FINAL

BIOLOGICAL ASSESSMENT

PREPARED FOR

CHAMISA CAES AT TULIA LLC

PREPARED BY

Blanton & Associates, Inc.
Environmental Consulting • Planning • Project Management
5 Lakeway Centre Court, Suite 200
Lakeway, Texas 78734
512-264-1095
blantonassociates.com

JANUARY 2014

EXECUTIVE SUMMARY

Chamisa CAES at Tulia LLC submitted its Greenhouse Gas Prevention of Significant Deterioration (PSD) permit application in October 2012 for its proposed power plant (referred to hereafter as the *proposed project*) near the City of Tulia in the Counties of Swisher and Castro, Texas. The federal permitting process requires compliance with Section 7 of the Endangered Species Act (1973) as amended (ESA). This Biological Assessment (BA) was commissioned to fulfill the ESA requirements. The proposed project would consist of a compressed air energy storage (CAES) power generation facility, an overhead electrical transmission line to bring electrical power to the facility (power-in line), and an overhead electrical transmission line to deliver power to the electrical utility grid (power-out line).

The property for the proposed project consists of old field, pasture (degraded shortgrass prairie) and croplands. The property for the power generation facility is 207 hectares (ha) (512 acres (ac)), and is bounded to the north by State Highway 86, to the east by the Marshall Formby Memorial Highway (Interstate Highway 27), to the south by County Road Q, and to the west by an adjacent ranch. The proposed 10.0-kilometer (km) (6.2 mile) power-in line would run inside an existing power line right-of-way (ROW) along State Highway 86 from the Swisher Electric Cooperative Lakeview substation and would have a footprint of 32 ha (78 ac). There are two optional routes for the proposed power-out line. The first would run 9.3 km (5.8 mi) south from the power generation facility to a point of interconnection with an existing Competitive Renewable Energy Zone transmission line along a new ROW with an area of 29 ha (71 ac). The second would run 21.4 km (13.3 mi) west from the power generation facility to the Sharyland Nazareth substation along a new ROW with an area of 62.8 ha (155.2 ac). The total area for the proposed project would be 331 ha (817 ac). Provided all required permits have been issued, it is anticipated that construction would commence by June 2014, and that commercial operation would start in the last quarter of 2017.

The purpose of the proposed project is to provide a new source of reliable electrical power to meet growing, but fluctuating, statewide demand. The proposed project would generate up to 270 megawatts of electrical power from two expansion turbine trains driven by combusting stored compressed air and natural gas. The proposed project is innovative in its use of excess off-peak electrical energy (which is likely to be largely comprised of wind energy that would otherwise be unused) to pump compressed air into a reservoir consisting of multiple, on-site, subterranean caverns. During times of peak electrical demand, the proposed project would return electrical power to the grid by combusting the stored compressed air with natural gas to drive one or two expansion turbines. The use of compressed air in the combustion cycle significantly reduces the amount of natural gas needed to generate an equivalent amount of power with ambient (unpressurized) air. Consequently, this technology reduces emissions per unit mass of combusted natural gas. In addition, with its ability to store energy created by wind and photovoltaic solar facilities, which have no emissions, and low water consumption, the proposed project would provide societal benefits beyond economics and reliability.

In support of this BA, Waid Environmental performed atmospheric dispersion modeling of air pollutants that will be emitted by the proposed project. All predicted impacts from the project on the ambient air, as well as existing concentrations in the area, are demonstrated to comply with both the primary and secondary National Ambient Air Quality Standards (NAAQS). Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. All the predicted ambient air concentrations due to the project are less than the Significant Impact Levels (SILs) designated by the EPA for each pollutant and averaging period for which SILs have been established[1].

For this BA, the Action Area consists of the entirety of the property on which the proposed power generation facility would be located plus the footprint of the proposed power-in and both proposed power-out transmission lines options. Worst-case emissions dispersion modeling developed in support of this BA showed that no significant ambient air impacts would occur. The Action Area is in an arid region. Natural habitat and vegetation has been eradicated through cultivation and grazing. The immediate surroundings have been subjected to similar agricultural disturbance or are urbanized.

Federal agencies must establish, through consultation (or conferencing for proposed species) with the United States Fish and Wildlife Service (USFWS), that their actions would not jeopardize the continued existence of any threatened, endangered, or proposed species or result in the destruction or adverse modification of Designated Critical Habitat (DCH) (ESA, Section 7). This BA analyzes the potential effects of the proposed project on species that are protected under the ESA with potential for occurrence in the Action Area, i.e., those that have the potential to occur in Swisher and Castro Counties.

As determined by the USFWS, there is one federally endangered species, the whooping crane (*Grus americana*), and one federally proposed threatened species, the lesser prairie chicken (*Tympanuchus pallidicinctus),* that have potential for occurrence in Swisher and Castro Counties. Texas Parks and Wildlife Department lists two other federally endangered species for Swisher and Castro Counties, the black-footed ferret (*Mustela nigripes*) and the gray wolf (*Canis lupus*).

For the whooping crane, the Action Area is 90 miles west of the western boundary of the whooping crane's 94% migratory corridor. There are no recorded sightings of the whooping crane in the county, though extremely limited, marginal potential stop over habitat exists within the Action Area. There is virtually no possibility of the whooping crane occurring in the Action Area. Therefore, the recommended determination is that the proposed project would have no effect on the whooping crane.

For the lesser prairie chicken, the Action Area is devoid of suitable habitat (mixed grass prairie with woody shrub cover). There are no recorded sightings of the lesser prairie chicken in the county. There is virtually no possibility of the lesser prairie chicken occurring in the Action Area. The construction and operation of the proposed project are not likely to result in adverse impacts to this proposed species.

[1] On January 22, 2013 in the case of *Sierra Club v. E.P.A No. 10-1413* (D.C. Cir Jan. 22, 2013,) the U.S. Court of Appeals for the District of Columbia vacated the SILs for particulate matter with diameters less than 2.5 microns ($PM_{2.5}$). At this time, therefore, there are no SILs for $PM_{2.5}$. However, the ambient air impacts of the project, when combined with the background ambient air concentrations in the surrounding environment, have been found to comply with the NAAQS. The project impacts of $PM_{2.5}$ were also found to be well below the SILs which had been established prior to the Court of Appeals' January decision.

The black-footed ferret and the gray wolf have been extirpated from the State of Texas and thus will not occur in the Action Area. Therefore, the recommended determinations are that the proposed project will no effect on either the black-footed ferret or the gray wolf.

No areas of DCH were identified in the Action Area; therefore, the BA recommends a finding of “no effect” on DCH by the proposed project.

Table of Contents

Appendices

Figures

Tables

ABBREVIATIONS/ACRONYMS AND UNITS

Acronyms

AQRV	air quality related values
BA	Biological Assessment
BMP	best management practice
CAA	Clean Air Act (1970) as amended
CAES	compressed-air energy storage
CFR	Code of Federal Regulations
DCH	Designated Critical Habitat
EHS	Environmental Health and Safety
EPA	Environmental Protection Agency
EPN	emission point number
ESA	Endangered Species Act (1973) as amended
ESL	Effect Screening Level
FM	Farm-to-Market
GAP	Geographic Approach to Planning
GHG	greenhouse gas
IFC	International Financial Corporation
NLCD	National Land Cover Database
NPS	National Park Service
NSPS	New Source Performance Standards
NSR	New Source Review
NWR	National Wildlife Refuge
PBR	permit-by-rule
PSD	Prevention of Significant Deterioration
SCR	selective catalytic reduction
SIL	significant impact level
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSP	total suspended particulates
TXNDD	Texas Natural Diversity Database
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compounds

Units

ac	acre
BTU	British thermal unit
cm	centimeter
dB	decibel
ekW	electrical kilowatts
gpm	gallons per minute
ha	hectare
hp	horse power
in	inch
kg	kilogram
km	kilometer
ekW	electrical kilowatt
L_{Aeq}	A-weighted equivalent sound level
lb	pound
m	meter
mi	mile
MMBTU	million BTU
MW	megawatt
µm	micrometer
ppmvd	parts per million by volume, dry basis
tpy	tons per year

1.0 INTRODUCTION AND BACKGROUND

Chamisa CAES at Tulia LLC has submitted an application for a Prevention of Significant Deterioration (PSD) Air Quality Permit for Greenhouse Gas (GHG) Pollutants for a proposed power plant (referred to hereafter as the *proposed project*) near the City of Tulia, in the Counties of Swisher and Castro, Texas (**Figure 1**). Under the U.S. Environmental Protection Agency's (EPA) *Tailoring Rule* for phased-in permitting of GHG-emitting sources, from January 2, 2011, new sources that have the potential to emit 75,000 tons per year (tpy) or more of GHGs are subject to PSD permitting requirements (EPA 2010). EPA issued the Federal Implementation Plan for Texas as a final rule, under which EPA will be the permitting authority for major sources of GHG (EPA 2011). GHGs include the aggregate of carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (EPA 2012a).

Federal GHG permitting creates a federal nexus requiring Chamisa CAES at Tulia LLC (referred to hereafter as Chamisa) to comply with Section 7 of the Endangered Species Act (1973) as amended (ESA) (USFWS 2005). This Biological Assessment (BA) has been conducted in order to satisfy the Section 7 ESA requirements and provides the results of a detailed study of the potential effects of the proposed federal action on plant and wildlife species that are listed as threatened or endangered under the authority of the ESA. The BA is based on detailed reviews of the proposed project and pertinent literature; on-site habitat and vegetation assessments; and an analysis of the potential effects on federally listed species and designated critical habitat (DCH) due to the construction and operation of the proposed project within the Action Area (i.e., the area of potential impacts) (**Section 3.0**).

1.1 Proposed Project

The purpose of proposed project is to provide a new source of reliable electrical power to meet growing, but fluctuating, statewide demand. The proposed project would operate two new expansion turbine trains that would generate up to 270 megawatts (MW) of electrical power by combusting compressed air and natural gas. The proposed project is innovative in its use of excess off-peak electrical energy (that would otherwise be unused) to pump compressed air into a reservoir consisting of multiple, on-site, subterranean caverns. Chamisa's compressors can capture renewable energy whenever it is available and save that energy until it is needed. The electrical power required to run the compressors would enter the power generation facility through a new (power-in) transmission line. During times of peak electrical demand, the proposed project would return electrical power to the grid by combusting the stored compressed air with natural gas to drive one or two expansion turbines. The power generated by the power facility would be sent to the grid by a new (power-out) transmission line. The use of compressed air in the combustion cycle significantly reduces the amount of natural gas that would have to be used to generate an equivalent amount of power with ambient (unpressurized) air. Consequently, this compressed-air energy storage (CAES) technology reduces emissions per unit mass of combusted natural gas. Provided all required permits have been issued, it is anticipated that construction would commence by June 2014. The anticipated commercial operation date for the project is the last quarter of 2017.

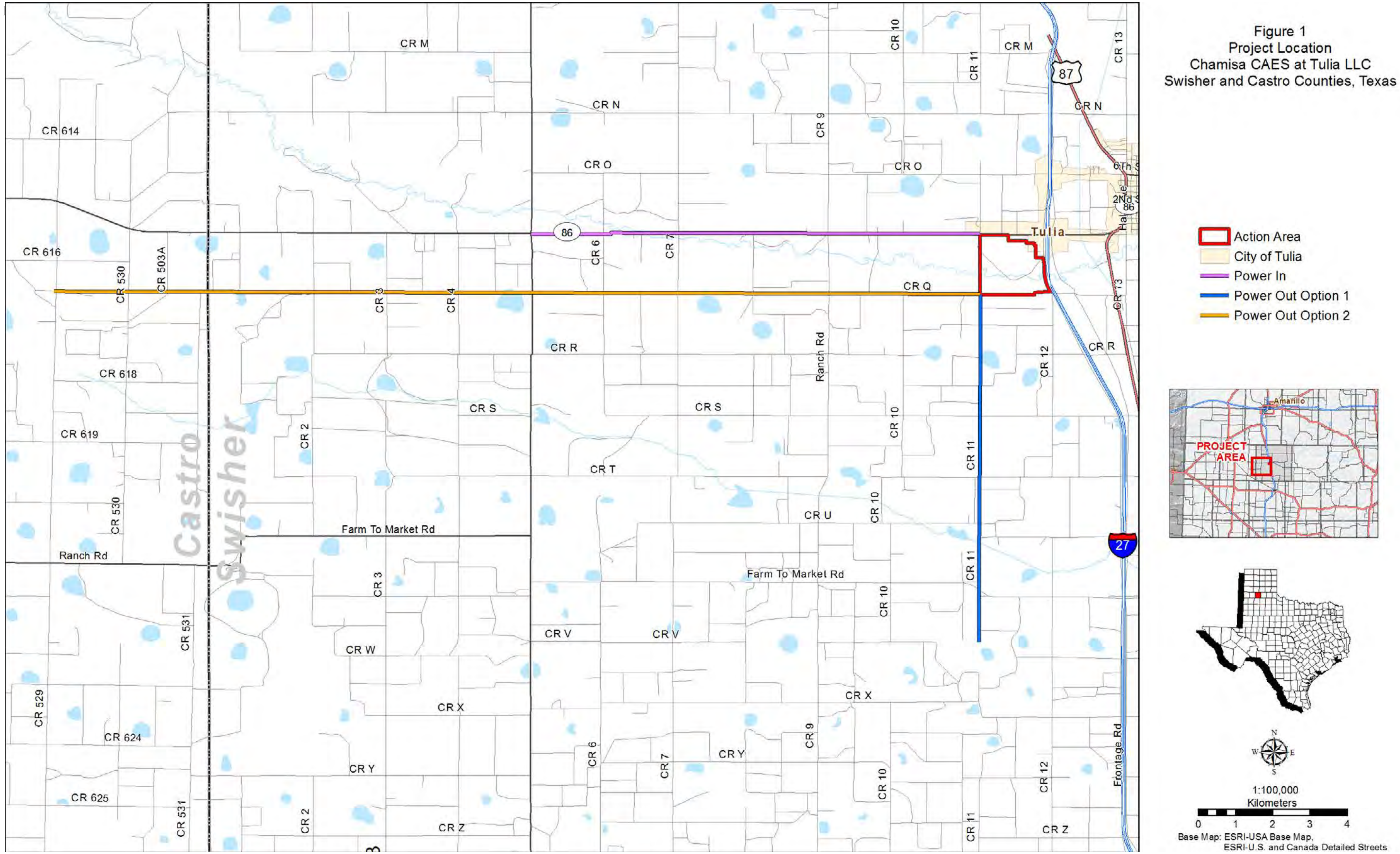


Figure 1
Project Location
Chamisa CAES at Tulia LLC
Swisher and Castro Counties, Texas

1.2 Definition of Study Area

The study area that is referenced throughout this BA is the Action Area, which has been defined as the entirety of the property on which the proposed power generation facility would be located plus the combined footprints of the proposed transmission line routes (shown in overview in **Figure 1** and in detail in **Figures 2** through **5**). The analysis of federally listed species and DCH likely to be affected by the proposed project is focused on impacts within the project's Action Area.

1.3 Endangered Species Act

The objective of this BA is to evaluate the effects of the proposed project on the federally listed species and DCH that are protected under the ESA. A brief overview of the ESA is presented below to provide the context for the evaluation of regulatory compliance.

As described in the United States Code (USC), the ESA prohibits *take* of any federally listed species (16 USC §1538(a)), where take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC §1532(19)). The ESA requires that federal agencies ensure that any activity that an agency funds, authorizes, or carries out does not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of DCH (16 USC §1536). The United States Fish and Wildlife Service (USFWS) has legislative authority under the ESA to list and monitor the status of wildlife species whose populations are considered to be imperiled (16 USC §1533). Species listed as *endangered* or *threatened* by the USFWS are provided full protection, while those listed as *proposed* species are not protected but must be studied. This protection not only prohibits the direct take of a protected species but also includes a prohibition of indirect take, such as destruction of habitat or DCH. Federal listings for protected animal and plants are provided in separate chapters of the Code of Federal Regulation (CFR): 50 CFR 17.11 for animals and 50 CFR 17.12 for plants. The federal process stratifies potential candidates based upon the species' biological vulnerabilities. The vulnerability decision is based on many factors affecting the species within its range and is always linked to the best scientific data available to the USFWS. While on the *candidate* list, species are not provided any federal protection but may be protected by state law. ESA implementing regulations (50 CFR 402) require completing a BA to determine whether a proposed project may affect a listed species.

Three possible determinations of effect are considered under the ESA (USFWS and National Marine Fisheries Service [NMFS] 1998):

1) No effect—A no-effect determination means there are absolutely no effects from the proposed project, positive or negative, to a listed species. No-effect determinations do not require written concurrence from the USFWS unless the National Environmental Policy Act analysis is an Environmental Impact Statement. However, the USFWS may request copies of no-effect assessments for its files.

2) May affect, but is not likely to adversely affect—This determination may be reached for a proposed project where all effects are *beneficial*, *insignificant*, or *discountable*. Beneficial effects have

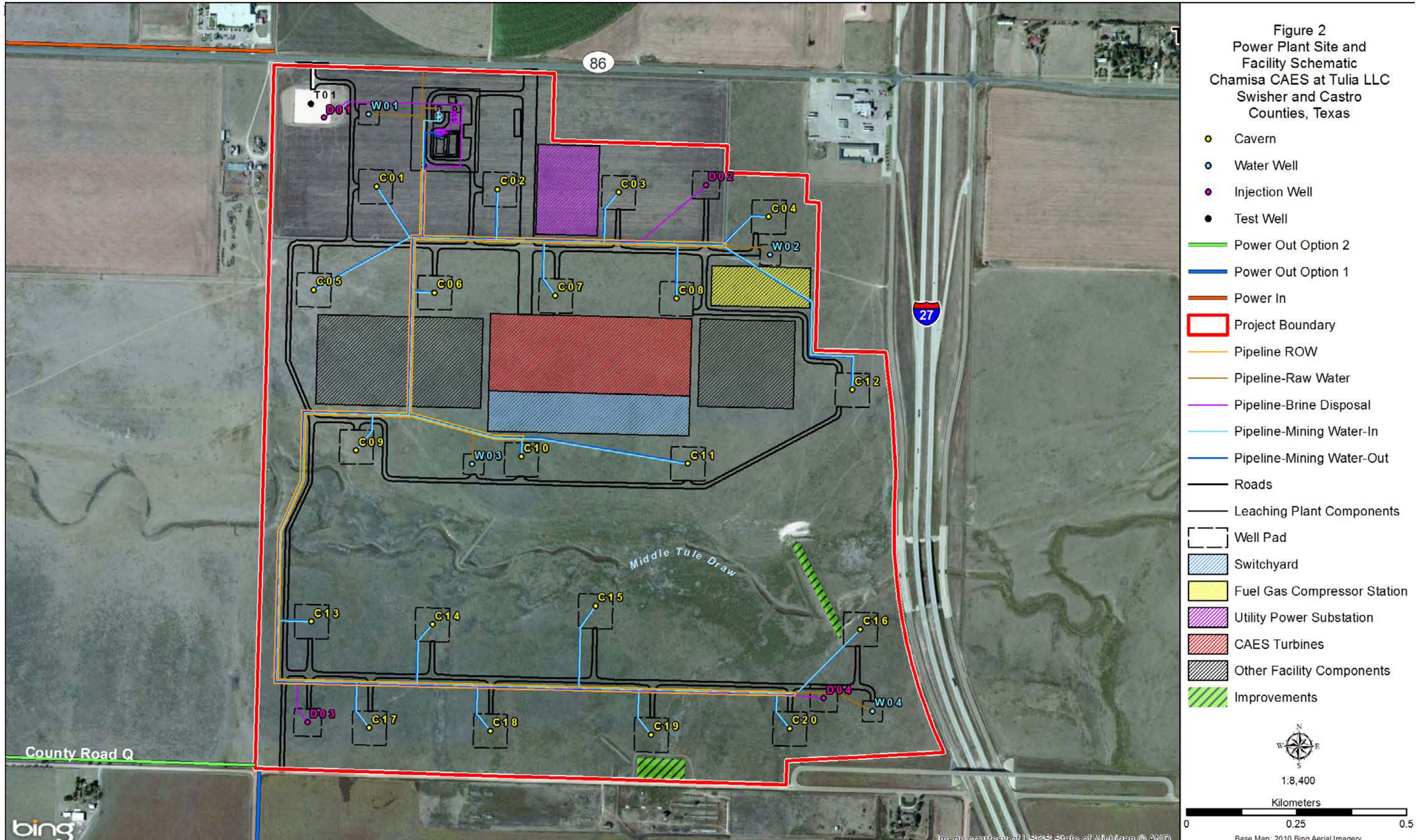


Figure 2
Power Plant Site and
Facility Schematic
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas
Cavern
Water Well
Injection Well
Test Well
Power Out Option 2
Power Out Option 1
Power In
Project Boundary
Pipeline ROW
Pipeline-Raw Water
Pipeline-Brine Disposal
Pipeline-Mining Water-In
Pipeline-Mining Water-Out
Roads
Leaching Plant Components
Well Pad
Switchyard
Fuel Gas Compressor Station
Utility Power Substation
CAES Turbines
Other Facility Components
Improvements
1:8,400
Kilometers
0
0.25
0.5
Base Map: 2010 Bing Aerial Imagery
86
27
T01
D01
W01
C01
C02
C03
D02
C04
W02
C05
C06
C07
C08
C12
C09
W03
C10
C11
Middle Tule Draw
C13
C14
C15
C16
D04
W04
D03
C17
C18
C19
C20
County Road Q
bing
Image courtesy of USGS State of Michigan © AND


Figure 3
Power In Transmission Line
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas
Cavern
Water Well
Injection Well
Test Well
Power In
Project Boundary
Pipeline ROW
Pipeline-Raw Water
Pipeline-Brine Disposal
Pipeline-Mining Water-In
Pipeline-Mining Water-Out
Roads
Leaching Plant Components
Well Pad
Switchyard
Fuel Gas Compressor Station
Utility Power Substation
CAES Turbines
Other Facility Components
Improvements
1:36,000
Kilometers
0 0.25 0.5 1 1.5 2
Base Map: 2010 Bing Aerial Imagery
County Road N
County Road O
County Road O
County Road 7
County Road 9
County Road 11
86
Swisher
FM 1424
Ranch Road 3141
County Road Q
County Road 10
County Road 6
County Road R
County Road S
County Road 11


Figure 4
Power Out Option 1
Transmission Line
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas
Cavern
Water Well
Injection Well
Test Well
Power In
Power Out Option 1
Power Out Option 2
Project Boundary
Pipeline ROW
Pipeline-Raw Water
Pipeline-Brine Disposal
Pipeline-Mining Water-In
Pipeline-Mining Water-Out
Roads
Leaching Plant Components
Well Pad
Switchyard
Fuel Gas Compressor Station
Utility Power Substation
CAES Turbines
Other Facility Components
Improvements
1:36,000
Kilometers
0 0.5 1 2
Base Map: 2010 Bing Aerial Imagery
US Hwy 87
County Road 13
County Road 12
County Road 11
County Road 10
County Road 9
County Road Q
County Road R
County Road S
County Road T
County Road U
Farm-To-Market Road 928
Ranch Road 3141
Frontage
Rest Area
Exit 74
Exit 68
Swisher
Cementery
bing

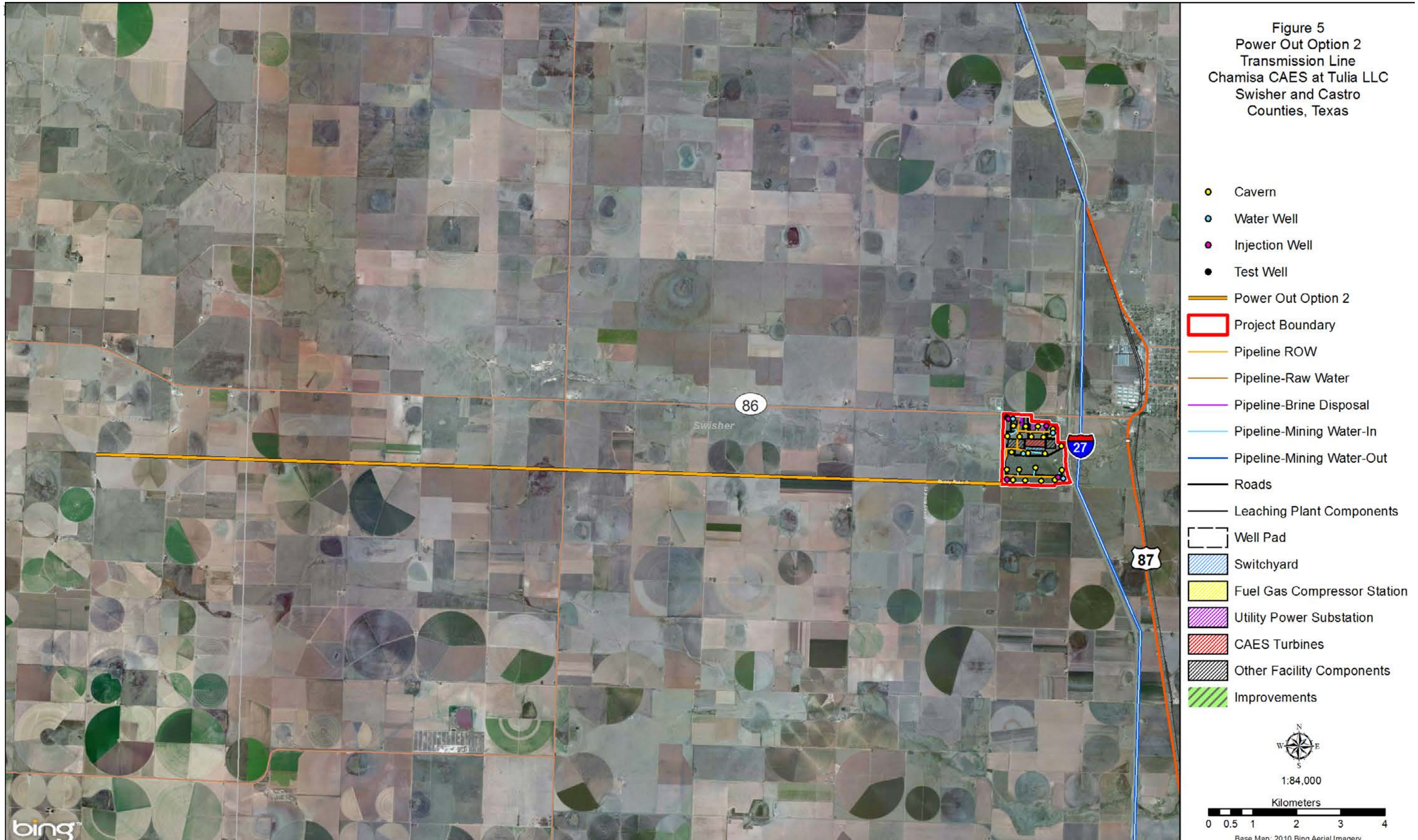


Figure 5
Power Out Option 2
Transmission Line
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas

contemporaneous positive effects without any adverse effect to a listed species or its habitat. Balancing of positive and negative effects does not outweigh adverse effects. Insignificant effects relate to the size of the effects and should not reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. This determination is usually reached through the *informal* consultation process, wherein written concurrence from the USFWS exempts the proposed project from *formal* consultation (USFWS and NMFS 1998).

3) May affect, and is likely to adversely affect—This determination means that all adverse effects cannot be avoided. Section 7 of the ESA requires that the federal action agency request initiation of formal consultation with the USFWS when a "may affect, likely to adversely affect" determination is made. A written request for formal consultation should accompany the BA. Note that, if an action agency and the USFWS find that the proposed project "*may affect, and is likely to adversely affect*" a listed species, or if the USFWS does not concur with an action agency's finding of "*not likely to adversely affect*," then formal consultation is required between the action agency and the USFWS (USFWS and NMFS 1998). Formal consultation results in the USFWS issuing a biological opinion as to whether the action, as proposed, will jeopardize the continued existence of any listed species.

This BA concludes with the recommended determinations of effect for each federally listed species with potential for occurrence in the Action Area.

1.4 Structure and Format of the Biological Assessment

This BA provides descriptions of the proposed project and its Action Area, the listed species and habitat therein, and the environmental baseline information necessary to support an analysis and determination of the effects of the proposed project on listed species and habitats (50 CFR 402, USFWS and NMFS 1998). Accordingly, this report is structured as follows:

1.0 Introduction and Background
2.0 Project Description
3.0 Identification and Discussion of the Action Area
4.0 Federally Listed Threatened or Endangered Species and Designated Critical Habitat of Potential Occurrence in the Action Area
5.0 Existing Conditions in the Action Area
6.0 Analysis of Potential Impacts and Determinations of Effect

2.0 PROJECT DESCRIPTION

2.1 Project Location and Footprint

The proposed project would have three components - the (CAES) power generation facility, the power-in transmission line and the power-out transmission line.

- ***CAES Power Generation Facility***: The power generation facility would be located approximately 2.4 km (1.5 mi) west of downtown Tulia in Swisher County, Texas. (**Figures 1** and **2**). The property where the power generation facility would be located consists of 207.3 ha (512.2 ac) of old field and pasture, bounded to the north by State Highway 86, to the east by the Marshall Formby Memorial Highway (Interstate Highway 27), to the south by County Road Q, and to the west by an adjacent ranch. The centroid of the power generation facility is located at longitude 101º 48' 14.46" west, latitude 34º 31' 17.77" north.

- ***Power-in Transmission Line***: The 10.0-kilometer (km) (6.2 mile) power-in line would run inside an existing power line right-of-way (ROW) owned by the Swisher County Electric Co-Op along State Highway 86 from the Lakeview substation and would have a footprint of 31.5 ha (77.8 ac) (**Figures 1** and **3**). The power-in line would run within existing and new rights-of-way obtained by the Swisher County Electric Co-Op which will build, own and operate the power-in line.

- ***Power-out Transmission Line***: There are two optional routes for the proposed power-out line. The first would run 9.3 km (5.8 mi) south from the power generation facility to a point of interconnection with an existing Competitive Renewable Energy Zone transmission line along a new ROW with an area of 28.8 ha (71.2 ac) (**Figures 1** and **4**). Chamisa anticipates this option would run within easements obtained by Sharyland Utilities through Swisher County. The second would run 21.4 km (13.3 mi) west from the power generation facility to the Sharyland Nazareth substation along a new ROW with an area of 62.9 ha (155.4 ac) (**Figures 1** and **5**). Chamisa anticipates this option would run within easements obtained by Sharyland Utilities through both Swisher and Castro Counties.

The combined footprints of all proposed project components, including both power-out line options, is 329.7 ha (815.1 ac).

2.2 Project Purpose

The purpose of the proposed project is to provide a new, reliable and economical source of electrical energy during peak consumption periods by using excess electrical power from the grid to store compressed air in underground storage wells (caverns) during off-peak periods. The economic advantages of this process are, first, that use of stored, compressed air versus ambient air reduces the mass of natural gas needed to produce an equivalent amount of electrical power. Second, excess electrical energy during off-peak periods would be converted to usable (combustible) compressed air. Overall, pollutant emissions and fuel consumption associated with this technology would be reduced as compared to that in more conventional gas-power plant designs. Third, the proposed project would enable the utilization of more wind and solar-generated energy by electric consumers.

2.3 Construction Information

The physical components of the proposed project to be constructed are the water wells, compression wells, air and water lines, leaching facility, expansion turbines, and supporting structures (**Figure 2)**. The transmission lines would consist of utility poles, transmission lines, and a switchyard for interconnection. The switchyard will be located on the project site.

Power Generation Facility Construction Plan: Construction of the proposed project would begin once all necessary permits are received and would last approximately 36 months. The proposed project facility would be constructed within the entire 207.3 ha (522 ac) owned by Chamisa and the transmission lines providing power to and taking power from the site would be constructed within the corridors described above. Construction would consist of clearing areas of vegetation as required, establishing site grade to facilitate and control drainage, separating the top soil, and utilizing existing soils and additional imported material in construction placement of foundations and berms, the design of which would be based on the site geotechnical investigation and which has not been performed at the time of this assessment. Construction activities would include erection of buildings and other structures including tanks; and, installation of equipment, systems and controls necessary to make the proposed project a complete and functional power generating facility. Site completion would include permanent drainage controls, erosion control, and surface restoration including sowing native grass seed in non-process areas.

The anticipated usage for large construction equipment items would be:

12 bulldozers – 26 weeks each
32 track excavators – 26 weeks each
8 mixer trucks – 8 weeks each
4 smooth drum rollers – 16 weeks each
8 skidsteer loaders – 26 weeks each
12 sideboom pipeline cranes – 26 weeks each
4 large capacity cranes – 16 weeks each
4 trenchers – 26 weeks each
2 motor graders – 26 weeks each
8 manlifts – 52 weeks each

Transmission Line Construction Plan: Construction of the proposed transmission lines would begin once all necessary permits and approvals are received. Access to the transmission line ROW is readily accessible from public and private roadways. Excavations would be done only for utility pole foundations. The power in transmission line will be independently constructed by Swisher County Electric Co-Op and the Co-Op will apply for the necessary approvals and will control the construction and operation of the line. The power in line will be independently constructed and operated by Sharyland Utilities. Sharyland Utilities will apply to Texas Public Utility Commission (PUC) in accordance with the PUC's rules and procedures for granting of a Certificate of Convenience and Necessity (CCN) for new transmission line construction. Only one power-out line option would be built, and it would be entirely new construction.

Dust and Noise: During construction, dust mobilization will be minimized by routinely employing best management practices (BMPs), and any potential impacts are projected to be negligible. Noise during construction will be temporary.

2.4 Emission and Emission Controls

The proposed project is a major source of GHG emissions because its anticipated emissions have global warming potential equivalent to more than 100,000 tpy of emissions of carbon dioxide (EPA 2012b). As a new major source of GHG emissions, the proposed project is required to obtain a pre-construction air quality permit under the PSD rules. No other emissions released by the proposed project are subject to permitting under the PSD rules because the emission rates are less than the levels defined as significant emission increases. Those emissions, however, are subject to the State of Texas pre-construction authorization requirements, and the authorization for the associated facilities and emissions is the subject of the Texas Commission on Environmental Quality (TCEQ) standard permit registration.

Emissions from the proposed project are summarized in **Table 1**. Start-up emissions are included in the annual emissions, with two start-up/shutdown cycles per day assumed for each engine. Annualized emissions are conservatively assumed to reflect 5,000 hours of operation at full load.

Table 1. Chamisa Total Potential Emissions from All On-Site Sources

Pollutant	Potential Emissions (tpy)
Sulfur Hexafluoride	0.0073
Hazardous Air Pollutants	3.46
Sulfur Dioxide	4.64
Volatile Organic Compounds	6.27
Particulate Matter ≤ 2.5 microns diameter	7.61
Particulate Matter ≤ 10 microns diameter	8.29
Nitrous Oxide	9.96
Ammonia	33.37
Oxides of Nitrogen	38.00
Carbon Monoxide	40.04
Methane	43.74
Carbon Dioxide	397,230
GHG	397,284
GHG as Carbon Dioxide-equivalents	401,415

2.5 Water Use and Handling

Storm Water Handling: Prior to beginning construction activities, Chamisa will apply for coverage under the Texas General Permit for Storm Water Discharges Associated with Construction Activity. Chamisa's construction contractor will use appropriate best management practices to manage storm water runoff related to construction.

Construction and Solution Mining Water: Construction and mining water will come from four on-site wells completed in the Dockum aquifer and would be located as shown on **Figure 2**. Plant and process water will come from Ogallala wells which currently exist on the project site and are located as shown on **Figure 2**. Brine solution from the mining phase is to be injected into four proposed brine disposal wells on the project site to be located as shown on **Figure 2**.

Cooling Water Handling: The proposed cooling towers will have three to four cycles of concentration. The cooling tower flow rate will be 21,592 gallons per minute (gpm), with 377 gpm of evaporation and a drift rate of 0.0010%. The cooling tower water will be treated according to federal regulations in order to minimize scaling, fouling, and the growth of bacteria, algae, and fungi. Makeup water (blowdown + evaporation + drift) for the cooling tower will be supplied by either an existing Dockum (Santa Rosa) or existing Ogallala well and will be treated accordingly. If solution mining continues after commencement of cooling tower operations, then, subject to obtaining the appropriate re-use permits, water from the cooling tower will be reused for solution mining purposes. If solution mining has ceased, cooling tower water will be disposed of in an appropriately permitted disposal well.

2.6 Operation and Maintenance Information

2.6.1 Operation

The proposed project will operate two 135-megawatt expansion turbine trains. Each train will use CAES technology developed by Dresser-Rand and will be equipped with selective catalytic reduction (SCR) and catalytic oxidation units to minimize emissions of nitrogen oxides and carbon monoxide. Exhaust emissions from the expansion turbine trains comprise the majority of air emissions from the plant site, with smaller emissions from an associated emergency generator engine, the natural gas and ammonia supply equipment, electrical equipment, and two cooling towers. The compressed air for the project will be stored in caverns developed at the site. Using the compressed air and combusting natural gas, the CAES expansion turbines can run at all ambient temperatures without any de-rating. The system can also ramp production up to full capacity in less than 10 minutes for a warm start-up or in less than 30 minutes for a cold start-up. This gives the proposed project the flexibility to meet a range of electrical service needs, including peaking, intermediate, base-load, tolling, and others. Electricity demand planning for west Texas indicates a regional requirement for power over the full range of services, but providing for peak power production is one of the major demand needs.

The process flow diagram (**Figure 6**) illustrates the electrical generation process steps for the proposed project. Power from the utility grid will operate multi-stage electric compressors to compress ambient air to pressures as high as 1,838 pounds-force per square inch absolute. The electricity to run the compressors will be generated by renewable energy sources or conventional power sources during non-peak operation. The compressed air will be stored in one of several caverns at the site. (The caverns will be formed by leaching salt from underground salt deposits. The cavern forming process will use only electrical driven equipment and will not generate any emissions). The electrical motors driving the air compressors will be operated independently of the electrical generators harnessed to the expansion turbines. Cooling water will be used to cool both the electrical motors and the two air compressor trains.

Compressed air withdrawn from the storage caverns will first be preheated in a recuperator with hot exhaust gases from the process. Natural gas will be combusted with the pre-heated air in high-pressure combustors before entering a high-pressure expanding turbine stage. Water will be injected into the turbine stages at higher production capacities to maximize power production and to help reduce the formation of nitrogen oxides. After expansion in the turbine, the turbine gases will be cooler and at lower pressure. The exhaust gases will enter low-pressure combustors, where additional natural gas will be combusted. The gases will then enter a low-pressure expanding turbine stage. Exhaust gases from that expansion turbine will exchange heat with the incoming cavern air in a recuperator, and pass through an

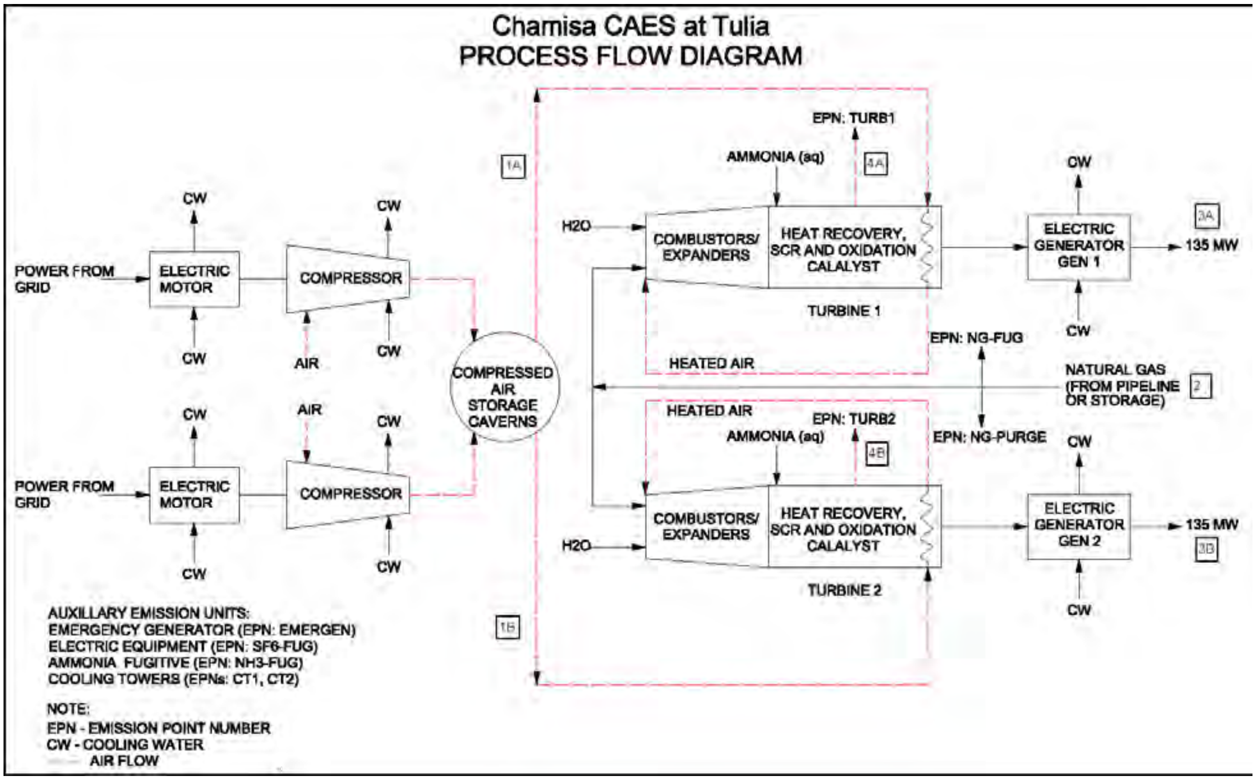


Figure 6 Process Flow Diagram

SCR unit (for reduction of nitrogen oxides) before exhausting to the atmosphere through two stacks. The catalytic oxidation and SCR units will be integrated with the recuperative heat exchangers. The electrical generators driven by the expansion turbines are rated to produce nominally 135 MW per expansion turbine train, with a peak gross production of 140.2 MW. Cooling water will be used to cool the electric generator sets.

Annually, the proposed project will combust up to 6,270,000 MMBTU of natural gas in the two CAES power trains to produce up to 1,425,000 MW of electricity. Heated cooling water from each compressor train and generator set will be cooled in mechanical draft cooling towers equipped with high-efficiency mist eliminators to minimize drift emissions. These cooling towers are authorized under permit-by-rule (PBR) 30 TAC §106.371. A natural gas-fired generator with a capacity of 1,400 electrical kilowatts (ekW) will provide emergency power when necessary. This generator will be equivalent to a Caterpillar SR4B-DM5498 generator set equipped with a G3516B LE (Low Emission) engine. The generator will operate in non-emergency operations less than 100 hours per year. This generator is authorized under PBR 30 Texas Administrative Code (TAC) §106.511.

All emissions points are designated by their emission point numbers (EPNs) and indicated schematically in the process diagram (**Figure 6**). The two expansion turbine trains will exhaust through their stacks, EPNs TURB1 and TURB2. The emergency generator will exhaust through its stack, EPN EMERGEN. The pollutant sulfur hexafluoride will be released in low-volume, fugitive leaks from circuit breakers designated EPN SF6-FUG. Fugitive leaks from the natural gas supply equipment will be released at EPN NG-FUG. Periodic maintenance purges of natural gas will be released at EPN NG-PURGE. Particulate matter emissions will be released from the two cooling towers (EPNs CT1 and CT2). Fugitive ammonia emissions will be released from the ammonia supply system (EPN NH3-FUG). Other process equipment and systems at the site support either the cavern development or the power plant. However, these equipment and systems are not emission sources. They include: (1) the air storage caverns; (2) equipment for the development and maintenance of the caverns; (3) electrically driven equipment including the air compressors, water and wastewater pumps, and instrument air compressors; and (4) water and wastewater treatment and handling systems. Aqueous ammonia unloading and storage facilities will also not be emission sources. Ammonia unloading will use vapor return and balancing so that vapors displaced from the ammonia storage tank during unloading are returned or balanced back to the ammonia transport vessel. Ammonia breathing losses will be eliminated by the use of a low-pressure tank to prevent the release of ammonia vapors generated by diurnal temperature variations.

2.6.2 Noise Levels

Noise is a potential direct or indirect effect on listed species that may cause their relocation away from the project or disruption of behaviors that are critical to survival. The project is located in a rural locale, with mixed agricultural, industrial, and transportation uses. Dresser-Rand equips its compressor-motor trains with its patented noise reduction technology, which can result in up to a 10 dB reduction in noise levels compared to centrifugal compressors that do not utilize this acoustic technology. In addition, a commercially reasonable attempt will be made to design the proposed project in conformance with the EPA's suggested guidance for protection of wildlife from environmental noise.

EPA guidance for the protection of the public health and welfare with an adequate margin of safety from environmental noise suggests a screening level of 55 dB (day-night average sound level) for outdoor settings (EPA 1974). By contrast, several studies report that noise up to 70 dB appears to cause little to no impairment to auditory function nor disturbance in behavior for a variety of animal species (EPA 1971). Moreover, sound levels measured at a receptor at a distance from a point source fall 6 dB with each doubling of distance away from the source. Given the safe noise levels at or near the proposed project, as well as the additional distance between the proposed project and potential habitat for listed species, the noise levels from the proposed project are anticipated to have no adverse effect on any listed species.

2.6.3 Dust

Dust mobilization will be minimized during operations by routinely employing BMPs, and any potential impacts are expected to be negligible.

3.0 IDENTIFICATION AND DISCUSSION OF THE ACTION AREA

The Action Area is defined as "…all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). Direct impacts are those occurring immediately from construction or operating activities, such as excavation or air emissions. Indirect impacts, which may include air emissions, noise, lighting, dust and erosion, are those that occur inside the Action Area, and that may occur with delay after the construction of the proposed project. The potential impacts to federally listed species and DCH are evaluated within the Action Area. As no DCH is associated with the Action Area for the proposed project, DCH will not be further discussed in this section.

The Action Area for the proposed project consists of the combined areas of potential impact from three distinct sets of infrastructure, each to be built in specific locations:

- **Power Generation Facility (Figure 2)**: The power generating infrastructure would consist of the gas-fired generators, the air compression facility, an electrical power substation, wells for storage of compressed air, wells for storage of waste water, water wells, and various other structures and buildings required for operations and maintenance. The water wells to be used for plant and process water currently exist on the site. The main impacts from operations of this infrastructure would be air emissions from the gas turbines, noise, and dust. The determination of the portion of the Action Area due to the power generating facility is discussed in **Section 3.1**.

- **Power Input Transmission Line (Figure 3)**: The transmission line to bring power into the power generating facility. This transmission line would be built by adding cable to an existing transmission line or by new construction. Operation of the transmission line is not associated with any significant impacts to endangered species. The determination of the portion of the Action Area due to the transmission lines is discussed in **Section 3.2**.

- **Power Output Transmission Line (Figures 4 and 5)**: The transmission line to send generated power to the grid. For this transmission line, two route options have been studied of which only one will be chosen. For either option, this transmission line would be entirely new construction, involving all activities required to erect new utility poles and string new cable. Operation of the transmission line is not associated with any significant impacts to endangered species. The determination of the portion of the Action Area due to the transmission lines is discussed in **Section 3.3**.

3.1 Action Area

3.1 Action Area Determination for the Power Generating Facility

The power generating facility would be the site where the gas-fired turbines would be located. Air emissions from the gas-fired turbines have the greatest potential for impact beyond their source. The portion of the Action Area for the power generating facility was therefore determined using emissions dispersion modeling (**Appendix A**) to define the distance from the source beyond which impact from emissions would, by stringent Federal and state regulatory definitions, be *de minimis*, or insignificant. The Clean Air Act (CAA) required the EPA to establish a National Ambient Air Quality Standard

(NAAQS) for each of six criteria pollutants considered harmful to human health and the environment for various exposures times (or averaging periods). The CAA identifies two types of NAAQS:

Primary NAAQS: a level set to afford health protection to the general public and to "sensitive" populations such as asthmatics, children, and the elderly.

Secondary NAAQS: a level set to afford protection to public welfare by limiting damage to animals, crops, vegetation, and buildings, and by avoiding decreased visibility.

While NAAQS are protective levels, the EPA has further established a "significant impact level" (SIL) for each NAAQS, except for $PM_{2.5}$. A SIL is set to a concentration that is less than the corresponding NAAQS, below which potential impacts from an air pollutant are considered *de minimis*. In emissions dispersion modeling, the emissions from the project alone are modeled and compared to the SILs. A full impact analysis, consisting of a NAAQS analysis is conducted for each pollutant and averaging period that shows predicted concentrations above the corresponding SIL.

Emissions associated with the proposed project were modeled using the American Meteorological Society/EPA Regulatory Model (AERMOD) air dispersion model. The predicted maximum ambient air concentrations of emissions from the proposed project are compared with the primary and secondary NAAQS and the SILs in-**Table 2**.

Table 2. Emissions Dispersion Analysis

Pollutant (NAAQS)	NAAQS ($\mu g/m^3$)	Averaging Time	SIL[a] ($\mu g/m^3$)	Max Modeled Concentration[d] ($\mu g/m^3$)	Max Modeled Concentration Above SIL?	Total Concentration (Modeled+ Background) ($\mu g/m^3$)
Carbon Monoxide (primary)	40,000	1-hour	2,000	204.86	No	N/A
	10,000	8-hour	500	63.92	No	N/A
Nitrogen Dioxide (primary)	188	1-hour	7.5[b]	4.75	No	N/A
Nitrogen Dioxide (primary and secondary)	100	Annual	1	0.086	No	N/A
Particulate Matter less than 10 µm diameter (primary and secondary)	150	24-hour	5	0.76	No	N/A
Particulate Matter less than 2.5 µm diameter (primary and secondary)	35	24-hour	1.2[e]	0.49	No	23
	15	Annual	0.3[e]	0.02	No	6.82

Table 2. Emissions Dispersion Analysis

Pollutant (NAAQS)	NAAQS ($\mu g/m^3$)	Averaging Time	SIL[a] ($\mu g/m^3$)	Max Modeled Concentration[d] ($\mu g/m^3$)	Max Modeled Concentration Above SIL?	Total Concentration (Modeled+ Background) ($\mu g/m^3$)
Sulfur Dioxide (primary)	196	1-hour	7.8[c]	0.46	No	N/A
Sulfur Dioxide (secondary)	1300	3-hour	25	0.42	No	N/A

[a] Unless otherwise specified, from 40 CFR §51.165(b)(2)
[b] http://www.tceq.texas.gov/assets/public/permitting/air/memos/interim_guidance_naaqs.pdf
[c] http://www.tceq.texas.gov/assets/public/permitting/air/memos/interim_guidance.pdf
[d] AERMOD result
[e] On January 22, 2013 the DC Circuit Court of Appeals vacated the SILs for particulate matter with diameters less than 2.5 microns ($PM_{2.5}$). At this time, therefore, there are no SILs for $PM_{2.5}$. However, the ambient air impacts of the project, when combined with the background ambient air concentrations in the surrounding environment, have been found to comply with the NAAQS. The project impacts of $PM_{2.5}$ were also found to be well below the SIL, which had been established prior to it being vacated.

All short-term modeling concentrations correspond to the maximum proposed emission rates during normal or start-up operations. All annual modeling concentrations correspond to the proposed annual emission rates. Project impacts are predicted to be less than the SIL for all pollutants and averaging periods for which SILs exist. For all pollutants and averaging periods except for $PM_{2.5}$, no further analysis was performed, and the impacts demonstrate that the project would not cause or contribute to any exceedance of the standard. For $PM_{2.5}$, a conservative ambient background concentration taken from representative monitoring data from Amarillo was added to the project impact to determine the total ambient concentration for comparison to the applicable standard. The total ambient concentrations were determined to comply with the applicable NAAQS. For $PM_{2.5}$, the project impacts were also found to be well below the SILs, although those standards are now invalid.

The area demonstrating ambient air impacts above the SILs is usually used to establish the Action Area for projects of air quality concern. Since the project demonstrates no significant ambient air impacts for all pollutants with established SILs, the portion of the Action Area related to the CAES power generation facility was determined to be limited to the entirety of the property where the CAES power generating facility would be located (**Figure 2**). Direct impacts may also be anticipated from transmission lines. Therefore, the Action Area is the entirety of the property for the CAES power generation facility plus the combined footprints of the proposed transmission line routes (including all options). The assessment of potential impacts to protected species and their habitats was conducted in this Action Area.

Guidance from Smith and Levenson (1980) was followed to assess whether the proposed project has the potential to exceed experimentally determined air quality related values (AQRV). AQRVs provide minimum levels at which adverse effects have been reported in the literature for use as screening concentrations. These screening concentrations can be concentrations of pollutants in ambient air, in soils, or in aerial plant tissues. This guidance has the following steps:

Step 1: Estimate the maximum ambient concentrations for averaging times appropriate to the screening concentration for pollutants emitted by the source. Include background concentrations when appropriate.

Step 2: Determine potential effects from airborne pollutants by checking the maximum predicted ambient concentrations against the corresponding AQRV screening concentration, PSD increments, or NAAQS, whichever is most conservative.

Step 3: Determine potential effects from trace metals by calculating the concentration deposited in the soil from the maximum annual average ambient concentrations, assuming all deposited metals are soluble and available for uptake by plants.

Step 4: Compare the increase in metal concentration in the soil to the existing endogenous concentrations.

Step 5: Calculate the amount of trace metal potentially taken up by plants.

Step 6: Compare the concentrations from Steps 3 and 5 with the corresponding screening concentrations.

Step 7: Re-evaluate the results of the Step 4 and 6 comparisons using estimated solubilities of elements in the soil recognizing that actual solubilities may vary significantly from the conservatively estimated values.

Step 8: If ambient concentration modeling results are unavailable, the significant levels for emissions may be used.

No trace metals are associated with the combustion of natural gas in reciprocating engines. Therefore, only Steps 1 and 2 of Smith and Levenson (1980) were required for this analysis. Smith and Levenson (1980) state "…trace metals in TSP may have greater impacts on vegetation and soils than the total amount of particulates."

For total suspended particulate matter (TSP), Smith and Levenson (1980) state that "no useable information other than that used to develop the ambient standards...was found in the review literature" and that "EPA's current procedure for TSP should suffice for the review of generic TSP." EPA's current procedure for TSP review corresponds to demonstrating compliance with the NAAQS for $PM_{2.5}$ and PM_{10}. Secondary NAAQS apply to protection of animals, crops, and vegetation. As shown in **Table 2**, Chamisa will comply with all PM NAAQS. **Table 3** compares the AERMOD results for sulfur dioxide, nitrogen dioxide, and carbon monoxide to their respective AQRVs. The maximum predicted concentrations are orders of magnitude lower than their respective AQRV screening concentrations (**Table 3**). Therefore, according to this analysis, the proposed project would not result in significant impacts to animals, crops, or vegetation.

Table 3. Screening Analysis – Direct Impacts on Plants, Soil, and Animals

Pollutant	NAAQS Averaging Period	Maximum Predicted Concentration (μg/m^3)	AQRV Screening Concentration† (μg/m^3)
Carbon Monoxide	1-hour	204.86	>1,800,000*
	8-hour	63.92	>1,800,000*
Nitrogen Dioxide	1-hour	4.75	>3,760*
	annual	0.086	100
Sulfur Dioxide	1-hour	0.46	917
	3-hour	0.42	786

†Table 3.1, Smith and Levenson (1980).

* Value not available. A conservative value (the next longer averaging period) is provided.

In conclusion, the portion of the Action Area attributable to construction and operation of the power generating facility is defined by the boundaries of the Chamisa CAES property on which that facility would be constructed (**Figure 2**). This portion of the Action Area is located in Swisher County, Texas.

3.2 Action Area Determination for the Power Input Transmission Lines

The proposed power input transmission line (power-in) would be built by adding new transmission cable to an existing transmission line that runs along State Highway 86 from the Lakeview Substation to the proposed power generating facility site (**Figure 3**). At the point where the existing transmission line reached the proposed power generating facility site, the proposed transmission line would run across State Highway 86 into the proposed power generating facility site. It is anticipated that the existing right-of-way will incur minimal disturbance while the new transmission cable is added, that the existing utility poles are sufficient and that any required work would occur within a 30.5-meter (100-foot) corridor centered on the existing transmission line. The portion of the Action Area attributable to the construction and operation of the proposed power input transmission line was therefore defined as a 30.5-meter buffer encompassing the existing the power line running along State Highway 86 from the Lakeview Substation to the proposed power generating facility site. This portion of the Action Area is located in Swisher County, Texas.

3.3 Action Area Determination for the Power Output Transmission Lines

The proposed power output transmission line (power-out) would be a newly built transmission line along one of two alternate routes (**Figures 4 and 5**).

Under Alternative 1, the proposed output transmission line would run south 9.3 km (5.8 mi) to a proposed point of interconnection with a proposed Competitive Renewable Energy Zone (CREZ) transmission line (**Figure 4**). This portion of the Action Area is located in Swisher County, Texas.

Under Alternative 2, the proposed output transmission line would run west 21.4 km (13.3 mi) to a proposed point of interconnection with the Nazareth Substation (owned and operated by Sharyland Utilities, LP) (**Figure 5**). For both of these alternatives, direct impacts to substrate, such as excavation for utility poles and construction vehicle traffic, would occur within a 30.5-meter (100-foot) corridor of leased, privately owned land that is immediately adjacent to the public right-of-way. This portion of the Action Area is located in the Counties of Swisher and Castro, Texas.

The portion of the Action Area attributable to the construction and operation of the proposed power output transmission line was therefore defined as a 30.5-meter (100-foot) buffer encompassing the land running along the proposed alternatives (**Figures 4 and 5**).

3.4 Identification of the Action Area

The Action Area for the proposed project is located in Swisher and Castro Counties, Texas, and is comprised of the entirety of the property for the proposed power generating facility, and a 30.5 m (100 ft) wide buffer running along each of the three proposed transmission line routes (**Figures 2-5**) (**Table 4**).

Table 4. Action Area and Infrastructure

Infrastructure	Location	County	Action Area (ha)	Length (km)	Buffer Width (m)
Power Generating Facility	Figure 2	Swisher	207.3	NA	NA
Power Input Transmission Line	Figure 3	Swisher	31.5	10.0	30.5
Power Output Transmission Line Option 1	Figure 4	Swisher	28.8	9.3	30.5
Power Output Transmission Line Option 2	Figure 5	Swisher and Castro	62.9	21.4	30.5
		Total	**330.5**	**40.7**	NA

4.0 FEDERALLY LISTED THREATENED OR ENDANGERED SPECIES AND DESIGNATED CRITICAL HABITAT OF POTENTIAL OCCURRENCE IN THE ACTION AREA

The proposed project Action Area is located in the Counties of Swisher and Castro, Texas (Figures 1-5). USFWS lists the whooping crane and the lesser prairie chicken in its listings of threatened, endangered or proposed species with potential for occurrence in Swisher and Castro Counties (USFWS 2013a). In addition, the Texas Department of Wildlife (TXPWD) lists the black-footed ferret and the gray wolf as federally endangered species for Swisher and Castro Counties (TXPWD 2013ab). The effects analysis for these species is presented in **Section 7**.

Table 5. Listed Species for the Counties of Swisher and Castro, Texas

Listed Species		Federal Status[1]	Documented Occurrences within the Action Area[2]
Common Name	**Scientific Name**		
Mammals			
Black-footed ferret	*Mustela nigripes*	Endangered*	none
Gray wolf	*Canis lupus*	Endangered*	none
Birds			
Whooping crane	*Grus americana*	Endangered	none
Lesser prairie chicken	*Tympanuchus pallidicinctus*	Proposed Threatened	none

Sources: [1] USFWS 2013a, [2] Texas Natural Diversity Database (TPWD 2013c).

(*) Species is listed by USFWS as endangered and is considered extirpated from the State of Texas, however it is listed by the Texas Parks and Wildlife Department for these counties.

4.1 Status of Federally Listed Threatened or Endangered Species and Designated Critical Habitat of Potential Occurrence in the Action Area

4.1.1 Black-footed Ferret

Federal Status: The black-footed ferret was listed as *threatened with extinction* under the Endangered Species Preservation Act of 1966 (USFWS 1967). In 1970, it was listed as *endangered* under the Endangered Species Conservation Act of 1969 (USFWS 1970) and is now under the protection of the ESA (USFWS 2005).

Species Description: The black-footed ferret is one of three species of ferret, a carnivore in the Mustelid or weasel family. This species is the only ferret native to North America. It has a black facemask, black legs and a black-tipped tail. Individuals may weigh up to 1.1 kilograms (2.5 pounds).

Population dynamics: The black-footed ferret was historically found throughout the Great Plains, mountain basins, and semi-arid grasslands of North America wherever prairie dogs occurred. The decline in the black-footed ferret population is directly linked to loss of prairie dog (*Cynomys spp*.) populations and habitat (USFWS 2013b). The black-footed ferret historically occurred in the project region, but it has been extirpated from Texas for many years, and it is not currently listed by USFWS as occurring in the project counties. The black-footed ferret was re-introduced into the wild in the Shirley Basin area of Wyoming after an intensive captive breeding program and now survives in three small, but wild, populations in Wyoming, Montana, and South Dakota (Davis and Schmidly 2004).

Documented occurrences within the Action Area: A search of the TXNDD (TPWD 2013c) (**Figure 7**) and the USGS Geographic Approach to Planning (GAP) database (USGS 2013a) revealed no documented occurrences for the black-footed ferret in Swisher County or Castro County. The black-footed ferret is still extirpated from Texas (TPWD 2013ab) and will, therefore, not occur in the project area nor be impacted by the project.

Designated Critical Habitat: No DCH has been established for the black-footed ferret.

4.1.2 Gray Wolf

Federal Status: The timber wolf (*Canis lupus lycaon*) was listed as threatened with extinction in 1967 (USFWS 1967). In 1978, distinct population segments (DPSs) of the species and subspecies of *Canis lupus* (gray wolf) were listed as *endangered*, except for a DPS in Minnesota that was listed as *threatened*, under the ESA (USFWS 1978a). Since then, DPSs of the gray wolf in the northern Rocky Mountains, the western Great Lakes, and Wyoming have been delisted (USFWS 2011ab, 2012a). In 2013, complete delisting of the gray wolf, except for the Mexican wolf subspecies, was proposed for the lower 48 states of the U.S. (USFWS 2013c).

Species Description: The gray wolf is the largest of the Canidae and the ancestor of the domestic dog (*Canis lupus familiaris)*. Many regional subspecies exist and there is considerable diversity in size, coat color, and genetic makeup among them.

Population dynamics: The gray wolf historically occurred in the project region, but it has been extirpated from Texas for many years, and it is not currently listed by USFWS as occurring in the project counties. The gray wolf has been reintroduced in Wyoming and Idaho, as well as Arizona and New Mexico (Mexican subspecies) (USFWS 2012b). In addition, the species has re-established in Montana by expanding southward from Canada.

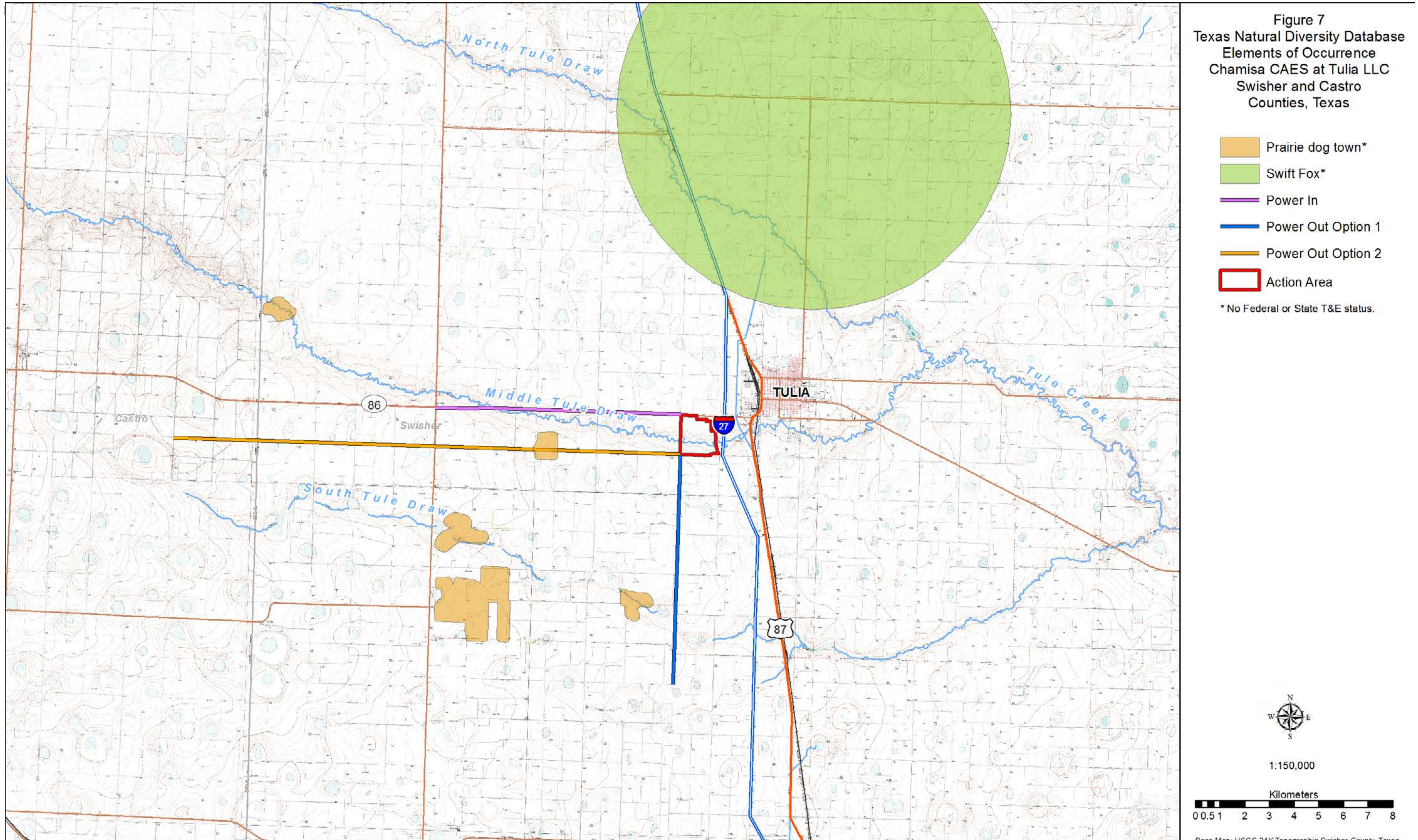


Figure 7
Texas Natural Diversity Database Elements of Occurrence
Chamisa CAES at Tulia LLC
Swisher and Castro Counties, Texas

Documented occurrences within the Action Area: A search of the TXNDD (TPWD 2013c) (**Figure 7**) and the USGS Geographic Approach to Planning (GAP) database (USGS 2013b) revealed no documented occurrences for the gray wolf in Swisher County or Castro County. The gray wolf has been extirpated from Texas (TXPWD 2013ab) and will, therefore, not occur in the project area nor be impacted by the project.

Designated Critical Habitat: No DCH has been established for the gray wolf in Texas.

4.1.3 Whooping Crane

Federal Status: The whooping crane was listed as *threatened with extinction* under the Endangered Species Preservation Act of 1966 (USFWS 1967). In 1970, it was listed as *endangered* under the Endangered Species Conservation Act of 1969 (USFWS 1970). Except when it is part of an experimental population that is considered nonessential (USFWS 1993, 2001, 2011c), the whooping crane remains on the list of federally endangered species.

Species Description: The whooping crane is a large, white crane with a dagger-like yellow bill and with reddish skin on the crown that is darker on the face and lower part of the beak. It is named for its distinctive alarm call, or whoop. The whooping crane is indigenous to North America and is its tallest bird with a standing height upwards of 1.5 m (5 ft). The wing span can exceed 2 m (7 ft). A distinctive behavioral feature of the whooping crane life cycle is a semiannual 4,000-kilometer (2,500-mile) migration between its northern (Canadian) breeding grounds and its southern (American) over-wintering grounds (see below) (**Figure 8**). Whooping cranes are omnivores. Their summer diet consists of insects, minnows, frogs, small birds, rodents, and berries. Their winter diet is also predominantly carnivorous, consisting mainly of blue crabs and clams from estuaries, but also includes acorns, snails, crayfish, and insects from upland areas (USFWS 2007).

Population dynamics: The whooping crane is one of the rarest birds and exists in the wild only in Canada and the U.S. The total population is approximately half wild and half captive (USFWS 2007). Three wild populations exist. The only self-sustaining, indigenous population of whooping cranes breeds in northwestern Canada and over-winters in the coastal bend region of southeastern Texas. The Canadian breeding grounds of this population are in the Wood Buffalo National Park in the Canadian provinces of Northwest Territories and Alberta. Its U.S. over-wintering grounds in Texas are in and around the Aransas National Wildlife Refuge (NWR). This population numbered 15 in 1941 (USFWS 2007). Recently, the portion of this population that uses the Aransas NWR was estimated to be 257 (USFWS 2013d). This population appears to be making increasing use of areas outside the Aransas NWR for over-wintering (USFWS 2013d). Because the only successful wild population is highly geographically restricted in nesting, wintering, and stopover sites, it is subject to catastrophic loss in the event of an adverse environmental event involving any of these areas. Diversification and expansion of breeding, wintering, and stopover sites is thought to be essential to the survival of the species. The other two wild populations are a result of experimental efforts to reintroduce captively bred populations into the wild in other geographic locations. One of these populations nests in Wisconsin and winters in Florida. The other is non-migratory and resides year-round in Florida. Neither of these experimental populations are

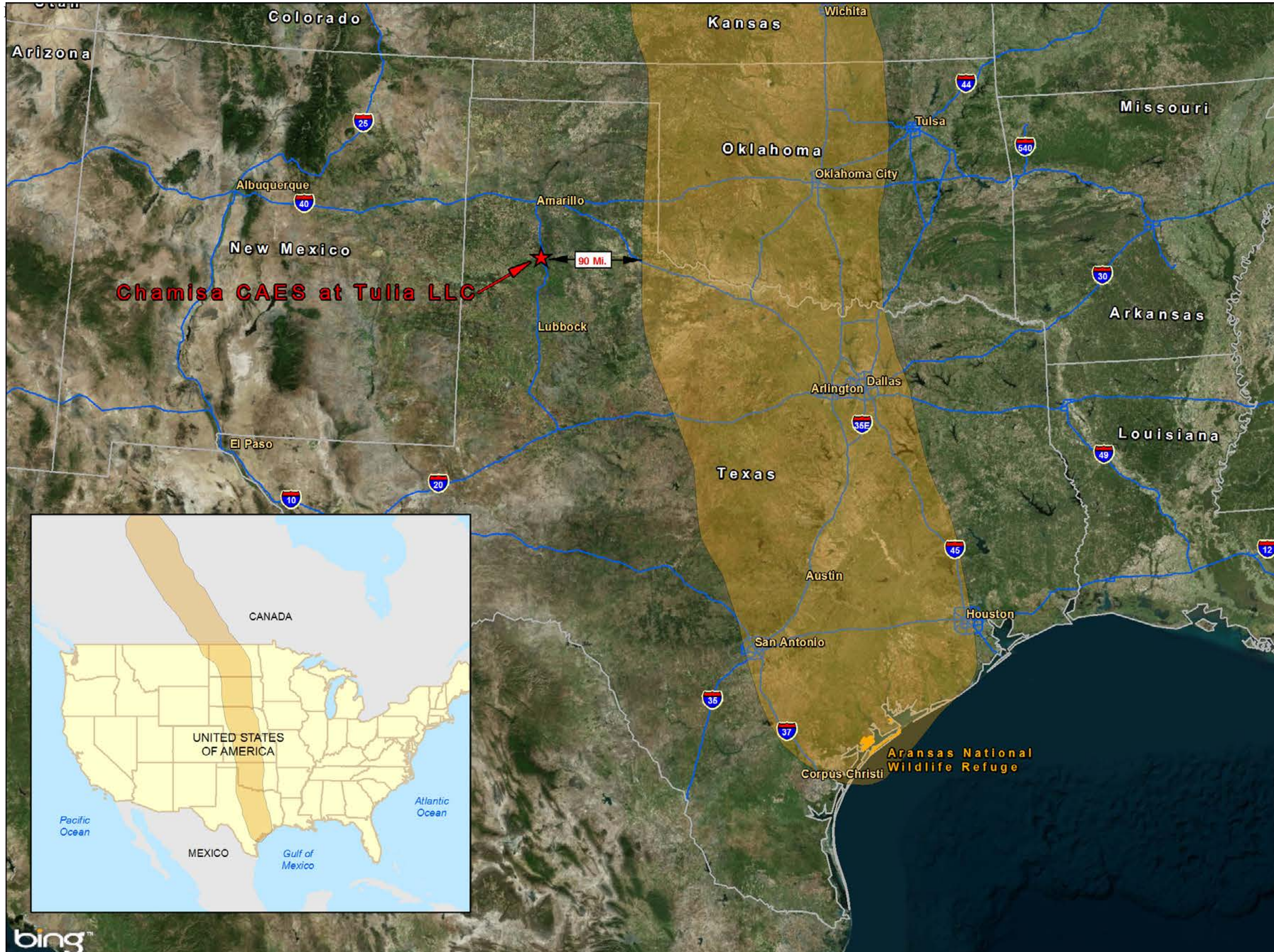


Figure 8
Action Area in Relation to
Whooping Crane Migration Corridor
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas

94% Whooping Crane Migration Corridor*

* Source: Digitized by Blanton and Associates from United States Fish and Wildlife Service Whooping Crane Recovery Plan 2006 page 20, figure 2.

N W E S

1:6,000,000

Kilometers
0 50 100 200 300

Base Map: 2010 Bing Aerial Imagery

thriving. Another attempt to reintroduce an experimental population in the western states of Colorado, New Mexico, Utah, and Wyoming was not successful. The USFWS is currently working on a project to establish a nonessential experimental population in 20 eastern states of the U.S., excluding Texas (USFWS 2001). In 2010, the indigenous and captive populations collectively totaled 535 individuals (USFWS 2013d).

Migration: The 4,000-kilometer (2,500-mile) post-breeding migration from Canada occurs from mid-October to late November (Oberholser 1974). The U.S. portion of the migratory pathway begins in Montana and North Dakota, and crosses over South Dakota, Nebraska, Kansas, and Oklahoma, before ending in the coastal bend of Texas (Oberholser 1974) (**Figure 8**). In Texas, whooping cranes winter from late October through April at the Aransas NWR and at Matagorda and St. Joseph's islands in Aransas, Calhoun, and Matagorda Counties. The spring return migration takes place from late March through April and follows the same flight corridor back to Canada. The Action Area is 90 miles west of the western boundary of the whooping crane 94% migratory corridor, which is used twice a year (see **Figure 8**).

Habitat usage during migration stopovers: The semiannual whooping crane migrations are composed predominantly of diurnal flight stages and dusk-to-dawn stopovers. Stopovers occur 12 to 15 times per total migration, or about every 300 km (190 mi) (Stehn 2007). Stopovers may last more than one night, and brief daytime stopovers also occur. Total annual migration time – flight time plus stopover time – is upwards of three months. Stopover habitat may consist of open bottomland and marshes, though cropland, playas, and various other aquatic habitats may also be utilized (Campbell 2003). Urban areas are usually avoided (USFWS 2007). The daily stopover site selection occurs prior to sunset and is generally opportunistic (i.e., for the most part, whooping cranes do not appear to fly to specific or established stopover points, and they will take advantage of a variety of habitats). However, certain sites in areas with limited suitable habitat (shallow wetlands) appear to be selectively revisited (USFWS 2009). Stopover selection and duration are highly influenced by local weather conditions (USFWS 2009).

Documented occurrences within the Action Area**:** A search of the TXNDD (TPWD 2013c) (see **Figure 7**) and the USGS Geographic Approach to Planning (GAP) database (USGS 2013c) revealed no documented occurrences for the whooping crane in Swisher County or in Castro County.

Designated Critical Habitat: No DCH has been established for the whooping crane in Swisher County or in Castro County (USFWS 1978b).

4.1.4 The Lesser Prairie Chicken

Federal Status: The lesser prairie chicken was proposed to be listed as *threatened* under the ESA in December 2012 (USFWS 2012c).

Species Description: The lesser prairie chicken is a ground-nesting grouse species that is native to the mixed grass prairies of the Great Plains, including the Texas Panhandle, Colorado, Kansas, New Mexico, and Oklahoma. This species has plumage similar to the greater prairie-chicken, but can be distinguished by alternating brown and buff-colored barring. Like other grouse species, lesser prairie chickens exhibit a lek mating system. Males of this species exhibit a mating ritual termed "booming" with sequences of vocalizations and posturing involving erected neck feathers, orange eyecombs, and inflated reddish-purple airsacs (USFWS 2012c).

Population dynamics: Conversion of native grasslands to cultivated cropland and overgrazed rangeland, habitat fragmentation, drought, and recreational hunting have led to the sharp population decline, with some studies estimating reductions in excess of 90 percent (USFWS 1997, USFWS 2010).

Habitat usage: Historically, the lesser prairie chicken occupied areas of the sand sagebrush-bluestem or the shinnery oak-bluestem grasslands of Colorado, Kansas, New Mexico, Oklahoma, and Texas. In Texas, they are confined almost exclusively to sandy ridges containing shinnery oak (*Quercus havardii*) and/or sand sagebrush (*Artemisia filifolia*), as well as tall grasses such as sand bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and switchgrass (*Panicum virgatum*). The lesser prairie chicken requires native landscapes with less than 30 percent cultivation to survive (Davis et al. 2008). Foraging habitat requires cover provided by sand-sage or shinnery oak brush. Nesting habitat requires mid-height or tall grasses for nesting. Ridgetops with native rangeland cover in the lower Great Plains are considered primary sites for lesser prairie chicken lek sites (Davis et al. 2008). These conditions for foraging, nesting, and lek habitats do not exist in or adjacent to the Action Area.

Documented occurrences within the Action Area: There are no documented sightings of the lesser prairie chicken in Swisher County or in Castro County (TPWD 2013ab, USGS 2013d) (**Figure 7**). The closest known lesser prairie chicken habitation is 76 km (48 mi) west of the Action Area in Lamb County, Texas (TPWD 2013d) (**Figure 9**).

Designated Critical Habitat: No DCH has been established for the lesser prairie chicken in Swisher County or in Castro County (USFWS 2012c).

5.0 EXISTING CONDITIONS IN THE ACTION AREA

This section provides an overview of the environmental baseline conditions in the Action Area to provide context for the evaluation of potential effects of the proposed project on federally listed threatened or endangered species.

5.1 Overview of Ecological Classification of the Region

The proposed project is located in the south central region of the Texas Panhandle, an area where agricultural land use is largely focused on the cattle industry (Almas et al. 2004). Wind energy and petroleum extraction are vital and prominent components of the local economy. Historically, biogeographic categorization of southern Texas was based on two independent schemes: biotic provinces (Blair 1950) and ecological zones (McMahan et al. 1984, Hatch et al. 1990). Biotic provinces are based on climate, plant and non-avian habitats, geological formations that form migratory boundaries, and soil types. Ecological zones take into account similar criteria but place greater emphasis on defining domains that are occupied by consistent floral associations. The Action Area is in the High Plains ecoregion

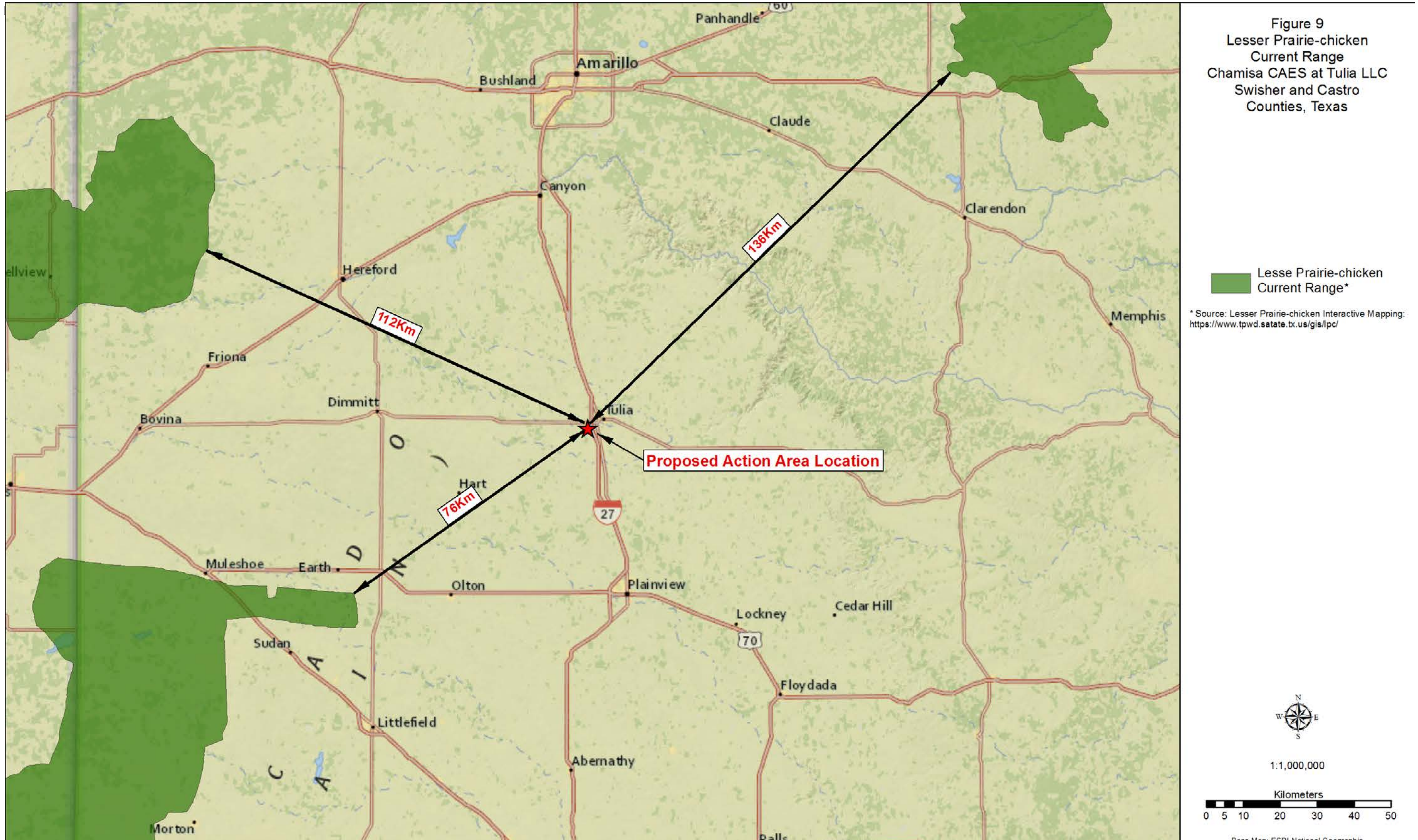


Figure 9
Lesser Prairie-chicken
Current Range
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas
Lesse Prairie-chicken
Current Range*
* Source: Lesser Prairie-chicken Interactive Mapping:
https://www.tpwd.satate.tx.us/gis/lpc/
1:1,000,000
Kilometers
0 5 10 20 30 40 50
Base Map: ESRI National Geographic
112Km
136Km
76Km
Proposed Action Area Location
Panhandle
Amarillo
Bushland
Claude
Canyon
Clarendon
Hereford
Memphis
Friona
Dimmitt
Tulia
Bovina
Hart
27
Muleshoe
Earth
Olton
Plainview
Lockney
Cedar Hill
70
Sudan
Floydada
Littlefield
Abernathy
Morton
Ralls

(McMahan et al. 1984, Hatch et al. 1990). Swisher County rainfall averages about 46 cm (18 in) per year. The prevailing winds are southerly. Average daily temperature extremes range from -6°C (21°F) to 11°C (51°F) in January, and from 17°C (62°F) to 33°C (91°F) in August (Larkin and Bomar 1983).

5.2 Soils and Vegetation

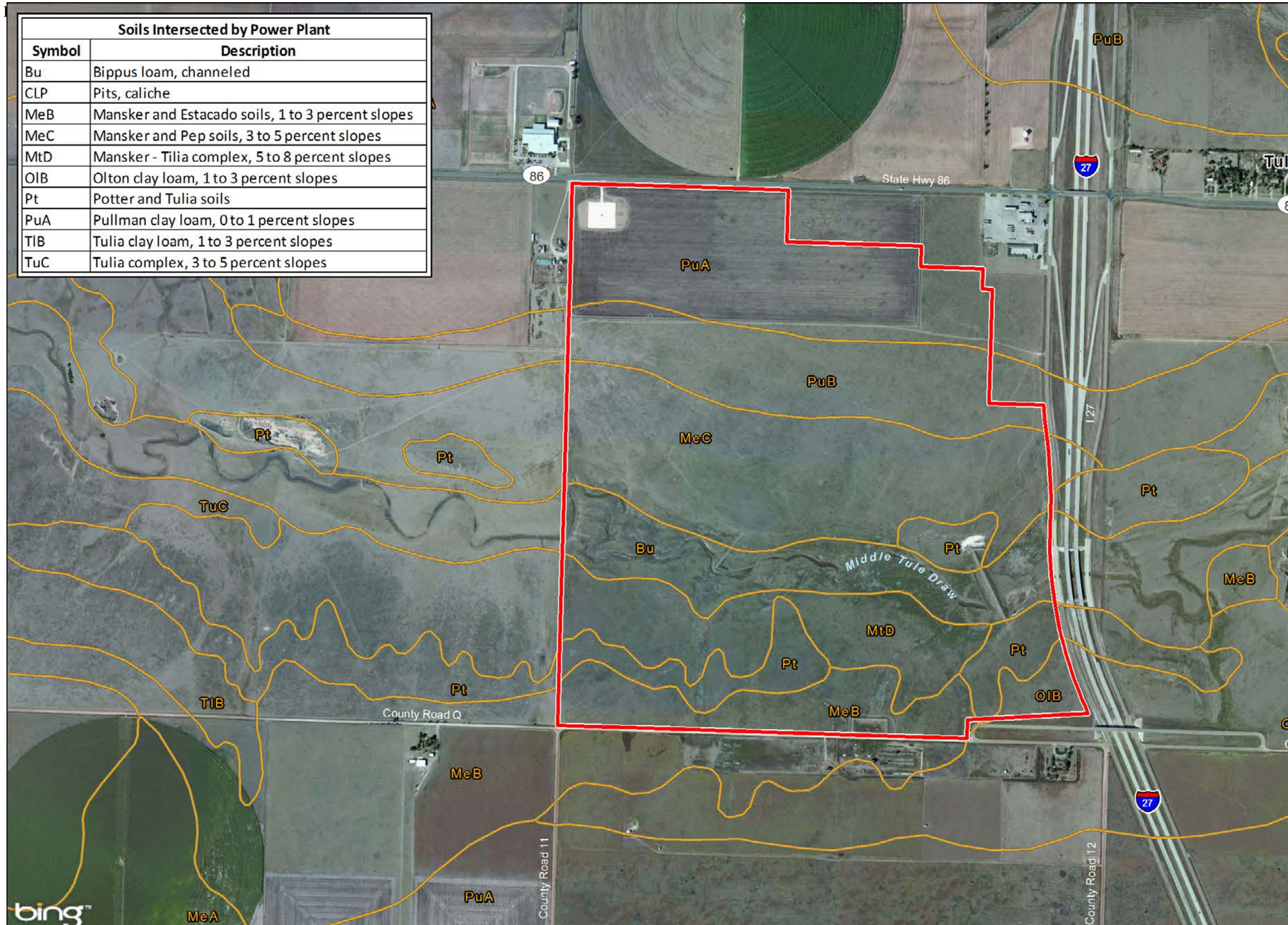
The Action Area is topographically flat, and the soils are typically varieties of clay loams (**Figures 10** through **13**). The Action Area is located within the Great Plains vegetational area as defined by Barkley (1986). Historically, this area consists primarily of grasslands that can be subdivided into tallgrass, mixed-grass, and shortgrass prairies. The vegetation type of the project area is considered shortgrass prairie (Billings 1988, Rose and Strandtmann 1986) and may be known locally as the western plains (Kirkpatrick 1992). The Action Area has been converted to cropland and rangeland used as pasture.

Rangelands have a mixture of native plants, with a significant constituent of introduced grasses and forbs that are typical of the region. Frequently seen species included sideoats grama (*Bouteloua curtipendula*), blue grama (*Boutelua gracilis*), hairy grama (*B. hirsuta*, silver bluestem (*Bothriochloa laguroides*), cane beard-grass (*Bothriochloa barbinodis*), purple three-awn (*Aristida purpurea*), whorled windmill-grass (*Chloris verticillata*), tumble-grass (*Schedonnardus paniculatus*), Johnson-grass (*Sorghum halepense*), Great Plains yucca (*Yucca glauca*), fireweed (*Kochia scoparia*), Russian thistle (*Salsola kali*), Lambert's articulated crazyweed (*Oxytropis lambertii*), Nuttall's sensitive brier (*Mimosa nuttallii*), goathead (*Tribulus terrestris*), snow-on-the-mountains (*Euphorbia marginata*), tuberous-rooted prickly-pear (*Opuntia macrorhiza*), narrow-leaf milkweed (*Asclepias engelmannia*), broad-leaf milkweed (*Asclepias latifolia*), white tridens (*Tridens albescens*), bush morning glory (*Ipomoea leptophylla*), lance-leaf frogfruit (*Phyla lanceolata*), Texas frogfruit (*Phyla nodiflora*), silver-leaf nightshade (*Solanum elaeagnifolium*), Patagonia plantain (*Plantago patagonica*), Heller's plantain (*Plantago helleri*), buffalo gourd (*Cucurbita foetidissima*), western ragweed (*Ambrosia psilostachya*), Arkansas lazy-daisy (*Aphanostephus skirrhobasis*), western mugwort (*Artemisia ludoviciana*), pasture thistle (*Cirsium undulatum*), Canadian horseweed (*Conyza canadensis*), Engelmann's daisy (*Engelmannia peristenia*), curly-cup gumweed (*Grindelia squarrosa*), common sunflower (*Helianthus annuus*), woolly paper-flower (*Psilostrophe tagetina*), prairie coneflower (*Ratibida columnifera*), prickly lettuce (*Lactuca serriola*), plains ironweed (*Vernonia marginata*), prairie broomweed (*Amphiachyris dracunculoides*), and hairy crab-grass (*Digitaria sanguinalis*).

Two, small, marginal playa lakebeds, adjacent to existing power lines, plowed fields and dirt roads, exist in the proposed power out-1 and power out-2 transmission line sections of the Action Area (**Figure 14**). They were dry during site visits, and dominated by Gray's ragweed (*Ambrosia grayi*) and Texas frogfruit.

5.3 Present Condition of the Action Area

The Action Area (**Figures 1-5**) encompasses 330.5 ha (816.6 ac) that fall within the Kansan biotic province (Blair 1950) and hence historically shared the biotic and climatic imprint of much of the Great Plains. Currently, the Action Area consists of commercial, government, and residential properties, cropland, pasture, and dry, vegetated playa lakebeds (**Table 4** and **Figure 14**). (See Appendix B for



Soils Intersected by Power Plant	
Symbol	**Description**
Bu	Bippus loam, channeled
CLP	Pits, caliche
MeB	Mansker and Estacado soils, 1 to 3 percent slopes
MeC	Mansker and Pep soils, 3 to 5 percent slopes
MtD	Mansker - Tilia complex, 5 to 8 percent slopes
OlB	Olton clay loam, 1 to 3 percent slopes
Pt	Potter and Tulia soils
PuA	Pullman clay loam, 0 to 1 percent slopes
TlB	Tulia clay loam, 1 to 3 percent slopes
TuC	Tulia complex, 3 to 5 percent slopes

Figure 10
NRCS Soils in Action Area
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas

Action Area
NRCS Soils

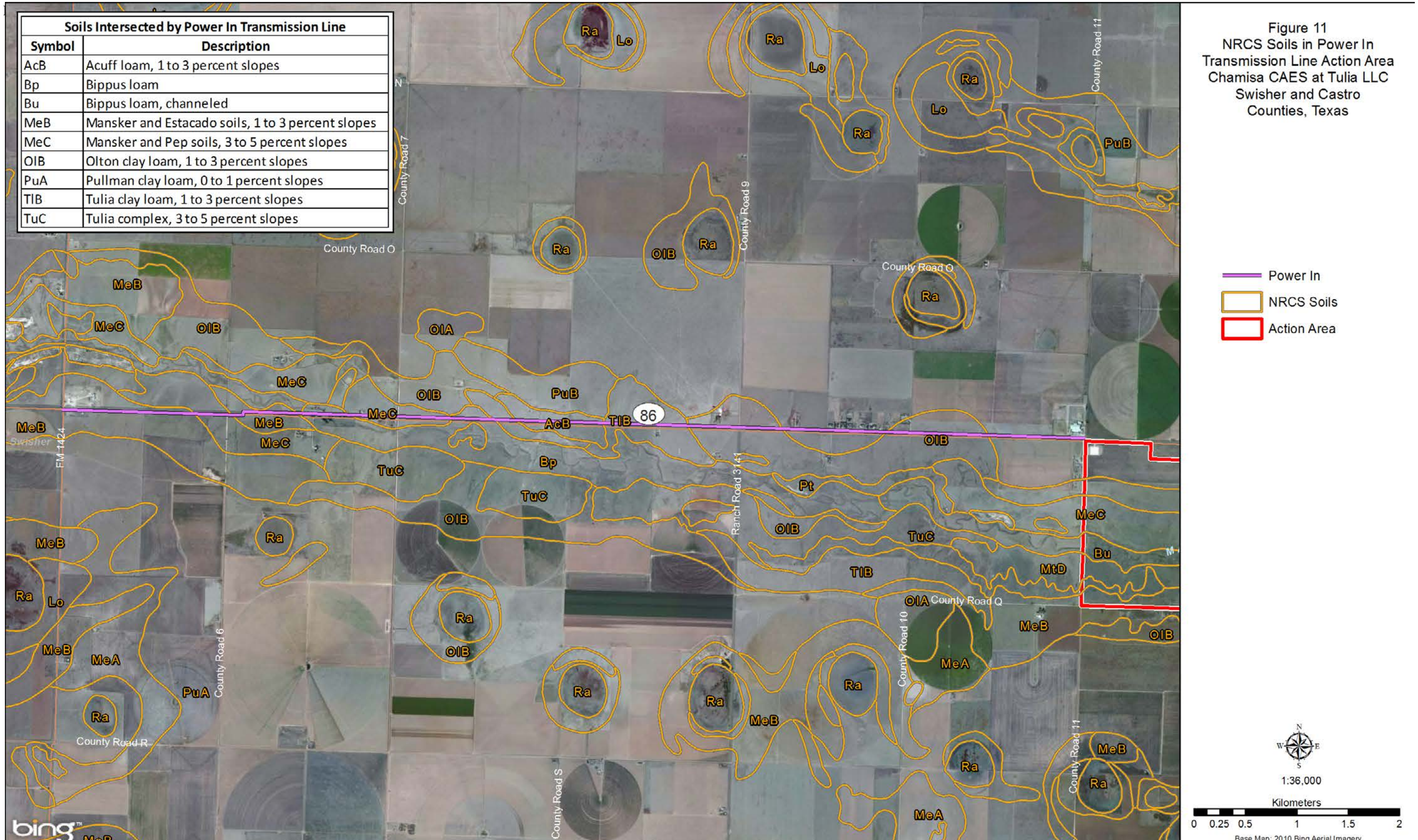
1:12,000
Kilometers
0 0.25 0.5

Base Map: 2010 Bing Aerial Imagery

Figure 11
NRCS Soils in Power In Transmission Line Action Area
Chamisa CAES at Tulia LLC
Swisher and Castro Counties, Texas

Soils Intersected by Power In Transmission Line

Symbol	Description
AcB	Acuff loam, 1 to 3 percent slopes
Bp	Bippus loam
Bu	Bippus loam, channeled
MeB	Mansker and Estacado soils, 1 to 3 percent slopes
MeC	Mansker and Pep soils, 3 to 5 percent slopes
OIB	Olton clay loam, 1 to 3 percent slopes
PuA	Pullman clay loam, 0 to 1 percent slopes
TIB	Tulia clay loam, 1 to 3 percent slopes
TuC	Tulia complex, 3 to 5 percent slopes



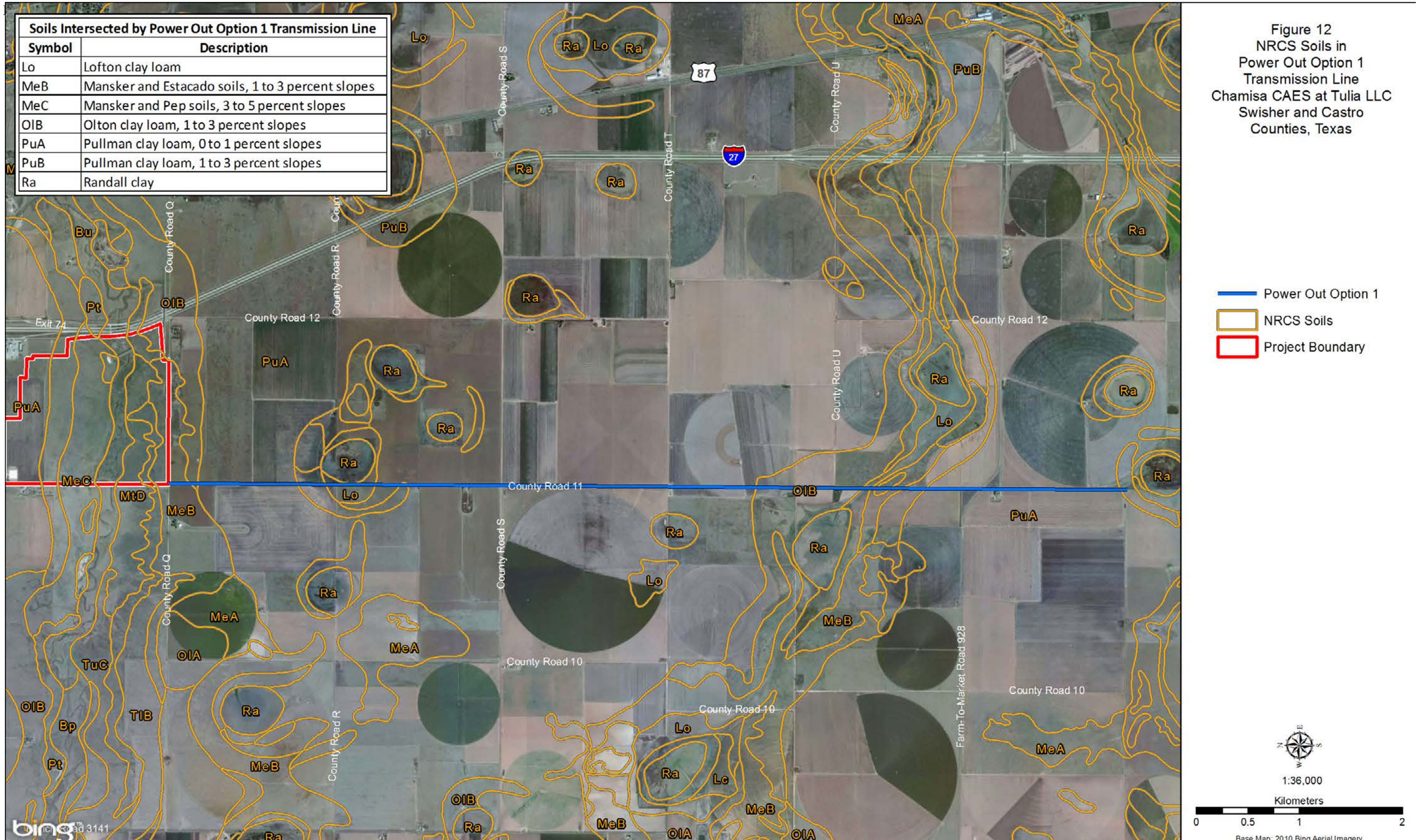
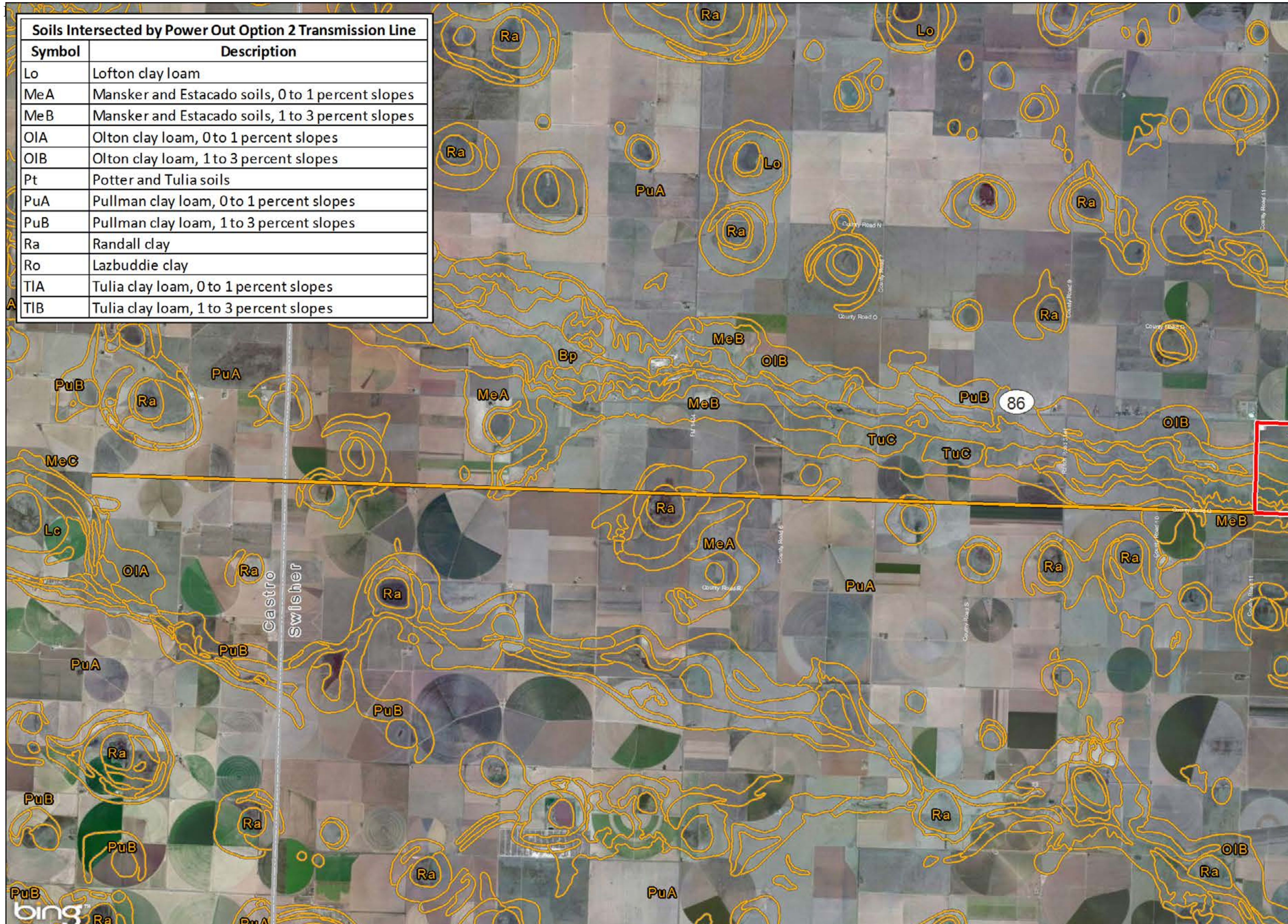


Figure 12
NRCS Soils in
Power Out Option 1
Transmission Line
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas



Soils Intersected by Power Out Option 2 Transmission Line

Symbol	Description
Lo	Lofton clay loam
MeA	Mansker and Estacado soils, 0 to 1 percent slopes
MeB	Mansker and Estacado soils, 1 to 3 percent slopes
OIA	Olton clay loam, 0 to 1 percent slopes
OIB	Olton clay loam, 1 to 3 percent slopes
Pt	Potter and Tulia soils
PuA	Pullman clay loam, 0 to 1 percent slopes
PuB	Pullman clay loam, 1 to 3 percent slopes
Ra	Randall clay
Ro	Lazbuddie clay
TIA	Tulia clay loam, 0 to 1 percent slopes
TIB	Tulia clay loam, 1 to 3 percent slopes

Figure 13
NRCS Soils in
Power Out Option 2
Transmission Line
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas

Power Out Option 2
Project Boundary
NRCS Soils

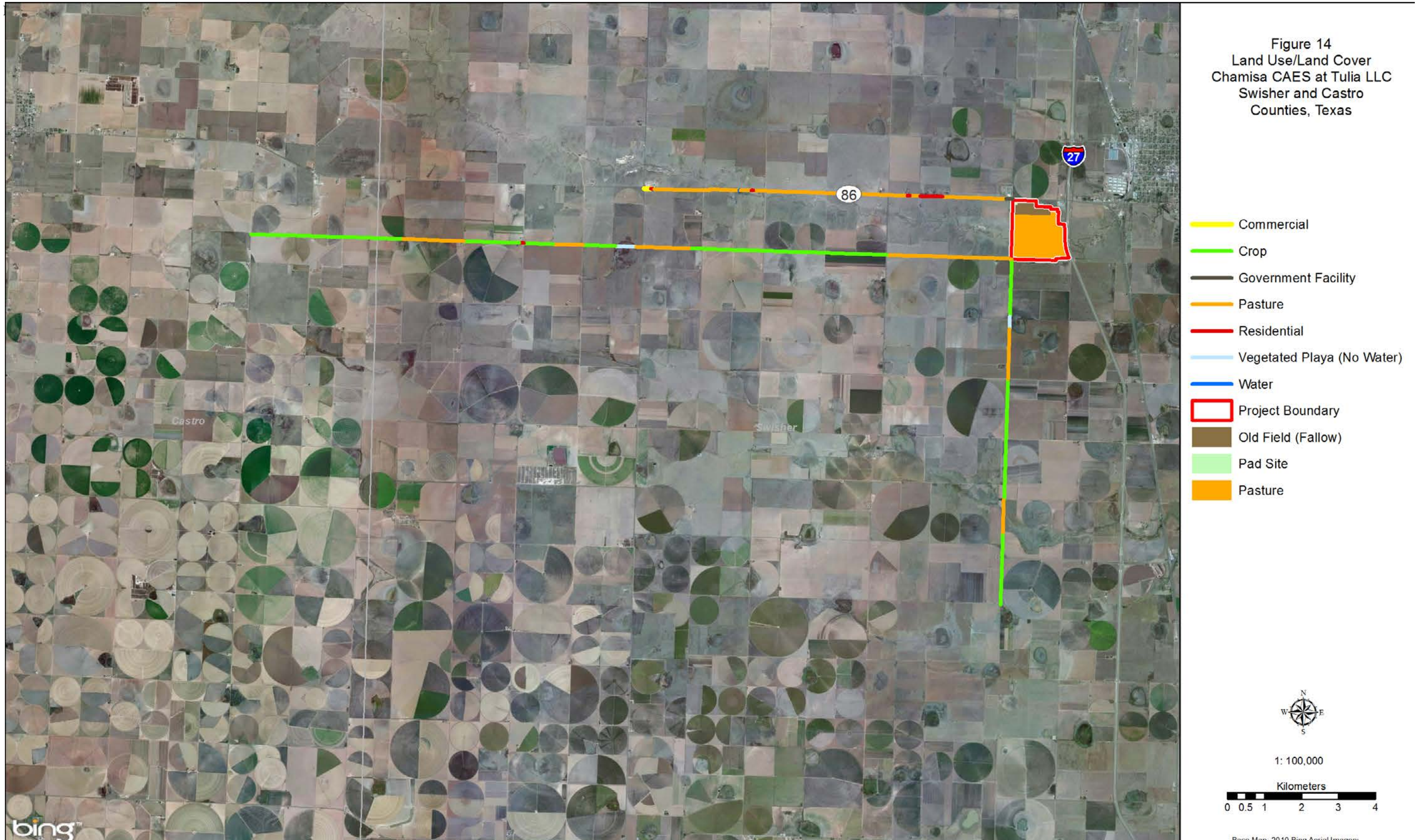


Figure 14
Land Use/Land Cover
Chamisa CAES at Tulia LLC
Swisher and Castro
Counties, Texas

photographs of the Action Area). Cropland, pasture, and old field comprise 97.7 percent of the Action Area. Dry, vegetated playa lakebeds account for 0.9 percent of the Action Area Though remnants of native vegetation remain, it has largely been replaced with introduced grasses. Improvements to the Action Area include water wells used to fill a stock tank located near an impounded stream (Middle Tule Draw), which runs across the southern portion of the power generating property, and a caliche pad in the northwest corner of the power generating property, fencing and dirt roads.

Table 4. Land Use and Land Cover in the Action Area

Type	Area		
	Hectares	Acres	Percent of Action Area
Commercial	0.5	1.3	0.2
Crop	59.3	146.6	18.0
Government Facility	0.6	1.5	0.2
Old Field (Fallow)	33.4	82.5	10.1
Pad Site	0.7	1.8	0.2
Pasture	229.6	567.3	69.6
Residential	2.9	7.1	0.9
Vegetated Playa (No Water)	2.8	6.9	0.9
Water	0.1	0.3	0.0

In conclusion, on-site inspection of the Action Area showed that preferred or suitable habitat for whooping crane stopovers, i.e., shallow wetlands, does not exist in the Action Area. The on-site inspection found that no suitable habitat for the lesser prairie chicken, i.e., intact native prairie, exists in the Action Area.

5.4 Normal and Impaired Water Segments within the Action Area

There are no TCEQ Water Quality Segments in the Action Area (TCEQ 2013).

6.0 ANALYSIS OF POTENTIAL IMPACTS AND DETERMINATIONS OF EFFECT

This section analyzes the potential for impact of the proposed project on federally listed species that may occur in Swisher County and in Castro County. This analysis takes into consideration the construction and operation/ maintenance phases of the project, as well as any direct, indirect, and cumulative effects, including any activities that may related to or depend on the proposed project.

A review of pertinent literature and current information on potential impacts of air emissions on threatened and endangered species of potential occurrence in the action area was conducted. This literature review was conducted by searching the University of Texas at Austin digital library (*www.lib.utsystem.edu*) as well as the online journal databases JSTOR (*www.jstor.org*) and BioOne (*www.bioone.org*). An extensive review of the literature did not find any publication that identified adverse impacts of air emissions on any listed species in the BA.

6.1 Black-footed Ferret

Potential to Occur in the Action Area: There are no documented sightings of the black-footed ferret in the Action Area and no recently documented sightings anywhere in the State (from which it is considered extirpated) (TPWD 2013ab). The black-footed ferret does not exist in the Action Area.

Recommended Determination of Effect: Because the black-footed ferret does not exist in the Action Area, the recommended determination of effect is that the proposed project will have no effect on the black-footed ferret.

6.2 Gray Wolf

Potential to Occur in the Action Area: There are no documented sightings of the gray wolf in the Action Area and no recently documented sightings anywhere in the State (from which it is considered extirpated) (TPWD 2013ab). The gray wolf does not exist in the Action Area.

Recommended Determination of Effect: Because the gray wolf does not exist in the Action Area, the recommended determination of effect is that the proposed project will have no effect on the gray wolf.

6.3 Whooping Crane

Potential to Occur in the Action Area: The Action Area is 90 miles west of the western boundary of the whooping crane's 320-kilometer (200-mile) wide 94% migratory corridor (**Figure 8**) (USFWS 2007). Statistically, 3% of all whooping crane sightings occurred west of this corridor. In essence, a tiny fraction of a very small population is predicted to occupy a vast area outside this corridor. Given a total migratory population of approximately 300 whooping cranes per migration, on average nine whooping cranes would fly west of this 4,000-kilometer-long corridor. The Action Area does not contain any features that would attract whooping cranes. Middle Tule Draw is an ephemeral drainage that is located in the southern half of the Action Area. This feature has no wetlands and no other characteristics that would attract whooping cranes. Stopping over would not be encouraged in or around the Action Area in its current condition – in fact, stopping over would be highly discouraged because the Action Area is close to an urban center, adjacent to a major interstate highway, and surrounded by dry, agricultural land. Neither the TXNDD (TPWD 2013c) nor the USGS GAP Analysis Program (USGS 2013c) documents any occurrence of the whooping crane in Swisher County or Castro County. There is virtually no possibility that the whooping crane would occur in the Action Area.

Potential Direct Effects: Documented take of whooping cranes from human-related activity is predominated by mortality of fledglings from collisions with electrical power lines during low flight (Stehn and Wassenich 2008, USFWS 2009). It is inferred that whooping cranes are most susceptible to such collisions when descending at the end, or ascending at the beginning, of a migratory stage in the vicinity of electrical power lines. The horizon at dusk and dawn may visually mask horizontal features such as power lines. Collisions with towers and buildings are rare, suggesting that whooping cranes are capable of avoiding adequately visible, tall structures. Of particular note, wind turbines do not appear to contribute to documented whooping crane mortality, even though these structures are known to be hazardous structures for many other species of flying vertebrates. The tallest structures of the proposed project will consist of highly visible, static structures (two expansion turbine stacks), no higher than 50 m (150 ft). Proximity to the City of Tulia and Interstate Highway 27 and lack of suitable habitat are factors that collectively are likely to cause the whooping crane to avoid the use of the Action Area as stopover sites. There are no data showing take of whooping cranes that is related to air emissions.

Potential Indirect Effects: The only whooping cranes expected in Swisher County or Castro County are those stopping over during their semiannual migrations between their nesting grounds in northwestern Canada and their wintering grounds in the coastal bend of Texas. Swisher County and Castro County are in a region of the Texas panhandle with flat terrain covered with croplands and grasslands. Native vegetation in this region is largely replaced by cultivation practices that render the land unsuitable as stopover habitat (USFWS 2007). Shallow depressions and draws exist, but are generally dry due to year-round arid conditions. Playas (shallow wetland depressions) may exist in the region and may be attractive to whooping cranes as stopover sites. The on-site survey found that no playas or other wetlands exist in the Action Area, but did find two, small marginal playa lakebeds. Thus, whooping cranes are unlikely to use the Action Area as a stopover site even as it currently exists. In conclusion, the construction of the proposed project would not result in loss of suitable stopover habitat.

Recommended Determination of Effect: Because the proposed project is not anticipated to have any direct or indirect impact on the whooping crane, and the whooping is not anticipated to occur in the Action Area, the recommended determination of effect is that the proposed project would have *no effect* the whooping crane.

6.4 Lesser Prairie Chicken

Potential to Occur in the Action Area: The closest known lesser prairie chicken habitation is 76 km (48 mi) west of the Action Area in Lamb County (TPWD 2013d) (**Figure 9**). There is no suitable habitat in the Action Area for the lesser prairie chicken. The Action Area and its immediate surroundings consist of degraded rangeland, roadways and urbanization and thus have no features that would attract the lesser prairie chicken. There is virtually no possibility that the lesser prairie chicken would occur in the Action Area.

Potential for Direct or Indirect Effects: Proximity to the City of Tulia and Interstate Highway 27, as well as lack of suitable habitat are factors that collectively are likely to cause the lesser prairie chicken to avoid the use of the Action Area. There are no data showing that take of lesser prairie chicken can be related to air emissions.Native vegetation in Swisher County and Castro County is largely replaced by cultivation and agricultural practices that render the land unsuitable as lesser prairie chicken habitat (USFWS 2007). Thus, the lesser prairie chicken would not use the Action Area. The construction of the proposed project would not result in loss of suitable habitat. The construction and operation of the proposed project are not likely to result in adverse impacts to this proposed species.

6.5 Designated Critical Habitat

No DCH has been established for the black-footed ferret, the gray wolf, the whooping crane or the lesser prairie chicken in Swisher County or in Castro County. Therefore, there would be no destruction or adverse modification on DCH by the proposed project. The recommended determination of effect is that the proposed project would have no effect on DCH for the black-footed ferret, gray wolf or whooping crane. There would be no likely impact on DCH for the lesser prairie chicken.

6.6 Summary of Determinations of Effect for Threatened or Endangered Species and DCH

Table 5. Determinations of Effect for Listed Species and DHC for the Counties of Swisher and Castro, Texas

Common Name	Scientific Name	Determination of Effect or Conclusion
Listed Species		
Mammals		
Black-footed ferret	*Mustela nigripes*	No Effect
Gray wolf	*Canis lupus*	No Effect
Birds		
Whooping crane	*Grus americana*	No Effect
Designated Critical Habitat		
Black-footed ferret	*Mustela nigripes*	No Effect
Gray wolf	*Canis lupus*	No Effect
Whooping crane	*Grus americana*	No Effect

7.0 REFERENCES

Almas L. K., Colette W. A., Wu, Z. 2004. Declining Ogallala Aquifer and Texas Panhandle Economy. Southern Agricultural Economics Association Annual Meeting, Tulsa, Oklahoma, February 14-18, 2004.

Barkley, T. M. 1986. Flora of the Great Plains. *In* The Great Plains flora association, eds. University Press of Kansas, Lawrence, Kansas, USA.

Billings, W. D. 1988. Alpine vegetation. *In* M. G. Barbour and W. D. Billings, Eds. 1988. North American terrestrial vegetation. New York, New York, USA.

Blair, W. F. 1950. The biotic provinces of Texas. Texas Journal of Science 2: 93-117.

Campbell, L. 2003. Endangered and Threatened Animals of Texas, Their Life History and Management. Texas Parks and Wildlife Division. Austin.

Davis, D. M., R. E. Horton, E. A. Odell, R. D. Rodgers and H. A. Whitlaw. 2008. Lesser Prairie-Chicken Conservation Initiative. Lesser Prairie-Chicken Interstate Working Group. 121 pp. Davis, W. B., and D. J. Schmidly. 1994. The Mammals of Texas. Texas Parks and Wildlife Press. Austin, Texas.

Environmental Protection Agency (EPA). 1971. Effects of Noise on Wildlife and Other Animals. EPA Office of Noise Abatement and Control. EPA Document NTID300.5.

_____. 1974. Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. EPA Office of Noise Abatement and Control. EPA Document 550/9-74-004.

_____. 2005. The Endangered Species Act of 1973. As Amended through the 108th Congress. 44 pp.

_____. 2010. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule. Federal Register. Volume 75. No. 106. Pages 31514-31608.

_____. 2011. Determinations Concerning Need for Error Correction, Partial Approval and Partial Disapproval, and Federal Implementation Plan Regarding Texas's Prevention of Significant Deterioration Program. Federal Register. Volume 76. No. 85. Pages 25177-25209.

_____. 2012a. Prevention of Significant Deterioration of Air Quality. 40 Code of Federal Regulations 52.21(b)(49)(i)).

_____. 2012b. Prevention of Significant Deterioration of Air Quality. 40 Code of Federal Regulations 52.21(b)(49)(v)(*a*).

Hatch S. L., K. N. Ghandi, and L. E. Brown. 1990. Checklist of the Vascular Plants of Texas. MP-1855. The Texas Agricultural Experimental Station. Texas A&M University, College Station, Texas.

Kirkpatrick, Z. M. 1992. A field guide: Wildflowers of the Western Plains. University of Texas Press, Austin, Texas, USA.

Larkin, T. J. and G. W. Bomar. 1983. Climatic Atlas of Texas. Texas Department of Water Resources. Publication LP-192.

McMahan, C. A., R. G. Frye, and K. L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

Oberholser, H. C. 1974. *The Bird Life of Texas*. 2 Volumes. University of Texas Press. Austin.

Rose, F. L. and R. W. Strandtmann. 1986. Wildflowers of the Llano Estacado. Taylor Publishing, Dallas, Texas, USA.

Smith, A. E. and J. B. Levenson. 1980. *A Screening Procedure for the Impacts of Air Pollution on Plants, Soils, and Animals*. EPA 450/2-81-078. Argonne National Laboratory, Argonne, Illinois, USA.

Stehn, T. 2007. Draft Whooping Cranes and Wind Farms – Guidance for Assessment of Impacts. USFWS. URL = http://www.neo.ne.gov/renew/wind-working-group/wind-whoopingcranes.pdf

Stehn T. and T. Wassenich. 2008. Whooping crane collisions with power lines: an issue paper. 2006 North American Crane Workshop.

Texas Commission on Environmental Quality (TCEQ). 2013. Surface Water Quality Viewer. URL = http://www.tceq.texas.gov/waterquality/monitoring/viewer.html

Texas Parks and Wildlife Department (TPWD). 2013a. Annotated County Lists of Rare Species. Swisher County. URL = http://www.tpwd.state.tx.us/gis/ris/es/ES_Reports.aspx?county=Swisher>.

_____. 2013b. Annotated County Lists of Rare Species. Castro County. URL = http://www.tpwd.state.tx.us/gis/ris/es/ES_Reports.aspx?county=Castro>.

_____. 2013c. Texas Natural Diversity Database (TXNDD). Element of Occurrence Records from Texas Parks and Wildlife Department's Rare, Threatened, and Endangered Species Database.

_____. 2013d. Lesser Prairie-Chicken Interactive Mapping. URL = https://www.tpwd.state.tx.us/gis/lpc/.

U.S. Fish and Wildlife Service (USFWS). 1967. Native Fish and Wildlife. Endangered Species. Federal Register. Volume 32. No. 48. Page 4001.

_____. 1970. Conservation of Endangered Species and Other Fish or Wildlife (First List of Endangered Foreign Fish and Wildlife as Appendix A).Federal Register Vol. 35. No. 106. Pages 8491-8498.

_____. 1978a. Reclassification of the Gray Wolf in the United States and Mexico, with Determination of Critical Habitat in the Michigan and Minnesota. Federal Register Vol. 43 No. 47 Pages 9607-9615.

_____. 1978b. Determination of Critical Habitat for the Whooping Crane. Federal Register. Volume 43. No. 94. Pages 20938-20942.

_____. 1993. Endangered and Threatened Wildlife and Plants; Establishment of an Experimental Nonessential Population of Whooping Cranes in Florida. Federal Register. Volume 58. No. 13. Pages 5647-5658.

_____. 1997. Endangered and Threatened Wildlife and Plants.90-day Finding for a Petition to List the Lesser Prairie-Chicken as Threatened. Federal Register Vol. 62 No. 130 Pages 36482-36484.

_____. 2001. Endangered and Threatened Wildlife and Plants; Establishment of an Experimental Nonessential Population of Whooping Cranes in the Eastern United States. Volume 66. No. 123. Pages 33903-33917.

_____. 2007. International Recovery Plan for the Whooping Crane, Third Revision. Endangered Species Bulletins and Technical Reports. Paper 45.

_____. 2009. Whooping Cranes and Wind Development – An Issue Paper. URL = ftp://wiley.kars.ku.edu/windresource/Whooping Crane and Wind Development FWS April 202009.pdf

_____. 2010. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Proposed Rule. Federal Register Vol. 75 No. 217 Pages 69222-69294.

_____. 2011a. Endangered and Threatened Wildlife and Plants; Reissuance of Final Rule To Identify the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and To Revise the List of Endangered and Threatened Wildlife. Federal Register Vol. 76 No. 87 Pages 25590-25592.

_____. 2011b. Endangered and Threatened Wildlife and Plants. Revising the Listing of the Gray Wolf (Canis lupus) in the Western Great Lakes. Federal Register Vol. 76 No. 249 Pages 81666-81726.

_____. 2011c. Endangered and Threatened Wildlife and Plants; Establishment of an Experimental Nonessential Population of Endangered Whooping Cranes in Southwestern Louisiana. Federal Register. Volume 76. No. 23. Pages 6066-6082.

_____. 2012a. Endangered and Threatened Wildlife and Plants. Removal of the Gray Wolf in Wyoming From the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population. Federal Register Vol. 77 No. 175 Pages 55530-55604.

_____. 2012b. 5-Year Review: Summary and Evaluation. Lower 48-State and Mexico Gray Wolf (Canis lupus) Listing, as Revised. Washington Office, Arlington, Virginia.

_____. 2012c. Endangered and Threatened Wildlife and Plants; Listing the Lesser Prairie Chicken as a Threatened Species; Proposed Rule. Federal Register. Volume 77. No. 238. Pages 73828-73888.

_____. 2013a URL=http://www.fws.gov/endangered/.

_____. 2013b. Black-footed Ferret Draft Recovery Plan. Endangered and Threatened Wildlife and Plants. Federal Register Vol. 78 (48): 23948-9.

_____. 2013c. Endangered and Threatened Wildlife and Plants. Removing the Gray Wolf (*Canis lupus*) From the List of Endangered and Threatened Wildlife and Maintaining Protections for the Mexican Wolf (*Canis lupus baileyi*) by Listing It as Endangered. Proposed Revision to the Nonessential Experimental Population of the Mexican Wolf. Proposed Rules. Federal Register Vol. 78 No. 114 Pages 35664-35719.

_____. 2013d. Species Profile. Whooping Crane. URL = http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B003.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1998. Endangered Species Consultation Handbook. Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.

U.S. Geographic Survey (USGS). 2013a. National Gap Analysis Program (GAP). Species Data Portal. Black-footed Ferret. URL = http://gapanalysis.usgs.gov/species/viewer/.

_____. 2013b. National Gap Analysis Program (GAP). Species Data Portal. Gray Wolf. URL = http://gapanalysis.usgs.gov/species/viewer/.

_____.2013c. National Gap Analysis Program (GAP). Species Data Portal. Whooping Crane. URL = http://gapanalysis.usgs.gov/species/viewer/.

_____. 2013d. National Gap Analysis Program (GAP). Species Data Portal. Lesser-prairie Chicken. URL = http://gapanalysis.usgs.gov/species/viewer/.

Appendix A

Atmospheric Dispersion Modeling Analysis

Atmospheric Dispersion Modeling Analysis

Chamisa CAES at Tulia, LLC

Tulia, Swisher County, Texas

Customer Reference Number: CN604262139
Regulated Entity Number: RN106598907

February 2013

STATE OF TEXAS
JOERG WINDOLPH
85630
LICENSED
PROFESSIONAL ENGINEER
2/21/12

Waid Corporation dba Waid Environmental
Certificate of Registration No. F-58

CHAMISA
ENERGY

TABLE OF CONTENTS

(In order, as listed in Appendix F
of TCEQ Air Quality Modeling Guidelines, February 1999)

SECTION 1.0

PROJECT IDENTIFICATION INFORMATION

Applicant: Chamisa CAES at Tulia, LLC

Contact: Alissa Oppenheimer
Managing Director
2300 North Ridgetop Road
Santa Fe, NM 87506
(612) 360-4403
ao@chamisaenergy.com

Facility: Chamisa CAES at Tulia, LLC

Permit Application No.: PSD GHG Permit Application for Electric Generation Facilities

Nearest City and County: Tulia, Swisher County

Modeler: Waid Environmental Contact:

Joerg Windolph, P.E.
Principal Engineer
10800 Pecan Park Blvd., Ste 300
Austin, TX 78750
(512) 255-9999
jwindolph@waid.com

SECTION 2.0

PROJECT OVERVIEW

The Chamisa CAES at Tulia power plant ("the Chamisa Facility") is a bulk energy storage system that will use compressed air energy storage (CAES) to produce nominally 270 MW of electrical power. The Chamisa Facility will be located between Amarillo and Lubbock in the Texas Panhandle in Swisher County, Texas. CAES technology can use electrical power from renewable energy technologies such as wind turbines and conventional power generation facilities to compress air and store the compressed air in underground storage caverns. As needed, the compressed air is released from storage, heated by mixing and combusted with natural gas, and exhausted through an expansion turbine to produce power.

Associated equipment to be constructed will consist of two expansion turbine trains, a natural gas-fired emergency generator (authorized under PBR 30 TAC §106.511), two cooling towers (authorized under PBR 30 TAC §106.371), and other supporting equipment This air dispersion modeling analysis has been performed in support of the project's biological assessment. This report documents the modeling methodology that was used in the enclosed air dispersion modeling analysis. Detailed process description and process flow diagram, as well as documentation of emission calculations, can be found in the appropriate sections of the standard permit registration. Copies of the modeling input tables are provided in Appendix A of this report.

2.1 Type of Permit Review

The proposed Chamisa Facility project triggers Prevention of Significant Deterioration (PSD) review for greenhouse gases (GHGs).

2.2 Constituents to be Evaluated

An air quality analysis was conducted for proposed project emissions of criteria air pollutants with a primary or secondary National Ambient Air Quality Standard (NAAQS). The applicable pollutants and averaging times are[1]:

- CO, 1-hr
- CO, 8-hr
- NO_2, 1-hr
- NO_2, annual
- Ozone, 8-hr (modeling not conducted because project increase is less than 100 tpy of NO_x and VOC)
- PM_{10}, 24-hr
- $PM_{2.5}$, 24-hr
- $PM_{2.5}$, Annual
- SO_2, 1-hr
- SO_2, 3-hr

[1] http://www.epa.gov/air/criteria.html

SECTION 3.0

PLOT PLAN

The proposed Chamisa Facility is shown on the enclosed plot plan in Appendix B. The plot plan includes a clearly marked scale, all property lines, all emission points, a true north arrow, UTM coordinates (NAD83), and all buildings and structures which could create downwash effects. The length, width, and heights of the buildings and structures are summarized in a table on the plot plan.

SECTION 4.0

AREA MAP

The area map is provided in Appendix C. It is an excerpt of a United States Geological Survey (USGS) 7.5-minute quadrangle. This area map displays a UTM coordinate grid, property lines, and a 3 km radius circle from the plant.

SECTION 5.0

AIR QUALITY MONITORING DATA

This air dispersion modeling analysis predicted off-property concentrations that are lower than the Significant Impact Levels (SILs) for all modeled pollutants and averaging times. Therefore, ambient monitoring background concentrations were not required for any of the pollutants and averaging times.

SECTION 6.0
MODELING EMISSIONS INVENTORY

6.1 On-Property Sources to be Reviewed

All new and increased emissions from the proposed Chamisa Facility were modeled.

6.2 Other On-Property and Off-Property Sources

Except for the emergency generator engine, all on-property sources with new and increased emissions of the affected pollutants were modeled. Since the scope of this modeling exercise was to determine the magnitude and area of potential impact for the proposed Chamisa Facility, no off-property sources were considered in this analysis.

The emergency engine was not included in the 1-hr NO_2 modeling demonstration because the emergency engine is not likely to operate when the normal NO_2 emission sources from the process are operating at their peak NO_2 emission rates. The Chamisa Facility limits the emergency engine to operate no more than 100 hours per year. Emergency operation is allowed but emergencies are not foreseeable and are not part of the permit's allowable emission rate. Exclusion of the intermittent emergency engine emission sources from the modeling demonstration is supported by the EPA's March 1, 2011 memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard."

6.3 EPN and Model Input File Source ID Number Cross-Reference

An EPN and model input file source ID number cross-reference is shown on the modeling input tables in Appendix A.

6.4 Stack Parameter Justification

Copies of the modeling input tables, which are provided in Appendix A, summarize source emission rates and release parameters in metric units used in the modeling. Cooling Tower emissions were modeled as pseudo-point sources with a height approximately equal to the expected cooling tower height. All other emission sources were modeled as point sources.

The permit proposes emissions from the turbines for seven different operating scenarios as well as startup and shutdown emissions. The seven operating scenarios range from low speed level to high speed level. The worst-case operating scenario was determined through modeling of each proposed scenario. For each modeled operating scenario, the expected temperature, velocity and NO_2 emission rate was used in the modeling. The stack parameters of the operating scenario other than startup and shutdown which resulted in the highest off-property impact were then used in the criteria pollutant modeling analysis for the 24-hr and annual averaging times. The stack exit parameter of the worst-case operating scenario were used in the modeling of the 1-hr, 3-hr, and 8-hr averaging times.

Source Locations

The locations of all modeled point sources are shown on the plot plan in Appendix B. Routine process emissions are released at fixed locations.

Emission Rates

New and increased emissions from the proposed project were modeled. An NO_2/NO_x ratio of 1.0 was assumed for the combustion sources for the 1-hr and annual NO_2 modeling.

Release Height

Estimated actual release heights were modeled for the point sources.

Temperature

Estimated actual exhaust temperatures were modeled for the point sources. The cooling towers were modeled with a temperature of 0K, which AERMOD equates to ambient temperature.

Exit Diameter

A minimal exit diameter of 0.001 m was modeled for the pseudo-point sources. Proposed actual stack diameters were modeled for all other point sources.

Exit Velocity

A minimal exit velocity of 0.001 m/s was modeled for the pseudo-point sources. Estimated actual stack exit velocities were modeled for all other point sources.

6.5 Scaling Factors

Scaling factors were not used in this modeling analysis..

SECTION 7.0

MODELS AND MODELING TECHNIQUES

Modeling was performed using EPA's AERMOD version 12060. The regulatory default options were used.

SECTION 8.0

SELECTION OF DISPERSION OPTION

The selection of either urban or rural dispersion coefficients for this modeling analysis is based on the land use method. The land use procedure involves classifying the land use within a 3000-m radius about the source by using the meteorological land use typing scheme proposed by August H. Auer, Jr., "Correlation of Land Use and Cover with Meteorological Anomalies," Journal of Applied Meteorology, May 1978, Vol. 17, pp. 636-643. If the land use Types I1, I2, C1, R2, and R3 account for 50% or more of the total area, urban dispersion coefficients should be used; otherwise, rural dispersion should be used.

The estimated land use is based on USGS 7.5-Minute Series Tulia, TX Quadrangle (illustrated using the area map in Appendix C) and publicly-available aerial photographs. Since, by inspection, the percent urban area is less than 50%, the rural dispersion coefficient was used in this modeling analysis.

SECTION 9.0

BUILDING WAKE EFFECTS (DOWNWASH)

The building downwash parameters input into the AERMOD model were prepared using the BPIP building downwash model (dated 04274). The "P" flag was set for preparing downwash related data for a model run utilizing the PRIME algorithm, as required by the AERMOD program. The locations of all buildings and structures are provided on the plot plan.

SECTION 10.0

RECEPTOR GRID - TERRAIN

Receptor elevations were considered and assigned using AERMAP (version 11103). Receptor elevations were extracted from several 7.5-Minute Series USGS maps. The maps include Center Plains School, Claytonville NW, Edmonson NE, Lakeview, Tule Lake, and Tulia. The maps are included on the attached CD.

SECTION 11.0

RECEPTOR GRID - DESIGN

Receptor grids used in this analysis are based on UTM coordinates (NAD 1983). Receptors were placed on the property line every 25 meters. A 25 meter receptor spacing was then used out to 100 meters from the property line. A 100 meter receptor spacing was then used out to 1,000 meters from the property line and a 500 meter receptor spacing was used out to 5000 meters from the property line.

SECTION 12.0
METEOROLOGICAL DATA

Meteorological data for Swisher County was obtained from the TCEQ's website[2] and used in the modeling analysis. Meteorological data for Swisher County uses surface data and upper air data from Amarillo (AMA). The surface station base elevation is 3591 feet.

To develop their meteorological data files, TCEQ processed the surface and upper air data using AERMET (version 11059). TCEQ provides three different meteorological data sets – low, medium, and high surface roughness. The AERSURFACE program (dated 13016) was run to determine which data set to use.

Land cover data was obtained from the USGS NLCD92 archives[3]. AERSURFACE was run using this land cover data and a default 1 km radius from the center of the plant. The resulting surface roughness length of 0.074 meter corresponds to TCEQ's low surface roughness category (0.001-0.1 meter). Therefore, the low surface roughness meteorological data set was used.

Criteria pollutant modeling was performed using five years of concatenated meteorological data.

[2] http://www.tceq.texas.gov/permitting/air/modeling/aermod_datasets.html
[3] http://landcover.usgs.gov/us_map.php

SECTION 13.0

MODELING RESULTS

An air quality analysis was conducted for project emissions of criteria air pollutants with a primary or secondary National Ambient Air Quality Standard (NAAQS). The tables included at the end of this section summarize the modeling results.

Worst-Case Operating Scenario

The permit proposes emissions from the turbines for seven different operating scenarios as well as startup and shutdown emissions. The seven operating scenarios range from low speed level to high speed level. The worst-case operating scenario was determined through modeling of each proposed scenario. For each modeled operating scenario, the expected temperature, velocity and NO_2 emission rate was used in the modeling. The stack parameters of the operating scenario other than startup and shutdown which resulted in the highest off-property impact were then used in the criteria pollutant modeling analysis for the 24-hr and annual averaging times. The stack exit parameter of the worst-case operating scenario were used in the modeling of the 1-hr, 3-hr, and 8-hr averaging times.

The modeling determined that the startup mode resulted in the highest off-property impacts. The high speed level operating scenario resulted in the highest off-property impact from the operating scenarios other than startup and shutdown.

Table Worst-Case Operating Scenario Results

No.	Operating Scenario	Modeled Impact ($\mu g/m^3$)
WC_Sc1	LSL	1.556
WC_Sc2	Part Load 3	1.469
WC_Sc3	H2O “Off”	1.751
WC_Sc4	H2O “On”	1.402
WC_Sc5	Part Load 2	2.208
WC_Sc6	Part Load 1	2.546
WC_Sc7	HSL	3.112
WC_Sc8	Startup	4.888
WC_Sc9	Shutdown	3.235

Criteria Pollutants

All new and increased emissions from the proposed Chamisa Facility were modeled, and the resulting concentrations were compared to the appropriate Significant Impact Level (SIL). If the concentration is less than the SIL, no further analysis is required. If the concentration is greater than the SIL, then a Radius of Significant Impact is defined, a representative ambient monitoring background concentration is added, and the resulting total design concentration is compared to the secondary NAAQS standard.

CO, 1-hr

1-hr CO modeling was performed using five years of concatenated meteorological data. The maximum 1-hr average concentration from any of the modeled years was 205 µg/m^3, which is below the SIL of 2,000 µg/m^3.

CO, 8-hr

8-hr CO modeling was performed using five years of concatenated meteorological data. The maximum 8-hr average concentration from any of the modeled years was 64 µg/m^3, which is below the SIL of 500 µg/m^3.

NO_2, 1-hr

1-hr NO_2 modeling was performed using five years of concatenated meteorological data. The maximum 1-hr average concentration from any of the modeled years was 4.75 µg/m^3, which is below the SIL of 7.5 µg/m^3.

NO_2, annual

Annual NO_2 modeling was performed using five years of concatenated meteorological data. The annual concentration averaged over the modeled years was 0.086 µg/m^3, which is below the SIL of 1.0 µg/m^3.

PM_{10}, 24-hr

24-hr PM_{10} modeling was performed using five years of concatenated meteorological data. The highest 24-hr average concentration from any of the modeled years was 0.76 µg/m^3, which is less than the SIL of 5 µg/m^3.

$PM_{2.5}$, 24-hr

24-hr $PM_{2.5}$ modeling was performed using five years of concatenated meteorological data. The maximum 24-hr average concentration from any of the modeled years was 0.49 µg/m^3, which is less than the SIL of 1.2 µg/m^3.

$PM_{2.5}$, Annual

Annual $PM_{2.5}$ modeling was performed using five years of concatenated meteorological data. The annual average concentration averaged over the modeled years was 0.02 µg/m^3, which is below the SIL of 0.3 µg/m^3.

SO_2, 1-hr

1-hr SO_2 modeling was performed using five years of concatenated meteorological data. The highest 1-hr average concentration from any of the modeled years was 0.46 µg/m^3, which is below the SIL of 7.8 µg/m^3.

SO_2, 3-hr

3-hr SO_2 modeling was performed using five years of concatenated meteorological data. The highest 3-hr average concentration from any of the modeled years was 0.42 µg/m^3, which is below the SIL of 25 µg/m^3.

Summary of Criteria Pollutant Modeling Results

Pollutant	Averaging Time	SIL [a,b,c] (µg/m^3)	Max Modeled Concentration (µg/m^3)	Max Modeled Concentration Above SIL?	Radius of Significant Impact (km)	Ambient Monitoring Background Concentration (µg/m^3)	Total Design Concentration (µg/m^3)	NAAQS Standard (µg/m^3)
CO	1-hr	2,000	204.86	No	N/A	N/A	N/A	40,000
CO	8-hr	500	63.92	No	N/A	N/A	N/A	10,000
NO_2	1-hr	7.5	4.75	No	N/A	N/A	N/A	188
NO_2	Annual	1	0.086	No	N/A	N/A	N/A	100
PM_{10}	24-hr	5	0.76	No	N/A	N/A	N/A	150
$PM_{2.5}$	24-hr	1.2	0.49	No	N/A	N/A	N/A	35
$PM_{2.5}$	Annual	0.3	0.02	No	N/A	N/A	N/A	15
SO_2	1-hr	7.8	0.46	No	N/A	N/A	N/A	196
SO_2	3-hr	25	0.42	No	N/A	N/A	N/A	1300

[a] Unless otherwise specified, from 40 CFR §51.165(b)(2)

[b] For 1-hr NO_2, from TCEQ's July 22, 2010 "Interim 1-Hour Nitrogen Dioxide (NO_2) NAAQS Implementation Guidance"

[c] For 1-hr SO_2, from TCEQ's August 1, 2010 "Interim 1-Hour Sulfur Dioxide (SO_2) NAAQS Implementation Guidance"

SECTION 14.0

CD

Model input/output and associated electronic files are provided on a CD.

APPENDIX A

MODELING INPUT TABLES

Modeled Release Parameters for Point Sources

UTM Zone 15

EPN	MODEL ID	DESCRIPTION	UTM EAST	UTM NORTH	HEIGHT		DIAMETER		VELOCITY		TEMPERATURE	
			(m)	(m)	(ft)	(m)	(ft)	(m)	(ft/sec)	(m/sec)	(° F)	(° K)
TURB1	TURB1	Turbine 1	242660	3823762	150	45.7	14	4.27	45	13.7	210	372
TURB2	TURB2	Turbine 2	242746	3823762	150	45.7	14	4.27	45	13.7	210	372
EMERGEN	EMERGEN	Emergency Generator	242584	3823682	10	3.05	1	0.305	187	57	932	773
CT1	CT1	Cooling Tower 1	242540	3823795	45	13.7	0.00328	0.001	0.00328	0.001	Amb.	0
CT2	CT2	Cooling Tower 2	242540	3823722	45	13.7	0.00328	0.001	0.00328	0.001	Amb.	0

Modeled Emission Rates for Criteria Pollutant Emission Sources

EPN	MODEL ID	DESCRIPTION	1-hr and 8-hr CO		1-hr NO_2			Annual NO_2			24-hr PM_{10}		24-hr $PM_{2.5}$		Annual $PM_{2.5}$		1-hr and 3-hr SO_2	
			CO Emission Rate (lb/hr)	CO Emission Rate (g/sec)	NO_x Emission Rate (lb/hr)	NO_2/NO_x Ratio (--)	NO_2 Emission Rate (g/sec)	NO_x Emission Rate (ton/yr)	NO_2/NO_x Ratio (--)	NO_2 Emission Rate (g/sec)	PM_{10} Emission Rate (lb/hr)	PM_{10} Emission Rate (g/sec)	$PM_{2.5}$ Emission Rate (lb/hr)	$PM_{2.5}$ Emission Rate (g/sec)	$PM_{2.5}$ Emission Rate (ton/yr)	$PM_{2.5}$ Emission Rate (g/sec)	SO_2 Emission Rate (lb/hr)	SO_2 Emission Rate (g/sec)
TURB1	TURB1	Turbine 1	8.63	1.09	9.73	1	1.23	18.95	1	0.546	1.404	0.177	1.404	0.177	3.78	0.109	0.86	0.108
TURB2	TURB2	Turbine 2	8.63	1.09	9.73	1	1.23	18.95	1	0.546	1.404	0.177	1.404	0.177	3.78	0.109	0.86	0.108
EMERGEN	EMERGEN	Emergency Generator	9.93	1.25	0	-	0	0.1	1	0.00288	0.16	0.0202	0.16	0.0202	0.008	0.00023	0.022	0.0028
CT1	CT1	Cooling Tower 1	-	-	-	-	-	-	-	-	0.08	0.0101	0.005	0.00063	0.02	0.000576	-	-
CT2	CT2	Cooling Tower 2	-	-	-	-	-	-	-	-	0.08	0.0101	0.005	0.00063	0.02	0.0005758	-	-

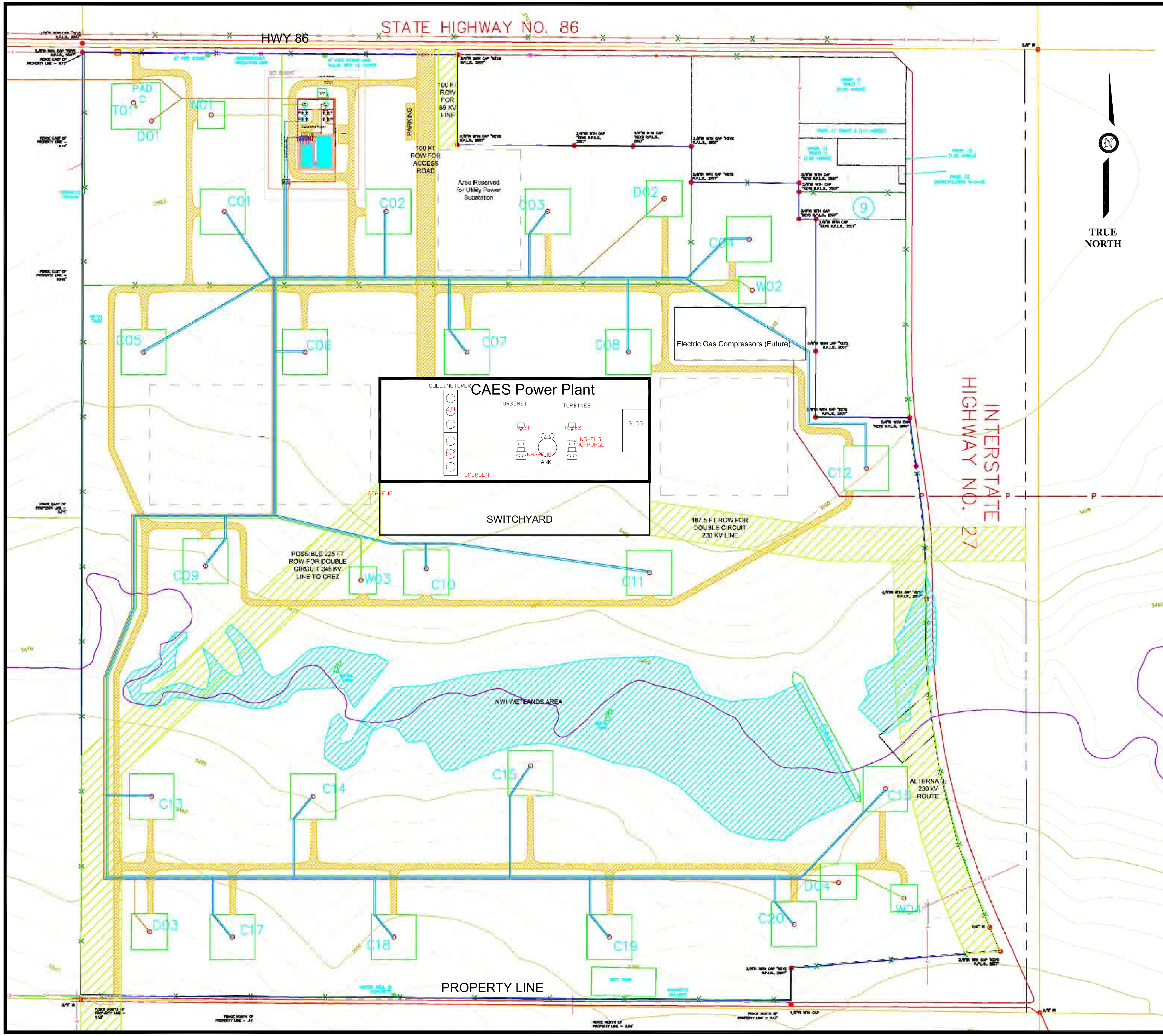
Notes: EPN EMERGEN is not included in the 1-hr NO_2 modeling demonstration because it is an emergency engine.

Modeled Release Parameters for Turbine Operating Scenarios

Scenario No.	Scenario	EPN/MODEL ID	DESCRIPTION	UTM EAST	UTM NORTH	MODELED EMISSION RATE		HEIGHT		DIAMETER		VELOCITY		TEMPERATURE	
				(m)	(m)	lb/hr	g/sec	(ft)	(m)	(ft)	(m)	(ft/sec)	(m/sec)	(° F)	(° K)
1	LSL	TURB1	Turbine 1	242660	3823762	1.379	0.174	150	45.7	14	4.27	11.04	3.36	210	372
1	LSL	TURB2	Turbine 2	242746	3823762	1.379	0.174	150	45.7	14	4.27	11.04	3.36	210	372
2	Part Load 3	TURB1	Turbine 1	242660	3823762	1.550	0.195	150	45.7	14	4.27	13.84	4.22	210	372
2	Part Load 3	TURB2	Turbine 2	242746	3823762	1.550	0.195	150	45.7	14	4.27	13.84	4.22	210	372
3	H_2O "Off"	TURB1	Turbine 1	242660	3823762	2.011	0.254	150	45.7	14	4.27	16.07	4.9	210	372
3	H_2O "Off"	TURB2	Turbine 2	242746	3823762	2.011	0.254	150	45.7	14	4.27	16.07	4.9	210	372
4	H_2O "On"	TURB1	Turbine 1	242660	3823762	1.619	0.204	150	45.7	14	4.27	16.17	4.93	210	372
4	H_2O "On"	TURB2	Turbine 2	242746	3823762	1.619	0.204	150	45.7	14	4.27	16.17	4.93	210	372
5	Part Load 2	TURB1	Turbine 1	242660	3823762	3.059	0.386	150	45.7	14	4.27	22.36	6.82	210	372
5	Part Load 2	TURB2	Turbine 2	242746	3823762	3.059	0.386	150	45.7	14	4.27	22.36	6.82	210	372
6	Part Load 1	TURB1	Turbine 1	242660	3823762	4.792	0.604	150	45.7	14	4.27	33.65	10.26	210	372
6	Part Load 1	TURB2	Turbine 2	242746	3823762	4.792	0.604	150	45.7	14	4.27	33.65	10.26	210	372
7	HSL	TURB1	Turbine 1	242660	3823762	6.605	0.833	150	45.7	14	4.27	44.9	13.69	210	372
7	HSL	TURB2	Turbine 2	242746	3823762	6.605	0.833	150	45.7	14	4.27	44.9	13.69	210	372
8	Startup	TURB1	Turbine 1	242660	3823762	9.726	1.227	150	45.7	14	4.27	36.52	11.1	210	372
8	Startup	TURB2	Turbine 2	242746	3823762	9.726	1.227	150	45.7	14	4.27	36.52	11.1	210	372
9	Shutdown	TURB1	Turbine 1	242660	3823762	6.800	0.858	150	45.7	14	4.27	41.7	12.7	210	372
9	Shutdown	TURB2	Turbine 2	242746	3823762	6.800	0.858	150	45.7	14	4.27	41.7	12.7	210	372

APPENDIX B

PLOT PLAN



Downwash Structure Name	Height (feet)	(meters)	Dimensions (meters)
BLDG	40.0	12.19	46.20 x 72.60
COOLINGTOWER	45.0	13.72	23.50 x 145.40
TANK	50.0	15.24	Diameter 31.62
TURBINE1	50.0	15.24	16.80 x 82.80
TURBINE2	50.0	15.24	16.80 x 82.80

Emission Point Number	Name	Location Easting, Northing (meters)
CT1	COOLING TOWER 1	242540, 3823795
CT2	COOLING TOWER 2	242540, 3823722
EMERGEN	EMERGENCY GENERATOR	242584, 3823682
NG-FUG	NG FUGITIVES	242742, 3823745
NG-PURGE	NG PURGE	242742, 3823745
NH3-FUG	AMMONIA FUGITIVES	242664, 3823726
SF6-FUG	SF6 FUGITIVES	242420, 3823651
TURB1	TURBINE 1	242660, 3823762
TURB2	TURBINE 2	242746, 3823762

0 100 200 400

SCALE IN METERS

LEGEND

- IRON ROD FOUND (IRF)/SPIKE NAIL (SNF)
- PLANNED WELLHEAD LOCATION
- PLANNED WELL PAD LOCATION
- WINDMILL
- PIPE STAND
- POWER POLE
- EXISTING OVERHEAD ELEC. LINE
- WIRE FENCE
- PROJECT PROPERTY BOUNDARY
- EXISTING ROAD BOUNDARIES
- SURVEY SECTION BOUNDARIES
- CREEK LINE
- PROPOSED ELEC. SUPPLY LINE
- PROPOSED FUEL GAS SUPPLY LINE
- PLANNED ROW FOR ACCESS ROADS
- PLANNED ROW FOR ELECTRICAL TRANSMISSION
- WETLANDS AREA (NATIONAL WETLANDS INVENTORY)
- USGS ELEVATION CONTOURS (5 FT CONTOUR INTERVAL)
- PIPELINE – RAW WATER
- PIPELINE – SOLUTION MINING WATER IN
- PIPELINE – SOLUTION MINING WATER OUT
- PIPELINE – DISPOSAL BRINE

LONQUIST & CO. LLC

AUSTIN HOUSTON | PETROLEUM ENGINEERS | ENERGY ADVISORS | WICHITA CALGARY

Texas License F-8652

3345 Bee Cave Road, Suite 201
Austin, Texas 78746
Tel: 512.732.9812
Fax: 512.732.9816

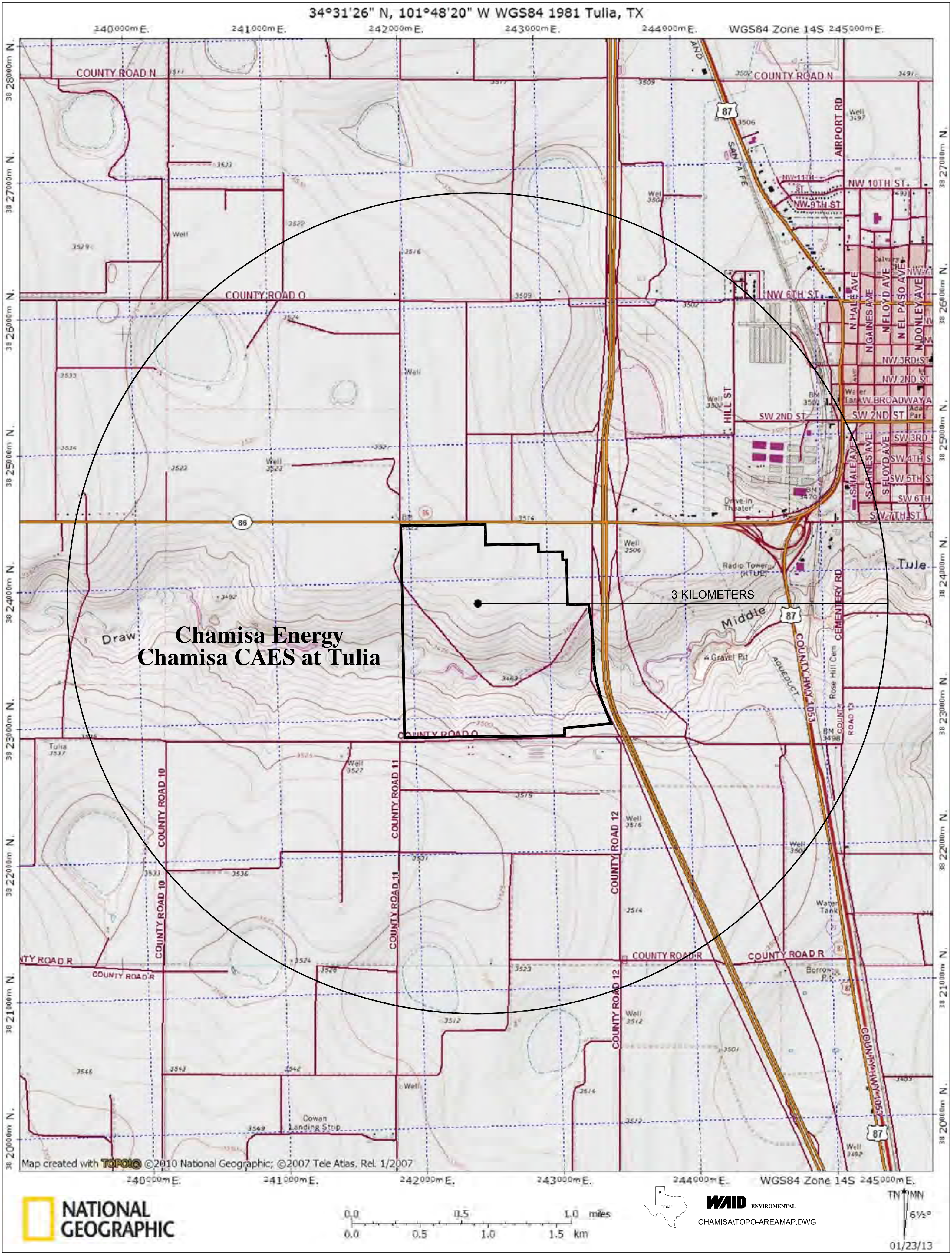
www.lonquist.com

DWW	10/1/12	1/3/13	PLOT	6

H:\CLIENTS\MURIN ENVIR\MUR8849\ACAD

APPENDIX C

AREA MAP


34°31'26" N, 101°48'20" W WGS84 1981 Tulia, TX
WGS84 Zone 14S
COUNTY ROAD N
COUNTY ROAD O
COUNTY ROAD R
COUNTY ROAD 10
COUNTY ROAD 11
COUNTY ROAD 12
AIRPORT RD
CEMETERY RD
HILL ST
NW 10TH ST.
NW 9TH ST
NW 6TH ST
SW 2ND ST
W BROADWAY
Drive-in Theater
Radio Tower
3 KILOMETERS
Tule
Middle
Draw
Gravel Pit
AQUEDUCT
COUNTY HWY 1053
Rose Hill Cem
Water Tank
Borrow Pit
Cowan Landing Strip
Well
Chamisa Energy
Chamisa CAES at Tulia
Map created with TOPO! ©2010 National Geographic; ©2007 Tele Atlas, Rel. 1/2007
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
TEXAS
WAID ENVIROMENTAL
CHAMISA\TOPO-AREAMAP.DWG
TN MN
6½°
01/23/13

Appendix B

Photographs Showing the Current Conditions of the Action Area

Photo 1. View to the north showing field and service center on I-27 (west side)

Photo 2. View to the south showing field and County Road Q

Photo 3. View to the south showing fence on western boundary of property

Photo 4. View to the west showing field, Middle Tule Draw, and pipe associated with dam


Photo 5. View to west showing dam on Middle Tule Draw


Photo 6. View to north showing small rise with Great Plains yucca and grasses in field

Photo 7. Power-In transmission Line

Photo 8. Power-In transmission Line – Swisher Electric Cooperative Lakeview Substation

Photo 9. Power-Out 1 Transmission Line – dry playa lakebed

Photo 10. Power-Out 2 Transmission Line ROW

Photo 11. Power-Out 2 Transmission Line – Sharyland Nazareth Substation