as primary access to the polygen plant site from I-20 would entail the construction of a 3.7-mi (6-km) access road leading from the polygen plant site to FM 866. This route would be constructed at the beginning of plant construction. This could result in temporary localized traffic delays during construction of the access road, as well as an increase in traffic due to road construction workforce and equipment.

Use of FM 1601 as an emergency and secondary access to the polygen plant site during construction would also result in changes to existing roads and traffic conditions. This access option would require construction of either an at-rail-grade crossing or a below-rail underpass at the UPRR rail line. Because the rail line is elevated, construction of an at-rail-grade crossing would require a redesign and reconstruction of a portion of the existing CR 1216 (Avenue G) to raise the roadway up to rail level. Construction activities would result in temporary localized traffic delays and a potential rerouting of CR 1216 (Avenue G) traffic during construction.

Projected use of FM 1601 for 5 percent of total TCEP construction traffic would represent a 150-, 525-, and 750-percent increase over current traffic for Years One, Two and Three, respectively. Depending on the timing of this traffic, there could be delays along the frontage road, the intersection between the frontage road and FM 1601 (which is controlled by a four-way stop sign), or the intersection of FM 1601 and CR 1216 (Avenue G) (which is controlled by a stop sign for FM 1601 traffic only). If an at-rail-grade crossing is constructed as part of the proposed access road, passing trains would result in an additional three- to five-minute delay to traffic.

Operations

Table 3.49 shows the maximum traffic increases that could be expected to result from the two-way commute of workers and truck traffic during polygen plant operations. These figures are based on approximately 150 workers (Summit 2010a) commuting primarily on FM 866. FM 1601 would remain a secondary access route with a use of approximately 15 vpd. All truck traffic would use FM 866. Approximately 21 trucks a day would be required for delivery of potable water and removal of slag. If slag is removed from the site by rail, truck traffic would be reduced to one truck per day.

Table 3.49. Potential Traffic Increases during TCEP Peak Operation

Roadway	Current AADT	Projected AADT	Increase (%)
I-20, at Penwell	15,580	15,595	<1
I-20, east of FM 866 exit	16,700	17,034	2
FM 866	1,500	1,835	22
FM 1601	20	35	75

Although potential points of slowed traffic flow would be similar to those described under construction traffic, any resulting delays would be far shorter.

Changes to Level of Service

As noted above, LOS A through C are considered to be acceptable roadway operating and mobility conditions. Based on a traffic analysis that was conducted as part of the FutureGen EIS (a similar energy project that would have used the polygen plant site and the FM 1601 access route), DOE expects that traffic impacts as a result of the TCEP would be minor. For this reason, a full traffic analysis was not conducted. However, to estimate changes to the LOS for FM 866, FM 1601, and I-20 as a result of the TCEP, DOE compared the FutureGen analysis to the expected TCEP construction and operations scenarios. Based on a peak construction workforce of 650 and an operations workforce of 200, the FutureGen traffic study concluded that FM 1601 would degrade from LOS A to LOS D during construction, and from LOS A to LOS B during operations (DOE 2007). The FutureGen analysis forecasted no changes to the LOS for I-20.

During TCEP construction, FM 1601 would provide access for 15–75 workers (5 percent of TCEP traffic). At maximum usage, this figure is 12 percent of the employment figure used in the FutureGen construction traffic analysis; thus FM 1601 is not likely to experience the LOS degradation projected under that scenario and would remain at an acceptable LOS. The continuation of the same commute pattern during the TCEP's operational phase would result in between seven and eight workers using this route, or 4 percent of the employment figure used in the FutureGen operations traffic estimates. Thus, DOE expects that the LOS would remain at an acceptable level during TCEP operations.

The use of FM 866 for 95 percent of the TCEP construction workforce would result in the following numbers of workers using this route daily over the three-year construction period:

- Year one: 285 workers (44 percent of the FutureGen employment figure)
- Year two: 998 workers (153 percent of the FutureGen employment figure)
- Year three: 1,425 workers (219 percent of the FutureGen employment figure)

Because FM 1601 and FM 866 roads are similar in size and capacity, it is assumed that given similar workforce scenarios, the LOS on FM 866 could degrade in a manner similar to that which was estimated for FM 1601 in the FutureGen EIS. Therefore, the TCEP construction workforce during year two and year three would be expected to impact local mobility and degrade LOS to at least the level reported for FM 1601 in the FutureGen traffic analysis; that is, an LOS of D.

During TCEP operations, approximately 140 workers would use FM 866. This is 70 percent of the number of workers used in the FutureGen analysis, which projected a LOS of B during operations. The potential degradation of FM 866 to LOS B represents a conservative estimate of impacts as a result of TCEP operations. LOS B is considered to be an acceptable roadway operating and mobility condition.

Table 3.50 summarizes the anticipated LOS changes resulting from TCEP construction and operation based on comparisons made to the FutureGen EIS traffic analysis.

Table 3.50. Potential Level of Service Changes during TCEP Construction and Operation

Roadway	Current LOS	Construction LOS	Operation LOS
I-20	A	Acceptable (A–C)	Acceptable (A–C)
FM 866	A	Unacceptable (D or lower) during Years 2 and 3	Acceptable (A–C)
FM 1601	A	Acceptable (A–C)	Acceptable (A–C)

3.16.5.2 IMPACTS FROM LINEAR FACILITIES

Construction of the natural gas, CO_2 and transmission utility lines required for TCEP operations could also cause temporary and localized congestion, particularly where these lines would cross existing roads and provide access to the construction staging areas. However, because construction of the utilities would be spread out along lengths of corridors, it is estimated delays to traffic would be minor and temporary.

3.16.5.3 IMPACTS TO RAIL TRANSPORTATION

For this analysis, it was assumed that a substantial portion of the raw and finished materials needed to construct the TCEP and linear facilities would be transported by rail. This would include structural steel, pipes, turbines, generators, separators, heat exchangers, and other components and materials. The rail system would also be used to transport coal to operate the TCEP and materials produced at the TCEP, such as urea, slag, and H_2SO_4.

Westbound trains delivering coal and other supplies would exit off of the UPRR rail line, using a 1-mi (1.6-km) rail spur leading to the polygen plant site. Urea and H_2SO_4 (and potentially slag) produced at the TCEP plant would be uploaded onto empty cars located on-site for eastbound transport from the polygen plant site. Rail facility design has not yet been finalized but would include a 1-mi (0.6-km) rail spur, on-site tracks to accommodate at least two coal unit trains (up to 135 railcars each) and two urea unit trains, a locomotive refueling location and road access for a tank truck, and an area for railcars needing maintenance with access for a railcar repair contractor. Slag and H_2SO_4 may be temporarily stored in railcars awaiting transport. The railcar maintenance area would support lubrication and minor repairs, while the refueling location would fuel a yard engine and, perhaps, plant vehicles.

Construction of new railroad sidetracks would result in temporary and minor adverse impacts to the existing rail lines because of potential interruptions to service as the railroad spur is connected to the existing system (DOE 2007). Once constructed, railcars containing construction or operational materials transported along the UPRR line would be directed onto the TCEP rail spur for unloading, thus preventing delays or congestion along the UPRR line. Additional on-site tracks would be utilized to accommodate trains that need to be loaded/unloaded, thus ensuring that the rail spur would remain open to receive incoming trains.

During full operating capacity, the polygen plant would consume approximately 5,800 tn (5,261 t) of coal per day, which would be delivered to the site by rail. Coal delivery would average three 135-car unit trains per week, although the maximum capacity of the TCEP for coal delivery would be up to five 135-car unit trains per day. Rail transport of urea produced at the polygen plant would average one train per week. Produced slag and H_2SO_4 could also be transported by rail. Details have not yet been finalized, but could entail an increase of rail traffic of one to two trains per month. This total additional rail transport (an average of up to six 135-car unit trains per week) represents a 5 percent increase over the existing rail traffic of 119 trains per week along the UPRR line near the proposed TCEP plant site and would not represent an increase that would exceed system capacity nor cause delay to existing railway operations. Each additional train added to the UPRR system would have the potential to delay traffic attempting to cross an at-grade rail crossing by approximately three to five minutes. UPRR is aware of the rail transport needs of the TCEP and has included them in company forecasts (Union Pacific Corporation 2009).

3.16.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Section 2.5. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce road transportation impacts are as follows:

- Coordinating with local authorities regarding the movement of oversized loads, construction equipment, and materials to prevent unnecessary traffic congestion and increased road hazards during the construction period.
- Coordinating with local authorities to implement detour plans, warning signs, and traffic-diversion equipment to improve traffic flow and road safety if construction-related traffic disruptions would be necessary.
- Conducting a traffic analysis at the primary access road intersections to determine the impact to intersection LOS and assess the need for additional mitigation measures such as installation of traffic signals, construction of dedicated turn lanes and queue storage at the frontage road intersections, and acceleration and deceleration lanes into and out of the main access intersection.
- Implementing a worker shuttle bus and/or carpooling program to reduce the number of worker vehicles commuting to and from the TCEP.
- Staggering the worker shift start and end times to reduce the peaking of construction worker traffic entering and exiting the TCEP.
- Coordinating with UPRR to connect sidetracks during lowest levels of existing rail traffic to reduce the potential of delaying existing railroad traffic.
- Coordinating with UPRR on construction methods to ensure minimal impacts to rail traffic if a separated grade rail crossing is constructed on FM 1601.

3.17 Materials and Waste Management

3.17.1 Background

Construction and operation of the TCEP would require a source of coal and other materials and access to markets for H_2SO_4, urea, captured CO_2, argon gas, and slag and the ability to dispose of any waste that is generated. This section discusses the management of the materials needed for the construction and operation of the proposed polygen plant and the management of wastes that would be generated. The section also describes the impact of the demands posed by the TCEP on the supply of construction and operational materials in the region and the impacts to regional waste management resources.

3.17.2 Region of Influence

The ROI includes the waste management facilities, industries that could use the TCEP by-products, and suppliers of construction materials, coal, and process chemicals that would be used in the construction and operation of the proposed polygen plant and associated linear facilities. The extent of the ROI varies by material and waste type. For example, the ROI for construction material suppliers and solid waste disposal facilities is small (within approximately 50 mi [80 km] of the proposed site) because these types of resources are widely available and the large volumes of materials that would be needed or waste that would be generated are costly to transport over large distances. Treatment and disposal facilities for hazardous waste are less common, and the associated ROI is within approximately 100 mi (161 km) of the proposed site.

3.17.3 Methodology and Indicators

The impacts analysis for materials and waste resources used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.51.

Table 3.51. Indicators of Potential Materials and Waste Impacts

Potential Impact	Impact Indicator
Increase in demand from construction and operation of the TCEP on the capacities of material suppliers in the ROI.	Types and quantities of required materials.
Effect of TCEP-produced CO_2, urea, H_2SO_4, and slag on regional demand and access to markets.	Quantities of produced products.
Effect on the capacity of waste management facilities including hazardous waste-collection services and nonhazardous waste landfills.	Types and quantities of sanitary waste, nonhazardous solid waste products, recyclable materials, and hazardous waste products.

Uncertainty regarding some of the specific equipment venders and detailed project design that would be employed in the polygen plant site made it difficult to precisely quantify some of the operational materials requirements and waste generation. A conservative, maximum value for each item was used in the analysis to provide an upper limit for the potential impacts of the equipment vendors and final designs that could be selected. The analysis is based on the best available information and is bounded by the assumptions DOE has made with regard to the project design and equipment venders. Where necessary, DOE used NEPA documentation and design information for facilities of similar scope and size to augment the TCEP-specific information.

The impacts of the transportation of materials to the site and wastes from the site are addressed in Section 3.16, Transportation.

3.17.4 Affected Environment

This section describes the availability of construction materials and process materials and the capacity of municipal, industrial, and hazardous waste disposal facilities to manage the wastes that would be generated by the TCEP.

3.17.4.1 CONSTRUCTION MATERIALS

Construction of the proposed TCEP would require local access to concrete, asphalt, and aggregate and fill materials, among others. A number of suppliers and producers of construction materials are available in the area, and a sample of the surrounding construction materials industry is provided below, including the suppliers' capacity if that information was available.

Concrete

A number of large and small companies in the Midland–Odessa area would be available to provide concrete for the TCEP. Most companies could set up portable concrete plants at the site to meet the demand. The below list includes the available concrete suppliers for the TCEP:

- Vines Ready-Mixed Concrete is the largest supplier of concrete in the area, with a capacity of 100 cubic yards (76 m^3) per hour. It has existing plants in Odessa, Midland, Big Spring, and Crane (Vines Ready-Mixed Concrete 2010).
- Transit Mix Concrete and Materials Company is located in Midland. No production quantities were given but the company did verify it could support the anticipated project needs. (Schilhap 2010).
- Odessa Concrete Supply is capable of producing 850 cubic yards (650 m^3) per day (Hetrick 2010).

Asphalt

Jones Brothers Dirt and Paving Contractors, Inc., in Odessa is the largest supplier of asphalt in the region with a capacity of 2,500 tn (2,268 t) of asphalt per day.

Aggregate and Fill Material

Aggregate suppliers in the Midland–Odessa area include Transit Mix Concrete and Materials Company, Jones Brothers Dirt and Paving Contractors, Inc., Barnett Sand & Gravel, and Capitol Aggregates. Fill material is readily available throughout the region. The largest suppliers include Jones Brothers Dirt and Paving Contractors, Inc., Vines Ready-Mixed Concrete, and Van Zandt Paving.

Steel, Piping, and Process Units

In addition to the construction materials discussed above, construction of the TCEP would also require other building materials including structural steel, piping, and various process units, such as the coal gasifiers, combustions turbines, and other chemical process units. These items would be supplied by various vendors both local and nonlocal and would be delivered to the site by either truck or rail. Laydown areas would be established as part of the construction process that would provide temporary storage for these materials.

3.17.4.2 PROCESS-RELATED MATERIALS

Coal

The TCEP would use low-sulfur, Powder River Basin sub-bituminous coal from Wyoming. This coal would be Wyodak seam coal from Rio Tinto's Cordero Rojo Mine, located approximately 25 mi (40 km) south of Gillette, Wyoming. An alternate coal, used for other design considerations, would be Wyodak-Anderson seam coal from Peabody Energy's North Antelope Rochelle Mine, located approximately 65 mi (105 km) south of Gillette, Wyoming. The Cordero Rojo Mine produced 41.6 tn (37.7 t) in 2009, and the Antelope Rochelle Mine produced 108.7 tn (98.6 t) during the same period (Boyd 2010). The annual volume of coal proposed for TCEP (2.1 million tn [1.9 million t] per year) would be 4.6 percent and 1.75 percent of the 2009 output of these mines, respectively. (Boyd 2010).

Process Chemical Supply Markets

Process chemical requirements for the TCEP (see Table 2.3) would include common water treatment and conditioning chemicals, lubricants, and other industrial supplies that are widely used in the industry and that have broad regional and national availability. Suppliers of process water and waste water treatment chemicals are located close to the proposed project area (e.g., in and near the cities of Midland and Odessa).

3.17.4.3 WASTES

Construction of the TCEP would generate construction debris waste that would require off-site disposal. In addition, operation of the plant would generate industrial and hazardous waste that would require off-site disposal. Table 3.52 lists available industrial hazardous and nonhazardous waste landfills in the region and state, their approximate distances from the TCEP, and their current capacities (where available).

Industrial waste is waste produced by industrial activity. Hazardous (or toxic) waste, chemical waste, industrial solid waste and municipal solid waste are designations of industrial waste.
Municipal solid waste is commonly known as trash or garbage, is a combination of all of a city's solid and semisolid waste. It includes mainly household or domestic waste, but it can also contain commercial and industrial waste with the exception of industrial hazardous waste.
Hazardous (or toxic) waste is waste from industrial practices that causes a threat to human or environmental health and is regulated under the Resource Conservation and Recovery Act.
Chemical waste is waste that is made from harmful chemicals. Specific chemical wastes may or may not be classified as a hazardous waste.

Table 3.52. Municipal, Industrial, and Hazardous Waste Landfills in the Region of Influence

Landfill	City/State	Approximate Distance from TCEP (mi [km])	Available Capacity
Municipal Landfills			
Charter Waste Landfill	Odessa, Texas	4 (6)	26 million tn (99 years)
City of Midland Landfill	Midland, Texas	38 (61)	17 million tn (60 years)
Industrial Waste Landfills (nonhazardous)			
Charter Waste Landfill	Odessa, Texas	4 (6)	26 million tn (99 years)
Waste Control Specialists	Andrews, Texas	50 (80)	Not disclosed
Lea Landfill	Hobbs, New Mexico	100 (180)	Not disclosed
Hazardous Waste Landfills			
Waste Control Specialists	Andrews, Texas	50 (80)	Dependent on chemical composition
US Ecology Texas/Texas Ecologists, Inc.	Robstown, Texas	485 (780)	Dependent on chemical composition
Clean Harbor/Laidlaw	Deer Park, Texas	565 (909)	Dependent on chemical composition

Source: TCEQ (2010b).

3.17.5 Environmental Impacts of Summit's Proposed Project

3.17.5.1 CONSTRUCTION IMPACTS

Construction materials would be ordered in the correct sizes and number, resulting in small amounts of excess material that could be saved for use on a different project and very small amounts of waste to be disposed in a permitted landfill accepting construction debris. Heavy equipment would be used that require fuel, oils, lubricants, and coolants. Should any of these require disposal, they would be special waste or hazardous waste and appropriately managed by the construction contractor. Precautions would be taken to mitigate the impacts of petroleum and chemical spills and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Table 3.52 and Section 3.17.4.3. Impacts to waste collection services or disposal capacity would be small.

Polygen Plant Site

Polygen plant construction materials would consist primarily of structural steel beams and steel piping, tanks, and valves. Locally obtained materials would include crushed stone, sand, and lumber for the proposed facilities and temporary structures (e.g., enclosures, forms, and scaffolding). Components of the facilities would also include concrete, ductwork, insulation, electrical cable, lighting fixtures, and transformers. Sources for these construction materials are well established regionally, and the quantities of materials required to construct the proposed polygen plant would not create demand or supply impacts.

Waste from construction of the proposed facilities would include excess materials, metal scraps, and pallets, crates, and other packing materials. Excess supplies of new materials would be returned to vendors or be retained for future use. Surplus paint and other consumables, partial spools of electrical cable, and similar leftover materials would also be retained for possible future use in maintenance, repairs, and modifications. Scrap metal that could not be reused on-site would be sold to scrap dealers. Other scrap materials could also be recycled through commercial vendors. Packaging material (e.g., wooden pallets and crates), support cradles used for shipping large vessels and heavy components, and cardboard and plastic packaging would be collected in dumpsters and periodically transported off-site for disposal.

Construction equipment would include cranes, forklifts, air compressors, welding machines, trucks, and trailers. Operation of heavy equipment would require oils, lubricants, and coolants. Should any of these require disposal, they would be special waste or hazardous waste and appropriately managed by the construction contractor.

Petroleum products are sometimes spilled at construction sites as a result of equipment failure (split hydraulic lines, broken fittings) or human error (overfilled tanks). To mitigate the impacts of spills, use of petroleum products, solvents, and other hazardous materials would be restricted to designated areas equipped with spill containment measures appropriate to the hazard and volume of material being stored on the construction site. Refueling, lubrication, and degreasing of vehicles and heavy equipment would take place in restricted areas. A SPCC plan would be prepared in accordance with 40 C.F.R. § 112.7. Personnel would be trained to respond to petroleum and chemical spills and the necessary spill control equipment would be available on-site and immediately accessible.

Debris would be generated as a result of clearing and grading. Only 300 ac (121 ha) of the site would be required for the facilities comprising the polygen plant envelope (see Figure 2.3). Any excavated material could be used as fill on the site. This debris would be disposed on-site or transported to an off-site landfill for disposal.

The waste requiring disposal could be disposed of at permitted off-site landfills. Area industrial landfills would have sufficient capacity to receive nonhazardous construction debris waste (see Table 3.52). Because the quantity of waste from project construction would be small in comparison with available landfill capacity, the impact of the disposal of this waste would be low.

Linear Facilities

The following linear facilities and pipelines would be constructed to support the proposed TCEP:

- Up to 36.8-mi (59.2-km) of transmission line in new ROWs (maximum case, several options being evaluated)
- Process water supply pipeline corridors up to 41.2 mi (66.3 km) using new ROWs (maximum case, several options being evaluated)
- A 1.1-mi-long (1.8-km-long) CO_2 pipeline using new ROWs to connect to the existing Kinder Morgan CO_2 pipeline system
- A natural gas pipeline

Most corridors would require clearing of vegetation and grading, creating land clearing debris that may require removal from the site. The transmission line would be cleared of hazard trees but other low-growing vegetation such as mesquite would be primarily left in place. Construction debris disposal capacity is available at area landfills (see Table 3.52).

The construction of the pipelines, transmission lines, and access roads would require pipe, joining and welding materials including compressed gases, steel cable and structures, insulated wiring for transmission lines, and building construction materials such as lumber and masonry materials. Sources for these construction materials are well established regionally, and the quantities of materials required to construct the infrastructure would not create demand or supply impacts.

The proposed polygen plant site would be served by I-20 and two access roads. On-site roads would be needed in the polygen plant site.

The materials needed for on-site and access road construction are concrete, aggregate, and asphalt. Road construction results in minimal waste due to the ability to recycle and reuse these materials. Excavated soil would be used for fill elsewhere along the route and asphalt would be recycled. Road construction would require heavy equipment that would need fuel, oils, lubricants, and coolants. Should any of these require disposal, they would be special waste or hazardous waste and appropriately managed by the construction contractor. Precautions would be taken to mitigate the impacts of petroleum and chemical spills and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Table 3.52 and Section 3.17.4.3. Impacts to waste collection services or disposal capacity would be small.

The materials needed for construction of the on-site loop track and rail spur would be steel for rails and precast concrete rail bed ties, and rock for ballast. The sources for rails and rail bed ties are well established regionally; none of the quantities of materials required for constructing a rail spur would create demand or supply impacts. Furthermore, these materials would be ordered in the correct sizes and number, resulting in small amounts of excess material that could be saved for use on a different project and very small amounts of waste to be disposed in a permitted landfill accepting construction debris. In addition, to the materials to be installed, construction of the rail spur would require fuel, oils, lubricants, and coolants for heavy machinery, and compressed gasses for welding. Should any of these require disposal, they would be special waste or hazardous waste and shipped to a permitted hazardous waste treatment and disposal facility. Precautions would be taken to mitigate the impacts of petroleum and chemical spills, and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Table 3.52 and Section 3.17.4.3. Impacts to waste collection services or disposal capacity would be small.

3.17.5.2 OPERATIONAL IMPACTS

<u>Polygen Plant Site</u>

The TCEP is being designed to use Powder River Basin coal from Wyoming. Coal consumption would be approximately 5,800 tn (5,261.7 t) per day or up to 2.1 million tn (1.91 million t) per year. This represents 2.2 percent of the 95.4 million tn (86.6 million t) of coal of all types consumed by electric utilities in the state in 2009 (Energy Information Administration 2010a). Coal would be delivered to the proposed polygen plant site by rail and stored in two coal piles, each providing storage capacity for approximately nine days of operation with approximately 36 days inactive storage. Runoff from the coal storage areas would be collected and treated in the plant's ZLD waste water treatment system.

Table 2.3 provides the estimated on-site storage requirements of toxic and hazardous materials, assuming a 30-day supply would be maintained at the polygen plant site. Potential impacts from storage of the chemicals are discussed in Section 3.18, Human Health, Safety, and Accidents. These chemicals are commonly used in industrial facilities and widely available from regional and national suppliers. The coal gasification process would consume H_2SO_4, sodium hypochlorite, and lime. The sulfur produced by the polygen plant itself would be sufficient to meet the need for H_2SO_4, assuming a complete conversion of the sulfur to H_2SO_4. There are sodium hypochlorite producers located throughout the U.S., including Texas, and availability is high. Chemical Lime, one of the 10 largest lime producers in the U.S., operates plants in Texas, including nearby Bosque County (U.S. Geological Survey 2010b). Given that the chemicals that would be needed to operate the polygen plant are common industrial chemicals that are widely available and produced in large quantities in the U.S., the chemical consumption impact would be minimal.

Argon and H_2SO_4 would be by-products of the gasification and syngas cleanup processes and would be made available for commercial sale. Slag (an inert by-product of the gasification process) could be sold as a raw material for manufacturing cement and other products.

The coal gasification process would generate approximately 489 tn (444 t) of slag per day (178,485 tn [161,919 t] per year). Although slag is considered a potential revenue-producing stream and would be actively marketed by Summit, DOE assumed for purposes of this analysis that all of the slag would be disposed of at the closest nonhazardous industrial waste landfill. The Charter Waste Landfill in Odessa has a 26-million-tn (24-million-metric-t) capacity, is the closest nonhazardous landfill, and would use the TCEP's slag as an intermediate cover over waste material during the day.

Summit estimates that up to 23,360 tn (21,191 t) of clarifier sludge and filter cake from the ZLD process would be generated annually. The filter cake is expected to be nonhazardous but would be tested to confirm its characteristics. As with the inert slag, the clarifier sludge and filter cake would be disposed of at the Charter Waste Landfill.

Chemical waste would be generated by periodic cleaning of the HRSG and turbines. The wet cooling tower option has a greater demand for biocide usage (e.g., bleach). This waste would consist of alkaline and acidic cleaning solutions and wash water, which are likely to contain high concentrations of heavy metals. Chemical cleaning would be performed by outside contractors who would be responsible for the removal of associated waste products from the site. Precautions would be taken to prevent releases by providing spill containment for tanks used to store cleaning solutions and waste. Other waste would include solids generated by water and waste water treatment systems, such as activated carbon used in sour water treatment. Sulfur-impregnated activated carbon would be used to remove Hg from the syngas. This Hg sorbent would be replaced periodically and the spent carbon would likely be hazardous waste. The spent carbon would be regenerated and reused at the site. It could also be returned to the manufacturer for treatment and recycling or transferred to an off-site hazardous waste treatment facility. Used oils and used oil filters would be collected and transported off-site by a contractor for recycling or disposal. Given the municipal, industrial, and hazardous waste disposal capacities available in the region, the impact of disposal of TCEP-generated waste would be minimal. With the small amount of hazardous waste (e.g., paints, solvents, and spent carbon) that would be generated and the availability of commercial disposal facilities, the impact of managing TCEP operational wastes would be small.

Sanitary waste is spent water from residences and facilities that carries bodily wastes, washing water, food preparation wastes, laundry wastes, and other waste products of normal living. Based on approximately 30 gal (114 L) generated per day per person, the expected sanitary waste water discharge would total up to 4,500 gal (17,000 L) per day during operation (150 workers). This waste would be collected and discharged directly to an on-site underground septic disposal field. Thus, sanitary waste disposal for the TCEP would have no impact to the capacity of local waste water treatment facilities.

Linear Facilities

During normal operations, the transmission lines and pipelines would not require additional materials and would not generate waste, other than cleared vegetation, if necessary, that could be disposed of at a nonhazardous waste landfill.

On-site roads would require periodic resurfacing at a frequency dependent on the level of use and weathering. Asphalt removed from the road surface would be recycled. Road resurfacing would involve heavy equipment that would require oils, lubricants, and coolants. Should any of these require disposal, they would be special waste or hazardous waste and appropriately managed by the construction contractor.

Maintenance of the rail spur would consist of replacing the rails and equipment at a frequency dependent on the level of use and weathering. Replacement materials would be obtained in the correct sizes and quantities from established suppliers, and the small amount of waste remaining after materials are reused or recycled would be disposed of in a permitted facility. Any special or hazardous waste (e.g., oils and coolants) generated during rail replacement would be managed by the contractor.

3.17.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. Because no impacts would occur, no additional mitigation measures specific to materials and waste management resources would be necessary.

3.18 Human Health, Safety, and Accidents

3.18.1 Background

This section describes the potential human health and safety impacts associated with construction and operation of the TCEP. Health and safety impacts are evaluated in terms of potential risks to both workers and the general public. This section addresses occupational and public safety and health, including worker injuries, transportation safety, pipeline safety, exposure to contaminated sites, and risks to workers and the surrounding community from accidents that could occur at the polygen plant site.

As with any U.S. energy infrastructure, the TCEP could be the target of terrorist attacks or sabotage. DOE evaluated the potential impacts from a sabotage or terrorism event by analyzing major and minor system failures or accidents at the proposed polygen plant site, as well as gas releases along the CO_2 and natural gas pipeline(s) and at injection wells. The accident analyses evaluated the outcome of catastrophic events without determining the motivation behind the incident. Thus, such outcomes could be representative of the impacts from a sabotage or terrorism event. The level of risk is estimated based on the current conceptual design of the proposed TCEP; applicable health, safety, and spill prevention regulations; and expected operating procedures.

3.18.2 Region of Influence

The ROI for the occupational safety and health analysis is those areas where workers would be located. The ROI for potential worker and public health impacts is the modeled hazard zone where a specified threshold of risk would be exceeded by fire, explosion, or release of hazardous materials. This zone was determined through analysis of release conditions, weather, terrain, and mixture thermodynamics (Appendix C). The ROI for the analysis of CO_2 health and safety impacts is the modeled hazard zone for which there is a risk posed by leakages. For transportation safety, the ROI consists of the roadways on which TCEP workers and delivery vehicles would be traveling. The ROI for analysis of exposure to contaminated soils is the area within 100 ft (30 m) of the polygen plant property boundaries and linear facility ROWs.

3.18.3 Methodology and Indicators

The impacts analysis for human health, safety, and accidents used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.53.

Table 3.53. Indicators of Potential Impacts to Human Health and Safety

Potential Impact	**Impact Indicator**
Potential for worker injury and death during construction and operation of the facility	Total recordable incidents, lost workday cases, and fatalities
Increase in traffic during construction and operation could lead to increased roadway accidents	LOS rating for traffic and qualitative description on what that means to accident risks
Accidents or fatalities caused by rail transport of supplies, particularly at at-grade crossings	Number/location of at-grade rail crossings, estimated rail traffic and qualitative description on what that means to accident risks
Exposure to pollutants of potential concern during construction and operation of the facility	Number of sensitive receptors near the project area, including facility workers
A risk to public health and safety from electromagnetic field exposure or exposure to charged particulates	Location of new transmission lines; number of sensitive receptors near the project area, including facility workers
Exposure to pollutants of potential concern due to intentional destructive acts (i.e., sabotage)	Proximity to sensitive receptors, including facility workers
CO_2 or natural gas leaks, explosion, or fire due to construction or operation of the facility	
CO_2 or natural gas leaks, explosion, or fire due to intentional destructive acts (i.e., sabotage)	

The occupational safety and health analysis used BLS accident and incident rate data for activities that would be associated with the polygen plant and linear facilities. A quantitative risk analysis (QRA) was prepared to assess the level of risk posed to workers and the public by accidental releases from the proposed polygen plant or associated natural gas and CO_2 pipelines. The QRA is contained in Appendix C.

The analysis of risk from CO_2 pipeline and EOR activities was based on the analysis conducted for the FutureGen EIS, a similar energy project that would have used the same plant site and, for injection of CO_2, a sequestration site in the same Permian Basin region where the TCEP's CO_2 would be used for EOR (Tetra Tech 2007). The FutureGen analysis used data from analog sites to estimate risks to the public from the transport of $C0_2$, wellhead failures, or upward leakages from the injection reservoirs due to a variety of release mechanisms. Although the TCEP would be selling the CO_2 to others for EOR, these same failure scenarios would apply.

The transportation safety analysis used motor vehicle fatality rates and safety risks for at-grade rail crossings.

3.18.4 Affected Environment

3.18.4.1 OCCUPATIONAL SAFETY AND HEALTH

Worker safety in construction and industrial settings is regulated by OSHA. The TCEP would be subject to OSHA standards during construction and operations (e.g., OSHA General Industry Standards [29 C.F.R. Part 1910] and the OSHA Construction Industry Standards [29 C.F.R. Part 1926]). OSHA standards are designed to protect workers from potential construction and industrial accidents, as well as to minimize exposure to workplace hazards (e.g., noise, chemicals). Table 3.54 summarizes 2008 safety statistics from the BLS for industry categories that are relevant to the TCEP.

Table 3.54. National Statistics for Workplace Hazards

Industry	Nonfatal Recordable Incidents (per 100 full-time equivalent workers)	Lost Workdays (per 100 full-time equivalent workers)	Fatalities (per 100,000 full-time equivalent workers)*
Construction	4.7	2.5	9.7
Utilities (electric power generation, transmission, control, and distribution)	3.5	1.9	3.9
Chemical manufacturing	2.7	1.6	2.5

Sources: BLS (2008a, 2008b).

* In 2008, the Census of Fatal Occupational Injuries implemented a new methodology using hours worked for fatal work injury rate calculations rather than employment. The new methodology included a fatality rate for general manufacturing only, not chemical manufacturing specifically. For additional information on the fatal work injury rate methodology changes, please review BLS (2010c).

Limited data on polygen facilities are available; therefore, statistics from utility industry and chemical manufacturing have been referenced in this analysis. Construction of gasification facilities has long been a part of the chemical manufacturing industry. Similarly, construction and operation of combined-cycle power plants has long been part the electric utility industry. Therefore, the workplace hazards associated with the various components of the polygen plant are represented in the statistics presented in Table 3.54.

In the utility industry, electrical shocks, burns, boiler fires and explosions, and contact with hazardous chemicals are among the most common hazards to power plant workers (Hansen 2005). According to the National Board of Boiler and Pressure Vessel Inspectors, between 1999 and 2003, 1,478 boiler accidents were reported, resulting in 143 injuries and 26 deaths (power boilers include utility boilers, as well as boilers used by other industries for cogeneration and on-site power production) (National Board of Boiler and Pressure Vessel Inspectors 2010). Many power plant workers are also routinely exposed to dangerous chemicals such as corrosives (acids and bases), oxidizers, and solvents.

Falls account for the greatest number of fatalities in the construction industry, followed by transportation incidents and worker contact with electricity. Overexertion, being struck by an object, and falls were the most commonly reported reasons for lost workdays. Other common injuries include sprain and strains, and cuts or lacerations (Meyer and Pegula 2004).

In the chemical manufacturing sector, the leading causes of death in 2008 were fires and explosions, exposure to harmful substances, contact with objects and equipment, and assaults and violent acts[3] (BLS 2008a). In the manufacturing industry as a whole, the leading causes for lost workdays are contact with objects or equipment, overexertion, repetitive motion injuries, and falls (National Occupational Research Agenda and National Institute for Occupational Safety and Health 2010).

3.18.4.2 TRANSPORTATION SAFETY

Road Safety

Texas uses the Crash Records Information System to collect and analyze motor vehicle crash data. Table 3.55 contains the fatality rate per 100 million vehicle mi (161 million vehicle km) traveled from 2003 to 2009 in Texas. This table also includes TxDOT's estimate of the fatality rate per 100 million mi (161 million km) traveled from 2010 to 2014. Based on a 16 percent decrease in the state traffic fatality rate since 2003, TxDOT estimates a continued reduction through 2014.

Table 3.55. Texas Department of Transportation Fatality Rate 2003–2009 and Estimated Fatality Rate 2010–2014

Calendar Year	Rate per 100 Million Vehicle Miles (km) Traveled*
2003	1.75 (2.81)
2004	1.61 (2.59)
2005	1.52 (2.45)
2006	1.49 (2.40)
2007	1.43 (2.30)
2008	1.48 (2.38)
2009	1.47 (2.37)
2010	1.45 (2.33)
2011	1.43 (2.30)
2012	1.41 (2.27)
2013	1.39 (2.24)
2014	1.38 (2.22)

*Data for 2010–2014 are estimated.

Source: TxDOT (2010a).

[3] Includes violence by persons, self-inflicted injury, and attacks by animals.

Railroad Safety

Railroad Crossings

A structure that allows one track to cross another track or a highway at the same elevation is referred to as an at-grade crossing. A structure or set of structures allowing two tracks, or one or more tracks, and a highway to cross each other at different elevations is referred to as a grade-separated crossing. Grade-separated crossings are provided by either a railroad bridge over a highway or a road bridge over a railroad.

Trespassing on railroad property and collisions at highway-rail grade crossings are the two leading causes of death in the entire railroad industry, far surpassing worker or passenger fatalities (U.S. Department of Transportation 2004). At-grade rail-highway crossings can also contribute to motor traffic bottlenecks depending on their location. In addition, the presence of at-grade crossings near medical facilities can affect emergency response times due to ambulances delayed by railroad traffic.

Texas has the largest number of public highway-rail at-grade crossings in the nation and typically leads the nation in the annual number of automobile-train involved collisions (fatalities and injuries) at public highway-rail at-grade crossings. The incorporation of safety improvements at highway-rail crossings, such as train-activated signal systems, has shown to be a significant factor in reducing collisions involving motor vehicles and trains. As of 2009, Texas had 10,045 public highway-rail at-grade crossings, approximately 57 percent of which are equipped with active warning signal equipment (TxDOT 2010b). In Ector County, there are 36 at-grade crossings, of which 25 are public road crossings and the remainder are located on private roads or are pedestrian crossings (Federal Railroad Administration 2010a). On the portion of the UPRR line between the polygen plant and the city of Odessa, there are 25 at-grade crossings. There are at least seven hospitals or medical centers in downtown Odessa that are located within 0.5 mi (0.8 km) of the at-grade crossings for either Crane or Muskingum Avenues.

Since 1975, there were 66 reported incidents including seven fatalities, 25 injuries, and 34 incidents with property damage on the portion of the UPRR line between the polygen plant and the city of Odessa (Federal Railroad Administration 2010a). Twelve incidents along the UPRR line involved the transportation of hazardous materials. However, reports indicate that no releases of hazardous materials occurred during the incidents (Federal Railroad Administration 2010a).

The UPRR annually operates 17 trains a day, seven days a week, along the track near the proposed polygen plant (see Section 3.16, Transportation). UPRR's track structure in the ROI is rated as Class 5 by the Federal Railroad Administration. Class 5 tracks are suitable for 70-mi-per-hour (112.6-km-per-hour) operation (UPRR 2006, as cited in Horizon Environmental Services 2006b). However, coal cars can only operate at a maximum of 50 mi (80 km) per hour per timetable (UPRR 2004, as cited in Horizon Environmental Services 2006). Each 135-car unit coal train supplying the TCEP could take approximately two minutes to clear a public at-grade crossing at the maximum speed of 50 mi (80 km) per hour.

Track Safety

Railroads annually transport more than 1.5 million carloads of hazardous cargo, including toxic gases such as anhydrous NH_3. More than 99.99 percent of rail hazardous material shipments reached their destinations without a release caused by a train accident, and rail hazardous material accident rates are down 81 percent since 1980 (Association of American Railroads 2009).

Hazardous materials produced by TCEP operation would be transported on the UPRR rail system. The UPRR system covers 23 states in the western two-thirds of the U.S. and is the nation's largest hauler of chemicals (UPRR 2010). In 2009, transport in the UPRR chemical sector (including petroleum, plastics, soda ash, fertilizer and industrial chemicals) comprised 16 percent of UPRR's freight revenue. Additionally, the hazardous waste segment of the industrial products sector saw shipments double in 2009, largely driven by new uranium tailings business in Utah (UPRR 2009).

In 2006, a national hazardous materials audit was conducted to determine the level of Class I railroad compliance with the requirements for on-train placement of hazardous materials and accurate hazard communications on trains. UPRR had a noncompliance rate of 7.1 percent, the lowest of the seven Class I railroads inspected.

For 2009, UPRR reported a total of 148,651,734 rail mi (239,231,800 rail km) in the entire UPRR rail system and 441 train accidents (a train accident is defined as any event involving ontrack rail equipment that results in monetary damage to the equipment and track above a certain threshold) (Federal Railroad Administration 2009). Three of the accidents (0.68 percent of the total number of accidents) resulted in hazardous material releases from six railcars. There were no fatalities, although 200 people were evacuated (Federal Railroad Administration 2009). The primary causes of the accidents were human factors (26 percent), track defects (34 percent), and equipment, signal defects, or other causes (14 percent, 3 percent, and 18 percent, respectively).

As of August 2010, annual rail mileage for the UPRR rail system was 104,941,993 rail mi (168,887,800 rail km), with 297 train accidents (Federal Railroad Administration 2010b). Three of these accidents resulted in a hazardous material release from three railcars (1.01 percent of the total number of accidents). There were no fatalities and no evacuations. Primary causes of the accidents were human factors (31 percent), track defects (39 percent), and equipment, signal defects, or other causes (13 percent, 3 percent, and 20 percent, respectively) (Federal Railroad Administration 2010b).

Based on the total mileage in the UPRR system, the 2009 and 2010 accident rates are 2.97 and 2.83 accidents per million rail mi (per 161 million rail km), respectively (Federal Railroad Administration 2009 and 2010b).

3.18.4.3 CARBON DIOXIDE AND NATURAL GAS PIPELINE SAFETY

The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety governs pipeline safety. The Pipeline and Hazardous Materials Safety Administration is the primary federal regulatory agency responsible for establishing and enforcing regulations related to pipeline safety, reliability, and environmental protection. Through certification by Office of Pipeline Safety, the State of Texas also regulates, inspects, and enforces intrastate gas and liquid pipeline safety requirements. This work is performed by the Pipeline Safety Division of the RRC. Operator compliance with state and federal pipeline safety regulations is monitored through a comprehensive inspection and enforcement program comprising field inspections of operations, maintenance, and construction activities; programmatic inspections of operator procedures, processes, and records; incident investigations and corrective actions; and through direct dialogue with operator management (Office of Pipeline Safety 2010). In Texas, there are approximately 222,285 mi (357,733 km) of hazardous liquid and natural gas pipelines, including 165,910 mi, (267,006 km) of natural gas gathering, transmission and distribution lines, and 1,521 mi (2,448 km) of CO_2 transmission pipelines (Office of Pipeline Safety 2010). Between 2000 and 2009, there were 53 significant accidents associated with all pipelines (Office of Pipeline Safety 2010). This translates to approximately one accident per 4,200 mi (6,759 km) of pipeline.

> The Pipeline and Hazardous Materials Safety Administration defines **significant incidents** as those incidents reported by pipeline operators when any of the following specifically defined consequences occur: 1) fatality or injury requiring in-patient hospitalization; 2) $50,000 or more in total costs, measured in 1984 dollars; 3) highly volatile liquid releases of five barrels or more or other liquid releases of 50 barrels or more; or 4) liquid releases resulting in an unintentional fire or explosion.

3.18.4.4 EXPOSURE TO CONTAMINATED SITES

Exposure to certain chemicals can adversely affect human health through toxic reactions, carcinogenic effects, or both. Chemical exposure can occur from chemicals present in water or in soil from past industrial activities.

A Phase I environmental site assessment was performed on the proposed polygen plant site in April 2006 (Horizon Environmental Services 2006). The results of that assessment did not indicate any recorded or observed soil contamination on the site. A review of state records also indicates that there is no known ground water contamination on or within 1.0 mi (1.6 km) of the proposed polygen plant site (Horizon Environmental Services 2006). Given the widespread and historic use of land on the polygen plant site and in most of the linear facilities for petroleum and gas production, it is possible that oil or chemical leaks have occurred on the site or in the corridors. The linear facilities were not included in the assessment, and no studies have been done for those corridors.

3.18.5 Environmental Impacts of Summit's Proposed Project

3.18.5.1 OCCUPATIONAL HEALTH AND SAFETY

TCEP Construction

Using the OSHA workplace hazards statistics presented earlier, Table 3.56 depicts the total estimated number of recordable incidents, lost workdays, and fatalities that could occur during the three-year construction period, assuming a TCEP construction workforce of 650 workers during that period.

Table 3.56. Estimated Workplace Hazard Statistics for the Three-year TCEP Construction Period

Workforce	Recordable Incidents		Lost Workdays		Fatalities	
	Recordable Incident Rate per 100 Full-time Equivalent Workers	**Total Recordable Incidents (nonfatal)**	**Rate of Lost Workdays per 100 Full-time Equivalent Workers**	**Total Lost Workdays**	**Fatality Rate per 100,000 Full-time Equivalent Workers**	**Total Fatalities**
Construction (650)	4.7	92	2.5	49	9.7	< 1

Risks and hazards associated with construction of power lines, substations, access roads, public road upgrades, rail improvements, and pipelines would be addressed through a worker protection program currently under development by Summit for the TCEP. Many of these types of construction activities would be undertaken by companies specializing in this type of work and would be governed by their internal worker protection programs.

Emergency services during construction would be coordinated with the local fire departments, police departments, paramedics, and hospitals. A first-aid office would be located on-site for minor first-aid incidents. Trained and certified health, safety, and environmental personnel would be on-site to respond to and coordinate emergency response. All temporary facilities would have fire extinguishers, and fire protection would be provided in work areas where welding work would be performed.

TCEP Operations

TCEP operations would require approximately 150 workers. These workers would perform activities included in both chemical manufacturing and utility industries workplace hazard statistics; however, it is currently unknown how many workers would perform each type of activity. Therefore, the highest number of the two industry's statistics (as reported in Table 3.54) has been used in this analysis, and is shown in Table 3.57.

Based on these rates, Table 3.57 also presents the estimated yearly number of recordable incidents, lost workdays, and fatalities for an operations workforce of 150 workers. Over the life of the project, which is estimated to be 30 years, this would result in 158 recordable incidents, 122 lost workdays, and fewer than one fatality. The risk of fatality related to specific TCEP processes is discussed in more detail in Section 3.18.5.2.

Table 3.57. Estimated Annual and Total (30 years) Workplace Hazard Statistics for the TCEP

Workforce	Recordable Incidents		Lost Workdays		Fatalities	
	Recordable Incident Rate per 100 Full-time Equivalent Workers	Annual/Total Recordable Incidents (nonfatal)	Rate of Lost Workdays per 100 Full-time Equivalent Workers	Annual/Total Lost Workdays	Fatality Rate per 100,000 Full-time Equivalent Workers	Annual/Total Fatalities
Operations (150)	3.5	5.25/158	2.7	4.1/122	3.9	0.01/0.3

Polygen plant design features and management programs would likely be established to address hazardous materials storage locations, emergency response procedures, worker training requirements, hazard recognition, fire control procedures, hazard communications training, personal protective equipment training, and reporting requirements. For accidental releases, significance criteria would be determined based on federal, state, and local guidelines, and on performance standards and thresholds adopted by responsible agencies.

Spill prevention measures would be developed pursuant to the Clean Water Act and would likely include comprehensive containment and worker safety programs. The comprehensive containment program would specify the use of appropriate tanks and containers, as well as proper secondary containment using walls, dikes, berms, curbs, etc. Worker safety programs would specify that workers are aware of, and trained in, spill containment procedures and related health, safety, and environmental protection policies.

3.18.5.2 TRANSPORTATION SAFETY

Motor Vehicles

During the construction and operations phases, personnel and material would be moved by personal vehicles and trucks. The following assumptions were used in the analysis of the potential for roadway accidents:

- There would be an average of 650 workers per month over the entire three-year TCEP construction period, which is anticipated to occur from 2012 to 2014.
- 150 workers would be required for TCEP operations. The polygen plant would operate for 30 years.
- Construction workers would commute six days per week, 52 weeks per year. Operations personnel would commute five days per week, 48 weeks per year.
- Both construction and operations workers would commute from the Odessa area. Each worker would make one round-trip, for a total commute of 40 mi (64 km) per day. Although some workers could reside closer to the polygen plant site and/or carpool with other workers, this assumption provides a conservative scenario.
- Approximately 26 trucks per day for potable water and other construction materials would be required during peak construction periods. Approximately 21 trucks per day would be

required for delivery of potable water and removal of slag during operations. If slag is removed from the site by rail, truck traffic would be reduced to one truck per day. These trucks would also be traveling to and from the Odessa area.

Based on these assumptions, approximately 25 million mi (40 million km) would be driven over the three-year construction period. Based on a TxDOT 2012–2014 average fatal accident rate of 1.39 fatalities per 100 million vehicle mi (161 million km) traveled, fewer than one fatality (approximately 0.35) would be expected to occur due to the movement of workers and supplies using trucks and personal vehicles during construction of the TCEP. During the 30-year operations period, approximately 44 million mi (71 million km) would be driven. Using the 2014 TxDOT fatal accident rate, fewer than one fatality (approximately 0.61) would be expected to occur due to the travel of workers during TCEP operations. This estimate does not incorporate any further reductions or increases in the fatality rate beyond the 2014 estimate provided by TxDOT.

Railroads

TCEP Rail Facilities, and Supply and Product Transport

Rail facility design has not yet been finalized but would include a 1-mi (0.6-km) rail spur, on-site tracks to accommodate at least two coal unit trains (up to 135 railcars each) and two urea unit trains, a locomotive refueling location for a yard engine (i.e., a small locomotive) with road access for a tank truck, and an area for railcars needing repairs with access for a railcar repair contractor. The refueling station is expected to contain one or more fuel storage tanks similar in size to those at a typical gasoline filling station. The maintenance area would support the minor maintenance and lubrication of the railcars and yard engine. The maintenance area would store small quantities of grease, oil, and solvents. The sizes of tanks and the quantities of materials that could be stored on-site have not been determined at this time.

During construction, some supplies could be transported by rail. These materials have not been quantified but would not include hazardous materials. During operation of the TCEP, coal, urea, argon, H_2SO_4, and perhaps slag would be transported by rail. As reported in Section 3.18.4.2, UPRR's 2009 and 2010 accident rates were 2.97 and 2.83 per 1 million rail mi (1.6 million rail km) traveled, respectively. TCEP-related transportation would add to the number of rail miles in the UPRR system. Assuming a Powder River Basin mine origin near Gillette, Wyoming, for the coal supply, and traveling along identified UPRR coal delivery routes, the proposed coal route would be approximately 1,800 mi (2,896 km) long. Rail transport of three trains per week of coal to the TCEP would result in 281,000 rail mi (183,465 km) annually. Using the higher reported accident rate, the addition of TCEP rail transport would result in approximately 0.83 accidents annually (approximately 25 rail accidents over the entire life of the project).

Urea, argon, and H_2SO_4 would also be transported off the polygen plant site by rail. Rail transport of urea produced at the polygen plant would average one train per week. Buyers have not been secured, but preliminary information indicates that urea would likely be transported to the Midwestern U.S. Slag and H_2SO_4 rail needs have not yet been fully determined, but could entail an increase of rail traffic of one to two trains per month. UPRR is currently working with Summit to develop a comprehensive transportation plan that would meet Summit's needs and be consistent UPRR's delivery capabilities and obligations (Mullen 2009). Detailed loading and unloading procedures would be developed based on specific design and piping arrangement of rail tank cars and site conditions. Detailed H_2SO_4 unloading procedures and safety regulations can be found in the following industry and government publications:

- 49 C.F.R. Parts 171–181, Department of Transportation
- 29 C.F.R. Part 1910, Department of Labor (OSHA)

Transport of these products would also add to the number of rail miles in the UPRR system. Assuming a Midwestern U.S. destination requiring 1,500 mi (2,414 km) of rail travel, TCEP rail transport of one train per week for urea and two trains for other materials would result in an additional 114,000 rail mi (183,465 rail km) annually. Using the higher reported accident rate, the addition of TCEP rail transport would result in approximately 0.33 accidents annually (approximately 10 rail accidents over the entire life of the project).

Given the overall low frequency of hazardous material spills on railroads, the risk of a release of TCEP materials during rail transport would be low. The speed, path and harm of an accidental release of a toxic gas or vapor would depend on the type of chemical, wind, weather, time, geography, and population density of the surrounding area.

At-grade Crossing Safety

With regard to safety issues, the examination of at-grade crossing safety typically considers the expected numbers and locations of at-grade crossings, the volume of both vehicle and rail traffic at those crossings, the nature of road traffic (e.g., trucks or passenger vehicles), the design and safety features of the crossings, and train and vehicle speeds near any crossings.

Coal delivery would average three 135-car unit trains per week, although the maximum capacity for coal delivery would be up to five 135-car unit trains per week. Rail transport of urea produced at the polygen plant would average one train per week. Produced slag and H_2SO_4 may also be transported by rail. Details have not yet been finalized, but could entail an increase of rail traffic of one to two trains per month. This additional rail transport (an average of up to six 135-car unit trains per week) represents a 5 percent increase over the existing rail traffic of 119 trains per week along the UPRR line near the proposed TCEP plant site and would result in a 5 percent increased risk of accidents at the at-grade crossings. Each additional train added to the UPRR system would have the potential to delay any emergency vehicle attempting to cross an at-grade rail crossing by approximately three to five minutes. There are at least seven hospitals or medical centers in downtown Odessa that are located within 0.5 mi (0.8 km) of the at-grade crossings at Crane and Muskingum Avenues. Thus, an increase in rail traffic could result in adverse impacts to general health and safety by impeding emergency vehicles.

Summit proposes to provide secondary and emergency access to the polygen plant site from FM 1601. This would require the construction of a rail crossing. It has not yet been determined if the crossing would be an at-grade or separated grade crossing and, if constructed at-grade, if the crossing would be equipped with active warning signal equipment. Construction of an at-grade rail crossing would result in an increased risk to those accessing the TCEP from FM 1601. The access road would be used by approximately 5 percent of construction and operations traffic on a daily basis. During peak construction (year three), this would result in approximately 150 rail crossings per day. If a collision occurred at the proposed rail crossing during peak TCEP commute times, project traffic could temporarily obstruct emergency vehicle access and delay the response time, particularly during construction. There are no other at-grade rail crossings along the anticipated travel routes to the TCEP.

3.18.5.3 CARBON DIOXIDE AND NATURAL GAS PIPELINE SAFETY

The TCEP would require the installation of approximately 2.7 mi (4.3 km) of new natural gas pipelines and 1.0 mi (1.6 km) of CO_2 pipeline. Statistically, the accident rate associated with these lengths of new pipelines would be negligible. Failure rates specific to the pipeline types and diameter that would be used in the TCEP were incorporated into the accident scenario analysis that is summarized in Section 3.18.5.5 and contained in Appendix C.

3.18.5.4 EXPOSURE TO CONTAMINATED SITES

During construction of the polygen plant and linear facilities, workers could be exposed to soil contamination previously undiscovered on the polygen plant site or along the linear facilities. A Phase I environmental site assessment was performed on the proposed polygen plant site, and no indication of contaminated soils or other potential environmental risks were found. Therefore, the risk of discovering soil contamination during construction of the TCEP would be low.

Linear facilities were not examined as part of the assessment; however, portions of some linear facility features are in previously existing ROWs. These areas have already been disturbed during previous construction projects and presumably have been examined for evidence of soil contamination. All transmission line, natural gas and CO_2 pipeline, and access road options would require construction of new ROWs. The portion of each linear facility option that would require new versus existing ROWs is shown in Table 3.58.

Table 3.58. TCEP Linear Facilities

Linear Facility Option	New ROW (mi [km])	Existing ROW (mi [km])
WL1	21.0 (33.7)	20.0 (32.2)
WL2	8.7 (14.0)	0.06 (0.1)
WL3	9.2 (14.8)	5.4 (8.7)
WL4	1.3 (2.1)	1.3 (2.1)
TL1	9.3 (15.0)	0.0 (0.0)
TL2	8.6 (13.8)	0.0 (0.0)
TL3	2.2 (3.5)	0.0 (0.0)
TL4	0.6 (1.0)	0.0 (0.0)
TL5	36.8 (59.2)	0.0 (0.0)
TL6	32.8 (52.8)	0.0 (0.0)
$C0_2$	1.0 (1.6)	0.0 (0.0)
NG1	2.7 (4.3)	0.0 (0.0)
AR1	0.3 (0.5)	0.0 (0.0)
AR2	3.7 (6.0)	0.0 (0.0)
RR1	1.1 (1.8)	0.0 (0.0)

Most of the linear facilities would not be located in residential areas; however, there are 37 residences within 100 ft (30 m) of the WL1 ROW, 51 residences and one post office located within 100 ft (30 m) of the TL5 ROW, and 39 residences located within 100 ft (30 m) of TL6 ROW. There is one residence within 100 ft (30 m) of the NG1 ROW. Because of their proximity to these proposed ROWs, these residences could be at risk to exposure of hazardous materials that could be exposed during excavation for these linear facilities. However, risk to residents or workers could be substantially reduced through proper due diligence, which starts by conducting a Phase 1 environmental site assessment along unexamined ROW sections prior to construction. If this assessment identified potential environmental risks along these ROWs, it should be followed by Phase II (testing) and Phase III (removal and disposal of contaminated materials) assessments, as necessary, to reduce the risk (see Section 3.18.6, Mitigation).

3.18.5.5 POLYGEN PLANT RISK ANALYSES

This section summarizes the results of the analysis of potential impacts to human health that would result from an accident, equipment failure, or intentional destructive acts such as sabotage or terrorism involving TCEP process units and pipelines associated with flammable, acutely toxic, or asphyxiant releases. Although the probability of an act of sabotage or terrorism cannot be quantified, it is possible to estimate the potential human health effects of such an attack on the TCEP facilities, which would be similar to what could occur as a result of a component failure or human error.

In general, accidents that could be associated with TCEP process units include gas releases and exposure to toxic gas clouds (such as those containing H_2S) or asphyxiant gas clouds (such as those containing CO_2), torch fires or flash fires, and vapor cloud explosions. A QRA was conducted to estimate the level of risk posed to the public by potential releases of flammable, toxic, or asphyxiant fluids originating in TCEP process units. The study consisted of four primary steps:

- Selection of potential events that could lead to releases of flammable, toxic, and asphyxiant fluids at rates sufficient to create toxic or asphyxiant vapor clouds, flash fires, torch fires, pool fires, and vapor cloud explosions.
- Determination of the annual probability of occurrence of each event.
- Performance of a consequence analysis for each event to determine how far the toxic and asphyxiant vapor clouds could travel in lethal concentrations and the extent of all flammable hazards to lethal levels with the available mitigation systems in place.
- Combination of the consequence modeling results with the annual probabilities to calculate the risk to the public from the proposed TCEP and associated pipelines.

The analysis, which was conducted by Quest (2010) and contained as Appendix C, identifies eight toxic materials that would be present at the TCEP: CO, H_2S, NH_3, hydrogen cyanide, H_2SO_4, SO_2, hydrogen chloride, and COS. Two asphyxiants would also be present: CO_2 and N_2.

The QRA identifies several flammable gas mixtures. Additional localized hazards such as coal dust and urea piles were not included in the QRA because exposure to these mixtures would not extend off-site. Transportation accidents that could occur are discussed in Section 3.18.4.2. The QRA also identifies the following TCEP process units, associated pipelines, and storage facilities handling the aforementioned materials:

- NH_3 synthesis unit

- Hg removal and acid gas removal units
- H_2SO_4 plant
- CO_2 compression and drying unit
- Gasification unit
- Sour shift and gas cooling units
- Blowdown and sour water system
- Urea synthesis
- Air separation unit
- Gas turbine unit
- Anhydrous NH_3 storage
- CO_2 pipeline
- Natural gas pipeline

Results

QRA data indicate that toxic hazards would be dominated by the potential releases of NH_3 gas from the pipeline leading from the NH_3 synthesis unit to the urea synthesis plant or through NH_3 production or storage processes. Hazards associated with NH_3 gas releases could extend beyond the plant site boundaries. Risks would be greatest to those workers closest to the NH_3 synthesis unit (Cornwall 2010).

The highest level of fire risk in the TCEP would result from processes involving the production and transfer of syngas. Fire hazards at the polygen plant site would not extend beyond the plant itself (Cornwall 2010).

Risk calculations are expressed as a numerical measure representing the chance or probability that an individual in any one location would be exposed to a fatal hazard during a one-year period. Risk numerical values are further defined in Table 3.59.

Table 3.59. Risk Level Terminology and Numerical Values

Numerical Value	Shorthand Notation	Chance per Year of Fatality
1.0×10^{-3}	10^{-3}	One chance in 1,000 of a fatality annually
1.0×10^{-4}	10^{-4}	One chance in 10,000 of a fatality annually
1.0×10^{-5}	10^{-5}	One chance in 100,000 of a fatality annually
1.0×10^{-6}	10^{-6}	One chance in 1 million of a fatality annually
1.0×10^{-7}	10^{-7}	One chance in 10 million of a fatality annually
1.0×10^{-8}	10^{-8}	One chance in 100 million of a fatality annually

As shown above, a value of 1.0×10^{-6} (or 10^{-6} in shorthand notation) represents one chance in 1 million per year of a fatality caused by a release originating in the polygen plant or associated pipelines. If this risk level is predicted to occur at a particular location, it represents the annual chance of fatality at that location due to any of the potential releases from the TCEP equipment.

The risk probabilities contained in the QRA are expressed in contours. Each contour line represents the probability of human fatality in relationship to the polygen plant. Figure 3.31 presents the levels of risk of exposure to a lethal dose of a toxic material or exposure to a lethal asphyxiant level or exposure to a lethal radiant or overpressure exposure for all the potential releases evaluated. For example, the dark blue line labeled 10^{-6} represents the risk of fatality described above (i.e., a one in 1 million annual chance of a fatality as a result of any flammable, toxic, or asphyxiant fluid release occurring in the project area, the natural gas connector pipeline, or the CO_2 connector pipeline). The highest risk depicted in the contours indicates a one in 1,000 chance of a fatality; the lowest risk represents a one in 100 million chance.

Under all scenarios, plant workers would be the most at risk of injury or death. Quest has indicated that some assumptions underlying the analysis, such as the amount of equipment, consequences of equipment failure, and locations of individuals at all times of the day are conservative (i.e., overstated), and as such, the risk contours over-predict the risks.

For pipelines outside the project area, the QRA depicts risk as transects. A risk transect plots the annual risk of fatality caused by a release from the pipeline against the perpendicular distance from the pipeline. This method of risk presentation provides a simple method of risk comparison for multiple pipelines. Figure 3.32 presents the calculated risk transects for the incoming 4-in (10-cm) natural gas and 10-in (25-cm) export CO_2 pipelines associated with the TCEP.

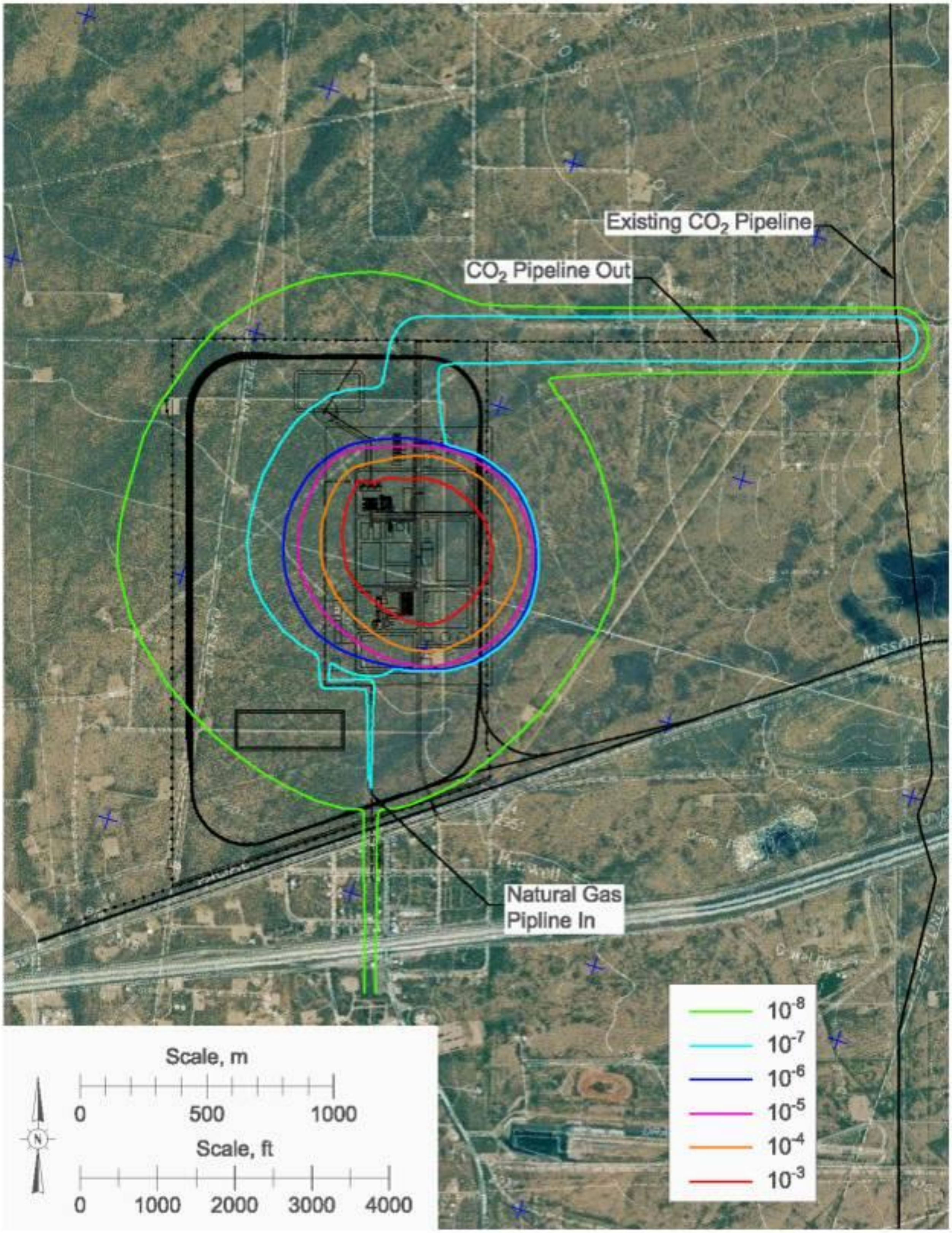

Figure 3.31. TCEP quantitative risk analysis risk contours (Quest 2010).

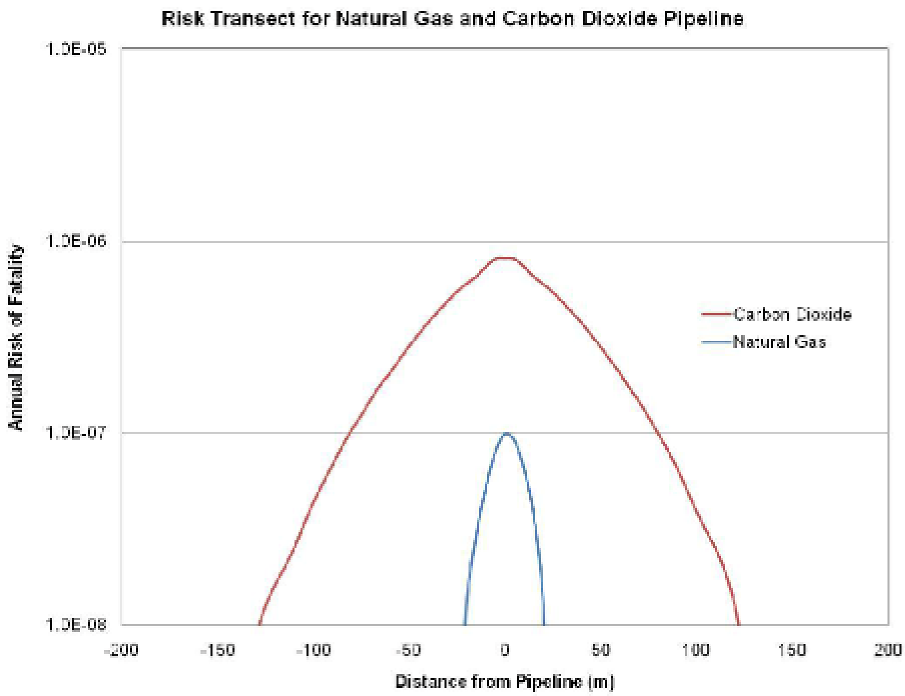

Figure 3.32. Risk transect for TCEP carbon dioxide and natural gas pipelines (Quest 2010).

As shown above, risk associated with CO_2 is less than 10^{-6} (one chance in 1 million of fatality per year) directly above the pipeline, decreasing to 10^{-7} at approximately 230 ft (70 m) from the pipeline, and to 10^{-8} at approximately 460 ft (140 m) from the pipeline. The natural gas pipeline would pose a lesser risk overall. The 10^{-7} contour shows up directly above the pipeline, but the risk decreases sharply and becomes minimal at approximately 82 ft (25 m) from the pipeline.

Conclusions

The QRA allows the following conclusions:

- The fatality risk levels posed by potential releases of flammable, toxic, and asphyxiant gases from the proposed TCEP and associated pipelines would be low.
- The closest residential area, Penwell, is located over 3,280 ft (1,000 m) to the south of the proposed polygen plant site. The residents in Penwell would not be exposed to any risk levels greater than 1.0×10^{-8} (one chance in 100 million of a fatality annually) from the TCEP.
- The high consequence/low probability of accidental releases associated with the NH_3 storage operations drive the outer (1.0×10^{-7} and 1.0×10^{-8}) risk contours. At the time of this analysis, the anhydrous NH_3 storage options and designs were not completed. Quest used assumptions involving the inventory and location options that may be employed were purposely conservative. The actual risk associated with the NH_3 storage options are expected to be lower when the polygen plant design is finalized. When the actual design is incorporated into the analysis, the 1.0×10^{-7} and 1.0×10^{-8} risk contours are expected to move inward, closer to the TCEP.

- The risks associated with the natural gas and CO_2 pipeline operations are low, below 1.0×10^{-6} in the immediate vicinity of the pipeline.

The QRA found the hazards and risks associated with the proposed TCEP and associated pipelines to be similar to those of process plant operations worldwide that handle low concentrations of toxic materials in gas streams, and concluded that the risks posed by flammable fluids are small because most of the flammable fluids would be processed in the gaseous phase.

3.18.5.6 POST-INJECTION RISK ANALYSES

The TCEP would annually capture approximately 3 million tn (2.7 million t) of CO_2, which would be purchased by others for EOR operations that would ultimately lead to geologic sequestration of the CO_2. The CO_2 stream used for EOR may also contain other gases, including up to 20 ppm H_2S. This section evaluates the potential impacts from CO_2 and H_2S, after injection into subsurface reservoirs.

CO_2 and other gases would remain trapped for extremely long time periods in subsurface reservoirs. However, these gases may also be accidentally released through one of the following key mechanisms (Intergovernmental Panel on Climate Change [IPCC] 2005):

- Upward leakage through the caprock due to either catastrophic failure and quick release or gradual failure and slow release;
- Release through existing faults or induced faults due to the effects of increased pressure;
- Lateral or vertical leakage into nontarget aquifers due to an unknown structural or stratigraphic connection with the target zone, or due to a lack of geochemical trapping and inadequate retention time in the target zone; and
- Upward leakage through inadequately constructed wells, abandoned wells, or undocumented wells.

If CO_2 were to escape the EOR reservoir, it could increase pore pressures in the vadose zone (near-surface unsaturated soils above the water table). This increase in pressure has been known to displace the naturally occurring and radioactive element radon, where it can accumulate in confined areas such as buildings and become a health hazard.

EPA mapped the Permian Basin as an area with a low potential for radon to exceed the recommended upper limit for air concentrations in buildings (EPA 2010f), indicating that there is a low potential for CO_2 to displace radon. If on the rare chance that CO_2 were to leak and radon were present in ore-bearing rocks, radon transport induced by CO_2 leakage would be highly localized over the point of CO_2 leakage.

As part of the FutureGen EIS, DOE evaluated potential accidents associated with carbon sequestration activities and their potential health effects on workers and the general public who may be exposed to the release of CO_2 and H_2S. The FutureGen EIS analysis (Tetra Tech 2007) included the same plant site as that proposed for the TCEP, and it included an injection well field location that would be geologically representative of the Permian Basin oil fields that would be injected with TCEP's CO_2 for purposes of EOR.

The analysis of releases from the geological storage of CO_2 is a new science, and there are no well-established methodologies for modeling these releases (IPCC 2005) or guidance from EPA. Further, many studies have concluded that it is impossible to confidently quantify the likelihood and magnitude of accidental releases of sequestered CO_2 (Vendrig et al. 2003, as cited in Tetra Tech

2007). Therefore, to provide a range of escape estimates for sequestered gases, the analysis used data from an analog database that included the site characteristics and results from studies performed at other CO_2 storage locations and from sites with natural CO_2 accumulations and releases. The expected incidence of pipeline ruptures or punctures was evaluated using existing CO_2 pipeline data. The estimated failure rate of wellhead equipment during operation was based on natural gas injection well experience. Failure frequencies for leakage scenarios were obtained from estimates of releases from existing injection sites and natural releases. Additional information regarding the analogs used in the assessment can be found in the Final Risk Assessment Report (Tetra Tech 2007) for the FutureGen EIS. The potential for accidents considered in this analysis were expressed on a per annum basis: likely (frequency $\geq 1 \times 10^{-2}$ per year), unlikely (frequency from 1×10^{-2} per year to 1×10^{-4}per year), and extremely unlikely (frequency from 1×10^{-4} per year to 1×10^{-6} per year). The following accident scenarios were analyzed for all four potential FutureGen sites, including the Odessa site:

- Ruptures in the pipeline transporting CO_2 and H_2S from the plant to the sequestration site (considered unlikely)
- Punctures in the CO_2 pipeline (considered unlikely to likely depending on the site)
- Wellhead failures at the injection well (considered extremely unlikely)
- Slow upward leakage of CO_2 from the injection well (considered extremely unlikely)
- Slow upward leakage of CO_2 from other existing wells (considered extremely unlikely to unlikely)

The probability of a slow upward leakage of CO_2 from other existing wells is location dependent. In old oil fields with old wells penetrating the reservoir undergoing EOR, the risks would be higher than in newer oil fields because, generally, the condition of existing wells is better in newer fields. Site-specific risks for oil fields that purchase and use TCEP's CO_2 cannot be estimated until the specific fields are identified.

One set of toxicity criteria was identified for short-term post-injection release scenarios consisting of the rupture of a pipeline or wellhead equipment that could result in a rapid release of gases lasting in the range of minutes or hours. The other set of toxicity criteria was identified for release scenarios where long-term releases could occur over longer periods of time as a result of smaller leaks.

The injection well field site used for the FutureGen risk analysis is located approximately 58 mi (93 km) south of the proposed polygen plant site and approximately 8 mi (13 km) from Fort Stockton. The study noted that the area is largely open with a relatively low population density and no sensitive receptors within 50-year sequestration plume footprint.

For both the short- and long-term release scenarios at the FutureGen Odessa site, exposures to CO_2 did not exceed either the acute toxicity criteria (20,000 ppmv) or chronic toxicity (10,000 ppmv) criteria and would therefore be unlikely to pose a risk to residential receptors post-injection. Assumed exposures to H_2S also would not exceed toxicity criteria for the short-term release scenarios. Further, H_2S was not assumed to be released through the caprock and would not exceed toxicity criteria for long-term releases through both existing and induced faults. However, long-term releases of H_2S from all three types of wells examined (CO_2 injection wells, abandoned oil and gas wells, and undocumented, abandoned, or poorly constructed wells) could result in exposures to concentrations that exceeded the toxicity criteria within 909 ft (227 m) of the release.

The analysis concluded that fewer than one person would be potentially affected by slow leakage of H_2S at the CO_2 injection well or other deep well and that the frequency of failure was quite low. However, the number of people affected at the time of such a release would depend on wind direction, speed, and atmospheric stability.

Currently, the entire Permian Basin has been identified as the potential area for TCEP-related EOR activities. Although the FutureGen injection well field location is in the general area targeted for EOR and contains similar geologic formations, the location where TCEP-related EOR activities would take place may or may not have the same population density. As a result, although the release scenarios and downwind distances of concern are likely to be similar, the numbers of residents or sensitive receptors that could be exposed cannot be estimated until a more exact area for EOR is identified.

The FutureGen report indicated that the only likely ecological effects from assumed releases of CO_2 and H_2S were olfactory effects in several insects. These effects would not be expected to significantly affect ecological communities. However, it should be noted that no ecological toxicity criteria were available for H_2S.

3.18.5.7 HAZARDOUS AIR POLLUTANTS

HAPs, also known as air toxics, are pollutants that cause or possibly cause cancer in humans or may cause adverse environmental and ecological effects. As discussed more fully in Section 3.3, Air Quality, a health effects evaluation was performed for the emissions of hazardous pollutants from the TCEP's operations using the TCEQ ESLs. The maximum predicted concentrations for all identified toxic compounds were below their respective ESLs, except for Tier I short-term coal dust. However, because the Tier II maximum concentration at a nonindustrial receptor was lower than the Tier I short-term ESL, the coal dust concentrations met the Tier II requirements for public health and no further analysis was performed, pursuant to TCEQ regulations.

3.18.5.8 TRANSMISSION LINES AND ELECTROMAGNETIC FIELDS

Magnetic fields can be induced by the movement of electrons in a wire (current) and electric fields are created by voltage, the force that drives the electrical current. All electrical wiring, devices, and equipment including transformers, switchyards, and transmission lines produce electromagnetic fields. The strength of these fields diminishes rapidly with distance from the source. Building material, insulation, trees, and other obstructions can reduce electric fields, but do not significantly reduce magnetic fields. Electrical field strength is measured in kilovolts per meter. Magnetic field strength is expressed as a unit of magnetic induction (Gauss) and is normally expressed as a milligauss, which is one thousandth of a Gauss. The average residential electric appliance typically has an electrical field of less than 0.003 kV/ft (0.01 kV/m). In most residences, when in a room away from electrical appliances, the magnetic field is typically less than 2 milligauss. However, very close to an appliance carrying a high current, the magnetic field can be thousands of milligauss.

Electric fields from power lines are relatively stable because line voltage does not vary much. However, magnetic fields on most lines fluctuate greatly as the current changes in response to changing loads (consumption or demand).

Transmission lines contribute a relatively small portion of the electric and magnetic fields to which people are exposed. Nonetheless, over the past two decades, some members of the scientific community and the public have expressed concern regarding human health effects from electromagnetic fields during the transmission of electrical current from power plants. The scientific evidence suggesting that electromagnetic field exposures pose a health risk is weak. The strongest evidence for health effects comes from observations of human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults (National Institute of Environmental Health Sciences 1999). The National Institute of Environmental Health Sciences report concluded that, "extremely low-frequency magnetic field exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard" (National Institute of Environmental Health Sciences 1999:1). Although a fair amount of uncertainty still exists about the electromagnetic field health effects issue, the following determinations have been established from the information:

- Any exposure-related health risk to an individual would likely be small;
- The types of exposures that are most biologically significant have not been established;
- Most health concerns relate to magnetic fields; and
- Measures employed for electromagnetic field reduction can affect line safety, reliability, efficiency, and maintainability, depending on the type and extent of such measures.

3.18.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Table 2.8 of Chapter 2. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts to human health and safety are:

- Constructing a separated grade rail crossing at the intersection of FM 1601 and the UPRR or including active warning signals at an at-grade crossing at that location to reduce risk to TCEP workers accessing the plant site

Conducting a Phase I environmental site assessment along unexamined ROW sections prior to construction of the linear facilities would reduce the risk of exposure to potentially hazardous materials that could be uncovered during excavation. If a Phase 1 assessment identifies potential environmental risks along the ROWs, it should be followed by Phase II (testing) and Phase III (removal and disposal of contaminated materials) assessments, as necessary, to reduce this risk.

3.19 Noise and Vibration

3.19.1 Background

3.19.1.1 NOISE

Noise is defined as unwanted sound because it interferes with speech communication and hearing or is otherwise considered annoying. The term "unwanted" can be subjective in nature and can vary greatly among individuals. An individual's response to noise is influenced by the type of noise, perceived importance of the noise, appropriateness in the setting, time of day, type of activity during which the noise occurs, and the sensitivity of the individual.

Sound is measured in decibels and is based on a logarithmic scale to account for the wide range of audible sound intensities. Under the logarithmic scale for sound (and noise), a 10-decibel (dB) increase would increase sound intensity by 10 times; a 20-dB increase would increase sound intensity by 100 times. As a result, methods have been developed for weighting the sound frequency spectrum to approximate the response of the human ear. The dBA uses a sound range of 0–140 dBA and is the most widely used weighted scale for environmental noise assessments because of its relative convenience and accuracy in correlating with people's judgments of what constitutes noise. Typical A-weighted sound and noise levels associated with common activities or situations are shown in Table 3.60.

Table 3.60. Typical A-weighted Sound Levels

Sound Source	Sound Level (dBA)	Typical Response
Carrier deck jet operation	140	Limits amplified speech
Jackhammer	130	Painfully loud
Jet takeoff (200 ft [61.0 m])	120	Threshold of feeling pain
Auto horn (3 ft [0.91 m])		
Riveting machine	110	
Jet takeoff (2,000 ft [609.6 m])		
Shout (0.5 ft [0.15 m])	100	Very annoying
New York subway station		
Heavy truck (50 ft [15.2 m])	90	Hearing damage (8-hour exposure)
Pneumatic drill (50 ft [15.2 m])		
Passenger train (100 ft [30.5 m])	80	Annoying
Helicopter (in flight, 500 ft [152.4 m])		
Freight train (50 ft [15.2 m])		
Freeway traffic (50 ft [15.2 m])	70	Intrusive
Air conditioning unit (20 ft [6.1 m])	60	
Light automobile traffic (50 ft [15.2 m])		

Table 3.60. Typical A-weighted Sound Levels

Sound Source	Sound Level (dBA)	Typical Response
Normal speech (15 ft [4.6 m])	50	Quiet
Living room	40	
Bedroom		
Library		
Soft whisper (15 ft [4.6 m])	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Threshold of hearing

Source: Council on Environmental Quality (1970).

People tend to respond to variations in sound pressure in a logarithmic manner. For example, when comparing similar sounds (e.g., changes in traffic noise levels) a 3-dBA change in sound-pressure level is considered detectable by the human ear in most situations. A 5-dBA change is readily noticeable by most people, and a 10-dBA change is perceived to be a doubling (or halving) of sound or noise.

When used by itself, a dBA value represents a sound level at a given instant or at a maximum level; however, noises can vary in level and duration. Those levels that vary over time and are applicable to this noise assessment are identified by two A-weighted scale descriptors: the equivalent sound level (Leq) and the day-night level (Ldn). Leq represents a steady-state sound with the same energy and A-weighted level as measured continuously over a given time period. It is used only when the durations and levels of sound, not the time of occurrence (day or night), are relevant. Ldn is defined as the energy average of an A-weighted sound level occurring during a 24-hour period, with an additional 10-dBA weighting imposed on Leq levels occurring during nighttime hours (10:00 p.m. to 7:00 a.m.) to account for a lower tolerance to noise at night when people are sleeping.

3.19.1.2 VIBRATION

Vibration consists of rapidly fluctuating motions with an average motion of zero. Ground-borne vibration can be a major concern for off-site damage to existing structures and can be potentially annoying or disturbing to humans and wildlife. Typical outdoor sources of perceptible ground-borne vibration are construction activities such as blasting or pile driving, steel-wheeled trains, and traffic on rough roads. Common effects of vibration include shaking of building structures (i.e., floors or windows), rumbling sounds, and—in some extreme cases—damage to buildings (Federal Transit Administration [FTA] 2006).

The measurement of ground vibration is peak particle velocity, which is the maximum speed (measured in inches per second or millimeters per second) at which a point on the ground moves relative to its static state. Although peak particle velocity is appropriate for evaluating the potential of building damage, it is not necessarily suitable for determining human response. The root-mean-square vibration velocity level is expressed in velocity decibels, meaning the vibration velocity in decibels relative to 1 microinch per second, and more appropriately describes effects of human disturbance from ground-borne vibration. Human perceptibility of vibration has a threshold of 65 velocity dB, but human response is not usually significant until vibrations exceed 70 velocity dB. Bulldozers and other heavy-tracked equipment generate vibration levels of approximately 96 velocity dB. The threshold for minor structural damage is 100 velocity dB or a peak particle velocity of 0.12 in per second (3.05 mm per second) for fragile buildings (FTA 2006).

3.19.2 Region of Influence

The noise and vibration ROI is the area within which there would be potential noise impacts from polygen plant construction and operation on nearby residential areas, and potential impacts on residents from project-related linear construction and commuter traffic noise. The ROI boundary for the polygen plant noise is a 1-mi (1.6-km) radius around the site perimeter. The ROI boundary for access roads is 0.25 mi (0.4 km) from the ROW boundary, based on the attenuation distance from a 90-dBA noise level (a heavy truck at 50 ft [15 m] as shown in Table 3.60) to the 62-dBA background level DOE observed in its FutureGen EIS (DOE 2007). The ROI for noise is dependent on the magnitude of noise emissions that would be generated and on existing or ambient noise levels, which would affect the degree of the noise impact.

3.19.3 Methodology and Indicators

The impacts analysis for noise and vibration used several indicators to assess type, magnitude, and severity of potential impacts from TCEP construction and operations. Potential impacts and their indicators are shown in Table 3.61.

Table 3.61. Indicators of Potential Noise and Vibration Impacts

Potential Impact	Impact Indicator
Disturbance to human receptors from increases in noise or vibration as a result of construction or operation of the TCEP	Estimated construction and operational noise levels at key receptors Acres of land impacted from construction and operation disturbance that exceeds ambient noise levels
Disturbance to human receptors from increases in noise or vibration as a result of an increase in vehicle/rail traffic patterns and volumes	

EPA has developed residential noise guidelines to protect human health and welfare (EPA 1974). EPA sound-level guidelines do not provide an absolute measure of noise impact, but rather a consensus on potential community interference. The EPA residential guidelines developed to protect against hearing loss established a safety threshold at 70 dBA/24-hour Leq; guidelines to minimize outdoor activity interference and annoyance have a short-term threshold of 65 dBA and a long-term threshold of 55 dBA Ldn. These threshold levels were used to analyze impacts from TCEP operations.

FTA established noise guidelines for transportation and construction projects to protect human health and safety (FTA 2006). FTA noise thresholds for project construction are shown in Table 3.62. These FTA thresholds were used in analyzing potential noise impacts that could be caused during TCEP construction and startup. Potential noise impacts caused by project operations were analyzed using EPA noise threshold levels discussed above because EPA guidelines have long-term noise levels thresholds for protecting human health and safety.

Table 3.62. Federal Transit Administration Construction Noise Thresholds

Land Use	8-Hour Leq (dBA)		Ldn (dBA)
	Day	Night	30-day Average
Residential	80	70	75*
Commercial	85	85	80†
Industrial	90	90	85†

Source: FTA (2006).

*In urban areas with very high ambient noise levels (Ldn > 65 dB), Ldn from construction activities should not exceed existing ambient + 10 dB.

†24-hour Leq, not Ldn.

3.19.3.1 NOISE

For this analysis, adverse impacts were considered to be noise intensities that would be caused by construction or operation of the TCEP that exceeded the FTA acceptable threshold levels for residential, commercial, and industrial areas. Potential noise-sensitive receptors (that is, people living and/or working near the project area) were identified based on the type of receptor locations (residences, schools, daycare facilities, hospitals, nursing homes, churches, and parks) and their proximity to the polygen plant site and linear facilities.

The evaluation of potential impacts from noise or vibration considered whether the proposed project would cause any of the following conditions:

- Conflict with federal, state, or local noise standards during construction or operation
- Disturbance (change of ≥3 dBA [Leq]) to noise-sensitive receptors from increases in noise or vibration as a result of construction-equipment operation and increases in construction vehicle or rail traffic patterns and volumes
- Disturbance (change of ≥3 dBA [Leq]) to noise-sensitive receptors from increases in noise or vibration as a result of operation activities, including increases in vehicle-traffic patterns and volumes and increases in railcar volumes

Baseline noise monitoring was conducted at the proposed polygen plant site on June 19, 2007, by DOE for the FutureGen EIS (DOE 2007). DOE conducted ambient noise monitoring to quantify baseline (ambient) noise levels at the nearest sensitive receptor site to the proposed TCEP. During field reconnaissance efforts for the TCEP (July 7–9 and August 30–September 2, 2010), DOE determined that sensitive receptor locations had remained relatively constant since 2007, and that the monitoring location used in 2007 remains the closest location to the polygen plant site. Because no discernable development has occurred in the area of the monitoring location to date, and traffic conditions have remained relatively constant, DOE determined that ambient noise data collected in 2007 are applicable to and sufficient for use as baseline conditions for the TCEP noise analysis.

DOE evaluated noise levels produced by both stationary sources (construction and operation equipment) and mobile sources (construction and operational vehicle and rail traffic). Standardized noise intensity and noise attenuation equations were used for the stationary source and mobile source analyses, and are shown below.

For both the stationary and mobile source analyses, standard sound equations were used (California Department of Transportation 1998) to predict ambient noise levels at the sensitive receptor location and compare the proposed project traffic-noise volumes. For the analysis, it was assumed that noise intensities below the FTA and EPA thresholds for human health and safety would have no adverse impacts to human health and safety.

3.19.3.2 VIBRATION

DOE used a screening process to determine the potential effects of ground-borne vibrations (e.g., blasting or pile driving, steel-wheeled trains, traffic on rough roads) on the identified vibration-sensitive receptors. If the distance from the source of ground-borne vibrations to a sensitive receptor is greater than 200 ft (61 m), FTA considers it reasonable to conclude that no further action is needed (FTA 2006). If sensitive receptors are closer than 200 ft (61 m) to ground-borne vibrations, further assessment criteria are recommended by FTA to quantitatively determine the potential annoyance impacts to humans and the potential damage to building or equipment. There may be potential vibration-related impacts to wildlife in the ROI. Noise and vibration impacts to wildlife are discussed in Section 3.8, Biological Resources.

3.19.4 Affected Environment

3.19.4.1 NOISE

Existing noise sources near the proposed project area include vehicle traffic on I-20, FM 866, FM 1601; traffic on adjacent unpaved roads; localized oil and gas pumping equipment; railroad traffic; and general ambient background noise. There are six noise-sensitive receptor locations south of the proposed polygen plant, mostly in Penwell. These sensitive receptor locations include two permanent residences north of I-20 (SL-1 and SL-2) and four permanent residences south of the highway (SL-3, SL-4, SL-5, and SL-6). These sensitive receptor locations are shown in Figure 3.33.

SL-1 was chosen as the representative monitoring site for the Penwell residences because it is the closest noise-sensitive location to the proposed polygen plant site, approximately 0.25 mi (0.4 km) south of the site boundary (Figure 3.33). Ambient noise data were collected at this site on June 19, 2007, and spanned 10 minutes during the early morning hours (DOE 2007). Local noise sources, overall environmental conditions, and area meteorological conditions were also noted prior to sampling. The air temperature (in degrees Fahrenheit) during the survey was in the mid to upper 70s, with relative humidity averaging 70 percent and barometric pressure averaging 29 in (74 cm) of Hg. DOE recorded an ambient noise level of 62 dBA at SL-1. When compared to a typical Ldn of 50 dBA for rural areas (EPA 1974), ambient noise quality at SL-1 appears to be heavily influenced by existing vehicle traffic on I-20, which is located approximately 800 ft (244 m) south.

Existing ambient noise levels would vary with location and level of human activity. Most of the TCEP linear facilities would pass through rural areas that would likely have Leq values in the range of 47–57 dBA, which is typical of a rural environment (DOE 2007). Areas with greater human activity near the cities of Odessa and Midland would have higher ambient noise levels.

3.19.4.2 VIBRATION

Existing sources of vibration in proximity to the proposed project area include haul truck traffic on I-20 and FM 866. However, no vibration-sensitive receptors (i.e., humans, buildings, and sensitive equipment) are located in the FTA-defined 200-ft (61-m) distance screening and human annoyance threshold (FTA 2006). Therefore, this potential impact was eliminated from further detailed impacts analysis.

3.19.5 Environmental Impacts of the Proposed Project

3.19.5.1 CONSTRUCTION

TCEP construction activities would include site clearing and grading, excavation, foundation laying, building construction, and finishing, all of which would be completed in approximately 36 months. The construction actions would produce increased ambient noise levels that include commuter and construction-vehicle traffic, construction-equipment operation, and steam-venting during polygen plant startup.

<u>Stationary Source Analysis</u>

Polygen Plant Site

The DOE stationary source analysis evaluated potential maximum effects of anticipated construction equipment noise levels at the polygen plant site on sensitive receptors. Table 3.63 presents standard noise levels from common construction equipment at various distances. These typical noise levels do not account for attenuation from air absorption, ground effects, and shielding from intervening topography or structures, all of which would further decrease the dBA levels shown below for each distance. Noise attenuation effects are not accounted for because some attenuation factors such as topography, wind speed and direction, and building shielding are site-specific.

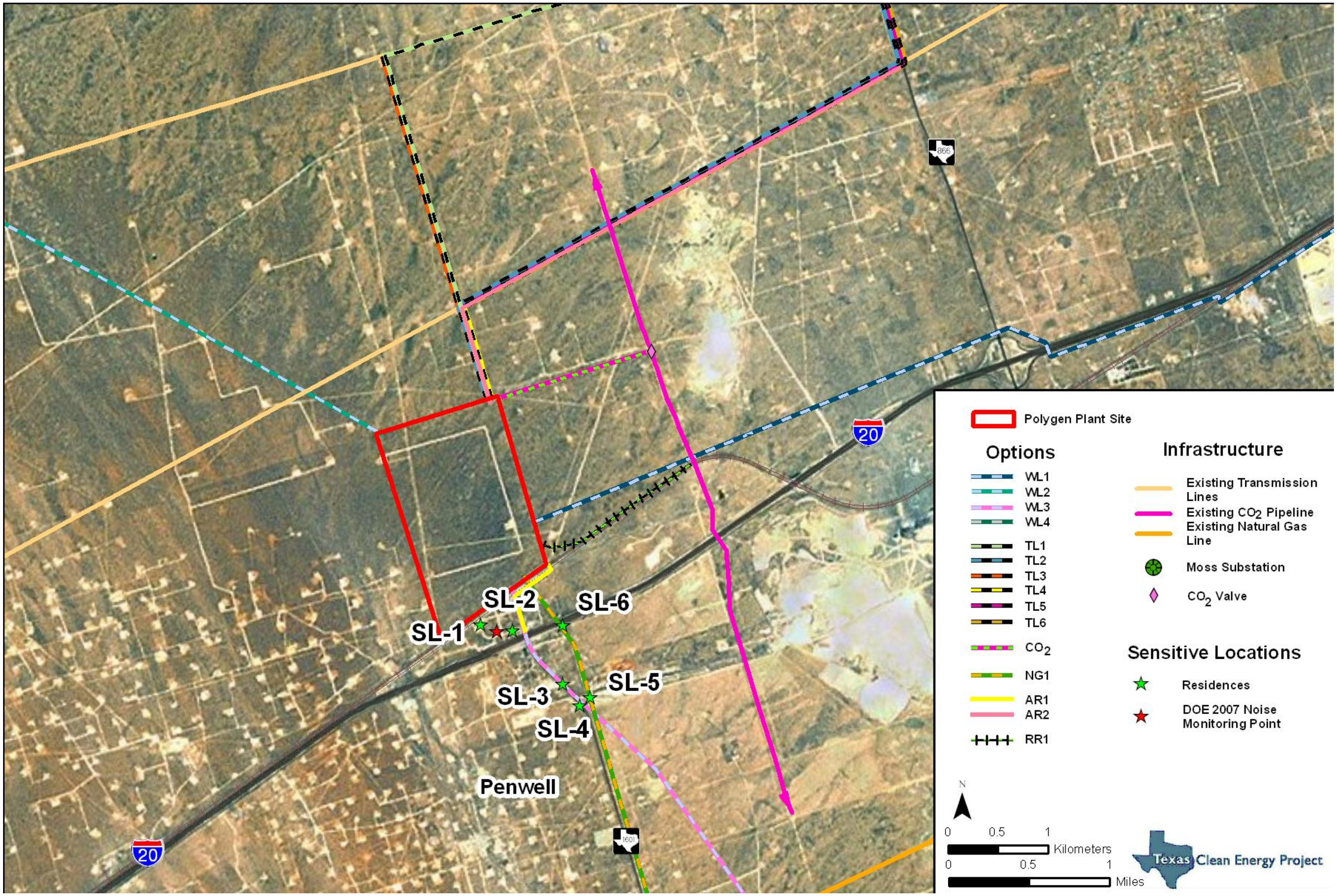

Figure 3.33. Noise receptor locations.

Table 3.63. Noise Levels from Common Construction Equipment

Construction Equipment	Typical Sound Pressure Level (dBA)*				
	50 ft (15 m)	100 ft (31 m)	500 ft (152 m)	1,500 ft (457 m)	3,000 ft (914 m)
Bulldozer (250–700 horsepower)	88	82	68	58	52
Front end loader (6–15 cubic yards)	88	82	68	58	52
Dump trucks (200–400 horsepower)	86	80	66	56	50
Grader (13- to 16-ft blade)	85	79	65	55	49
Shovels (2–5 cubic yards)	84	78	64	54	48
Portable generators (50–200 kilowatts)	84	78	64	54	48
Derrick crane (11–20 tn)	83	77	63	53	47
Mobile crane (11–20 tn)	83	77	63	53	47
Concrete pumps (30–150 cubic yards)	81	75	61	51	45
Tractor (0.75–2.00 cubic yards)	80	74	60	50	44
Un-quieted paving breaker	80	74	60	50	44
Quieted paving breaker	73	67	53	43	36

Source: EPA (1971); Barnes et al. (1976); CH2M Hill (2010).

* Sound attenuation was calculated using the following formula: $dBA_2 = dBA_1 + 20 \text{ Log}_{10} (D_1/D_2)$.

To determine the most conservative or maximum noise levels caused by project construction, the three loudest pieces of construction equipment (bulldozer, front end loader, and dump trucks) were combined. The combined noise level of 92.2 dBA was then attenuated over relative distances from the closest sensitive receptor north of I-20, (the SL-1 receptor site), as well as from the closest sensitive receptor site south of I-20 (SL-6) to the proposed polygen plant site. The existing ambient and proposed distance-attenuated noise levels were then combined to determine the estimated noise level at SL-1 and SL-6. Noise levels that would result from equipment-related construction activities associated with the TCEP are shown in Table 3.64.

Table 3.64. Noise Levels That Would Result from the TCEP at SL-1 and SL-6

Sensitive Receptor Location	Relative Distance (mi [km])	Existing Ambient Noise Level (dBA)	Equipment Noise Level Attenuated by Distance (dBA)	Estimated Noise Level (dBA)	Change in dBA
SL-1	0.25 (0.40)	62	63.8	66.0	4.0
SL-6	0.50 (0.80)	62*	57.7	63.4	1.4

*The ambient noise level at SL-6 was assumed to be the same as that measured for SL-1 because both are located near I-20.

The dBA noise levels presented in Table 3.64 approximate the noise intensity that would be experienced by people outdoors. Sound levels can be reduced by as much as 27 dB indoors, with windows closed. In dwellings with windows open, indoor sound levels can be reduced by up to 17 dB (EPA 1974). Construction-related equipment noise would be perceptible outdoors during the busiest periods of activity at the receptor locations north of I-20. SL-1 would experience a maximum (conservative) 4-dBA increase in noise. Those receptors south of I-20 would likely not hear a substantial noise level increase due to the existing ambient noise levels from vehicular traffic on I-20. The impacts from construction on residential and commercial land uses would be lower than FTA threshold levels, and thus would not be expected to result in adverse impacts on sensitive receptors near the proposed project area.

Intermittent increases in noise prior to and during polygen plant startup and commissioning would result from steam venting, which is a necessary part of the equipment-testing process prior to startup. Venting activities would last no more than two weeks, during which high-pressure steam (or air) would be allowed to escape through an outlet in the piping. A series of short sound blasts, lasting two or three minutes each, may be performed several times daily over that two-week period. Steam venting could be as loud as 120 dBA at the center of the polygen plant site and would attenuate to 84 dBA at the site boundary. Venting noise would further attenuate to 81 dBA at SL-1 and 79 dBA at SL-6. Table 3.65 shows the venting noise impacts that would occur at SL-1 and SL-6. Although substantially adverse on the proposed polygen plant site, these noise increases would be temporary and could be mitigated by limiting steam blows to daytime hours and providing advance notice to Penwell residents. The estimated levels of noise produced during the periods of steam venting would briefly exceed acceptable FTA levels for residential areas, but would meet FTA commercial and industrial-area construction threshold levels.

Table 3.65. Noise Levels That Would Be Caused by Steam Venting at SL-1 and SL-6

Sensitive Receptor	Relative Distance (mi [km])	Existing Ambient Noise Level (dBA)	Steam Venting Noise Level Attenuated by Distance (dBA)	Change in dBA
SL-1	0.25 (0.40)	62	81	19
SL-6	0.50 (0.80)	62	79	17

Linear Facilities

The construction of the linear facilities such as pipelines, access roads, and transmission lines would include site clearing, grading, excavation, foundation work, trenching, pipe laying, structure erection and installation, transmission wire installation, asphalt laying, and finishing work. These activities would require the use of heavy construction equipment that would likely be temporarily audible from locations outside the linear facility ROWs (temporary impacts would be those lasting for days or a few weeks, at most). The noise levels produced by linear-facility construction activities and heavy equipment would vary greatly depending on such factors as the operations being performed, the type of equipment being used, and if sound-attenuating features (e.g., trees, topography, buildings) were present. However, with the exception of NG1, AR1, and WL3, all other proposed linear facilities would enter the project area to the north or east of Penwell, and lie at least 0.5 mi (0.8 km) from the nearest receptors in and around Penwell. The construction of these linear facilities would likely create temporary, adverse noise impacts to sensitive receptors because they would be constructed close to all of the sensitive receptors along FM 1601 and in Penwell.

Additionally, there would be potentially adverse, temporary, construction-related noise impacts to receptors in outlying Odessa residential areas near the ROWs for TL5 and TL6.

Mobile Source Analysis

The DOE mobile source analysis evaluated the potential maximum effects of the anticipated increase in construction-vehicle traffic, including commuting construction workers, and haul trucks carrying equipment, supplies, and materials in and out of the project area. Expected maximum passenger car traffic would be 2,000 vehicle trips per day, with most traffic taking place during shift changes at 7:00 a.m., 5:00 p.m., and 11:00 p.m. Approximately 52 haul trucks per day would also access the project area. Primary access for construction would be on FM 866 (AR2) from I-20. Traffic could also access the proposed polygen plant site from FM 1601 (AR1); however, this road would have limited project-related use, serving as an emergency or supplemental access for TCEP vehicles. Projected AADT during peak construction was estimated for traffic on FM 866 and FM 1601. Noise levels that would result from traffic-related construction activities associated with the TCEP are shown in Table 3.66.

Table 3.66. Projected Traffic Conditions and Noise Increases during TCEP Peak Construction

Roadway	Existing Traffic (AADT*/PCE†)	Projected Traffic During Peak Construction (AADT*/PCE†)	Projected Change in Noise Levels (dBA)
I-20	15,580/116,538	18,630/120,992	0.2
FM 866	1,500/10,005	4,400/14,309	1.6
FM 1601	20/20	150/150	8.8

*AADT data obtained from Table 3.48 in Section 3.16, Transportation.

†PCE = passenger car equivalent, which is the adjusted AADT that accounts for truck sources, where one truck is equivalent to 28 passenger cars.

Traffic screening results indicate that the use of I-20 for construction-related activities would not result in substantial noise impacts on noise-sensitive receptors adjacent to I-20 and FM 866 because there would be an increase of less than 1 dBA for sensitive receptors located along both roadways. There would be a substantial increase (8.8 dBA) in noise intensity along FM 1601 and temporary noise-related impacts (during construction-related shift changes) to the two noise-sensitive receptors locations (SL-1 and SL-2) located north of I-20 in Penwell. The increase in noise along these access roads would meet FTA noise threshold levels, areas with high ambient noise levels (>65 dB) should not exceed that ambient noise by more than 10 dB, and the estimated dB increase from construction traffic would be within that range.

3.19.5.2 OPERATIONS

The TCEP operations-phase actions that would result in increased ambient noise levels include stationary sources such as plant equipment and transmission lines, as well as mobile sources such as worker and delivery vehicle traffic and rail traffic.

Stationary Source Analysis

Polygen plant operation equipment noise sources would be produced by the steam turbine-generator, gas combustion turbine-generator, HRSG, coal delivery and handling system, pumps, fans, compressors, vents, and relieve valves. Design measures used to reduce operational noise levels include locating and orienting plant equipment to minimize sound emissions, providing buffer zones, enclosing noise sources in buildings, installing inlet air silencers for the combustion turbine, and including silencers on plant vents and relief valves.

Based on the proposed design for the polygen plant, operations would produce an estimated Leq of 65 dBA at the southern fence line of the polygen plant site (Fluor 2010). Using this identified source noise level, DOE applied a sound attenuation equation to determine the noise levels at sensitive receptor locations. The operational noise level at the polygen plant boundary is estimated to attenuate to 61 dBA at SL-1 and 59 dBA at SL-6. These noise intensities would exceed the EPA 55 dBA Ldn noise threshold by 6 dBA at SL-1 and by 4 dBA at SL-6 for the long-term health and safety of nearby noise receptors. However, the 55 dBA level is applicable to outdoor activities; indoor noise attenuation, as discussed above, would reduce the long-term indoor noise levels to be in compliance with the EPA health and safety guidelines.

During operations, combustible gas or steam releases would occur from unscheduled restarts of the polygen plant or emergency-pressure safety valve discharges. If a flare operation or pressure safety valve discharge did occur, it could produce an increase in noise levels at the discharge point and temporarily increase the ambient noise levels near the noise source to a range from 96 to 105 dBA. Outdoor receptors within approximately 3,000 ft (914 m) of the polygen plant would experience adverse noise impacts of short, temporary duration. Therefore, receptors at SL-1 and SL-2 would be temporarily and briefly, but adversely affected, by these unpredictable and unscheduled noise increases.

No noise impacts would occur from operation of the pipelines. However, under wet weather conditions, the transmission lines may generate an audible or low frequency noise, commonly referred to as a “humming noise.” The audible noise emitted from transmission lines is caused by the discharge of energy (corona discharge) that occurs when the electrical field strength on the conductor surface is greater than the “breakdown strength” (the field intensity necessary to start a flow of electric current) of the air surrounding the conductor. The intensity of the corona discharge and the resulting audible noise are influenced by atmospheric conditions. Corona noise is generally not noticeable because humans are typically insensitive to low frequency noise. To reduce the potential for corona noise, the TCEP transmission lines would be designed, constructed, and maintained in accordance with current practices that operate below the corona-producing voltage.

Mobile Source Analysis

TCEP-related operations traffic would be intermittent and would be primarily caused from workers’ vehicles and delivery trucks traveling to and from the project area. The TCEP is expected to have approximately 150 full-time workers. As with the construction phase, operations traffic would access the site from the east using FM 866, with the use of FM 1601 as a project secondary or emergency access road. Expected vehicle traffic volume along FM 866 would be approximately 300 car trips and 52 truck trips daily during operation, with most traffic transiting the project area during shift changes at 7:00 a.m., 5:00 p.m., and 11:00 p.m. Noise levels caused by traffic-related operational activities associated with the TCEP are shown in Table 3.67.

Table 3.67. Projected Traffic Conditions and Noise Increases during TCEP Peak Operation

Roadway	Existing Traffic (AADT[*]/PCE[†])	Projected Traffic During Peak Operation (AADT[*]/PCE[†])	Projected Change in Noise Levels (dBA)
I-20	15,580/116,538	15,930/118,022	0.1
FM 866	1,500/10,005	1,835/11,474	0.6
FM 1601	20/20	35/35	2.4

[*]AADT data obtained from Table 3.49 in Section 3.16, Transportation.

[†]PCE = passenger car equivalent, which is the adjusted AADT that accounts for truck sources, where one truck is equivalent to 28 passenger cars.

Traffic screening results indicate that the use of I-20 and FM 866 for project operations and commuting would not produce substantial noise impacts on noise-sensitive receptors located along either roadway. As shown in Table 3.67, the projected noise increase from project-related traffic along the main project access way on FM 866 would be negligible. Also, distance attenuation from the roadway to the sensitive receptor locations would further reduce any noise impacts. There would be an increase in noise activity along the secondary access way on FM 1601 (a 2.4-dBA increase) that would affect the two noise-sensitive receptors locations located north of I-20 in Penwell (SL-1 and SL-2). The polygen plant operations and commuter traffic noise would have adverse impacts on sensitive receptors in Penwell, but the TCEP would not likely be the dominant source of noise at the noise-sensitive receptors because both receptor locations are in proximity to the I-20 transportation corridor and are more likely to be affected by noise from the traffic associated with the highway.

FTA provides estimated noise levels for a locomotive, railcars, whistles or horns, and track switches or crossovers as a freight train passes a nearby receptor (FTA 2006). The maximum level values ranging from 76 to 88 dBA are based on an operating speed of 30 mi (48 km) per hour approximately 50 ft (15 m) from the track centerline. Summit estimates that an average of seven 135-car unit trains per week would be required for coal, urea, H_2SO_4, and slag transport. When compared to existing daily trips of 17 trains (or a maximum of 119 trains per 7-day week) (DOE 2007), this would increase rail activity by 6 percent. It should be noted that rail traffic noise levels already exist from trains and cars traveling along the tracks through Penwell, and that the sensitive receptors closest to the rail line (SL-1 and SL-2) are already being impacted by this type of noise. There would be an adverse, minor increase in noise impacts to receptors at SL-1 and SL-2 in Penwell caused by the approximately 3 percent increase in rail traffic because SL-1 lies within 300 ft (91 m) of the track, and SL-2 lies within 1,100 ft (335 m) of the track. Receptors at SL-3 through SL-6 would not be impacted beyond existing conditions because the 3 percent increase in rail traffic would not likely be heard due to distance attenuation of train traffic noise levels and the intervening I-20 traffic.

3.19.6 Mitigation

Mitigation measures that Summit would implement as part of the construction and operation of the TCEP are described in Section 2.5. Additional mitigation measures that Summit could implement or that DOE could require as a condition of approval to further reduce impacts of noise and vibration are:

- minimizing diesel and gasoline generator use for operating construction equipment; and
- improving project area access routes where necessary to minimize traffic congestion, which would shorten commuter-related noise by reducing commuter times

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