Draft Environmental Assessment for Supercritical Carbon Dioxide Pilot Plant Test Facility Project

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Abstract: The United States (U.S.) Department of Energy (DOE) National Energy Technology Laboratory (NETL) prepared this Environmental Assessment (EA) to analyze the potential environmental, cultural, and socioeconomic impacts of partially funding a proposed project to design, construct, and operate a 10-megawatt-electric (MWe) Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility. DOE proposes to provide cost-shared funding to a project team led by Gas Technology Institute (GTI), Southwest Research Institute (SwRI®), and General Electric Global Research (GE-GR) for the proposed sCO_2 Test Facility Project at the SwRI, an existing research facility in San Antonio, Texas. The proposed sCO_2 Test Facility Project would involve the construction and 3-year operation of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation. Under the Proposed Action, DOE proposes to provide GTI with up to $79.9 million of cost-shared financial assistance under the sCO_2 Crosscut Initiative. Composed of the DOE Offices of Energy Efficiency and Renewable Energy, Fossil Energy, and Nuclear Energy, the sCO_2 Crosscut Initiative is a collaborative program with the specific mission to reduce the technical barriers and risks to commercialization of the sCO_2 power cycle. DOE's contribution would constitute about 70 percent of the estimated $113.3 million total project cost.

Availability: This draft EA is available to the public on DOE's National Energy Technology Laboratory website at https://www.netl.doe.gov/library/environmental-assessments and DOE's NEPA website at https://energy.gov/nepa/nepa-documents. The draft EA is also available at the following location:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effect
BMP	best management practice
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-eq	CO_2-equivalents
CWA	Clean Water Act
DBH	diameters at breast height
DOE	Department of Energy
EA	Environmental Assessment
EO	Executive Order
ESS	Environmental and Safety System
FEMA	Federal Emergency Management Agency
GE-GR	General Electric Global Research
GTI	Gas Technology Institute
HUC	hydrologic unit code
kV	kilovolt
lbs/hr	pounds per hour
LID	low-impact development
MS4	Municipal Separate Storm Sewer Systems
MW	megawatt
MWe	megawatt-electric
MWh	megawatt-hour
NAAQS	National Ambient Air Quality Standards

Acronym	Definition
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NHPA	National Historic Preservation Act
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTNC	non-transient non-community water system
NWP	Nationwide Permit
O_3	ozone
OSHA	Occupational Safety and Health Administration
Pb	lead
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM_{10}	particulate matter with a diameter of 10 microns or less
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
psig	pounds per square inch gauge
PWS	public water system
RCBC	Recompression Closed Brayton cycle
ROI	Region of Influence
ROW	right-of-way
SAWS	San Antonio Water System
sCO_2	supercritical carbon dioxide
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasure
SPPM	Safety Policy and Procedures Manual
SWPPP	Stormwater Pollution Prevention Plan
SwRI	Southwest Research Institute
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
tpy	tons per year

Acronym	Definition
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

CHAPTER 1 INTRODUCTION

The United States (U.S.) Department of Energy (DOE) National Energy Technology Laboratory (NETL) prepared this Environmental Assessment (EA) to analyze the potential environmental, cultural, and socioeconomic impacts of partially funding a proposed project to design, construct, and operate a 10-megawatt-electric (MWe) Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility. The proposed project is referred to as the sCO_2 Test Facility Project, and would be located at the existing Southwest Research Institute (SwRI®) campus in San Antonio, Texas.

1.1 BACKGROUND

Power cycles based on sCO_2 as the working fluid have the potential for higher thermal efficiencies when compared to state of the art steam based power cycles. With a higher fluid density than steam, the sCO_2 working fluid also enables the use of much smaller turbomachinery equipment, which would result in lower capital costs. Due to the unique features of sCO_2, the following are enabled:

- Potential for lower capital cost
- Compounding performance benefits from a more efficient cycle on balance of plant requirements
- Lower fuel use
- Reduced emissions
- Reduced water use
- Reduced cost of electricity

There is interest in the sCO_2 power cycle across multiple power generating technologies. Depending on the application, these improvements can likely be realized over a range of cycle temperatures, efficiencies, and capital costs. Recognizing these benefits, the DOE formed a sCO_2 Crosscut Initiative in 2013 with the specific mission to reduce the technical barriers and risk to commercialization of the sCO_2 power cycle. The sCO_2 Crosscut Initiative is composed of the DOE Offices of Fossil Energy, Energy Efficiency and Renewable Energy, and Nuclear Energy; leveraging the capabilities and interests of these organizations toward the development of the sCO_2 power cycle.

To address the mission of the sCO_2 Crosscut Initiative, DOE established the Supercritical Transformational Electric Power (STEP) program with the mission to design, build, and operate a 10-MWe sCO_2 pilot scale test facility for evaluating the power cycle and component performance over a range of operating conditions. Specifically, the project should demonstrate a 700 degrees Celsius (°C) turbine inlet temperature or higher design point, demonstrate the operability of the sCO_2 power cycle, verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

DOE issued Funding Opportunity Announcement (FOA) *DE-FOA-0001457, Supercritical Carbon Dioxide Pilot Plant Test Facility* on March 15, 2016 to request proposals for a facility to meet DOE's objectives. DOE received and competitively assessed multiple proposals based on the criteria published in the FOA before selecting the project proposed by Gas Technology Institute (GTI).

1.2 DOE'S PROPOSED ACTION

DOE's Proposed Action is to provide financial assistance to GTI for the sCO_2 Test Facility Project. DOE proposes to provide GTI with up to $79.9 million of cost-shared financial assistance under the sCO_2 Crosscut Initiative. Composed of the DOE Offices of Energy Efficiency and Renewable Energy, Fossil Energy, and Nuclear Energy, the sCO_2 Crosscut Initiative is a collaborative program with the specific

mission to reduce the technical barriers and risks to commercialization of the sCO_2 power cycle. DOE's contribution would constitute about 70 percent of the estimated $113.3 million total project cost. The Proposed Action does not involve connected actions. See Section 2.1 for details about the Proposed Action.

1.3 PURPOSE AND NEED

The purpose and need for DOE action is to advance the technology surrounding the sCO_2 power cycle, in order to improve performance and reduce capital costs across the portfolio of power generating technologies in the U.S. The benefits of sCO_2 have applicability in fossil, solar, geothermal, and nuclear power. The 10 MWe sCO_2 Test Facility would serve as an opportunity for industry and government to work together to develop and mature the technology at the pilot-scale to facilitate commercialization. The proposed project will spur the development of necessary designs, materials, components, operation and control systems, sensors, and understanding and characterization needed for commercial acceptance of large-scale sCO_2 power cycles. Proving favorable performance at this scale is the next step required to address technical issues, reduce risk, and mature this promising technology.

1.4 NATIONAL ENVIRONMENTAL POLICY ACT AND RELATED PROCEDURES

DOE prepared this EA in accordance with the National Environmental Policy Act (NEPA), as amended (42 United States Code [USC] 4321), the President's Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR 1021). This statute and the implementing regulations require that DOE, as a federal agency:

- assess the environmental impacts of its proposed action;
- identify any adverse environmental effects that cannot be avoided, should the proposed action be implemented;
- evaluate alternatives to the proposed action, including a no action alternative; and
- describe the cumulative impacts of the proposed action together with other past, present, and reasonably foreseeable future actions.

These provisions must be addressed before a final decision is made to proceed with any proposed federal action that has the potential to cause impacts to the natural or human environment, including providing federal funding to a project. This EA is intended to meet DOE's regulatory requirements under NEPA and provide DOE with the information needed to make an informed decision about providing financial assistance. In accordance with the above regulations, this EA allows for public input into the federal decision-making process; provides federal decision-makers with an understanding of potential environmental effects of their decisions before making these decisions; and documents the NEPA process.

1.4.1 Laws and Executive Orders

The EA also addresses other applicable laws and regulations, including but not limited to the following:

- National Historic Preservation Act;
- Archeological Resources Protection Act;
- Clean Air Act (CAA);
- Clean Water Act (CWA);
- Protection of Wetlands (Executive Order [EO] 11990);
- Floodplain Management (EO 11988);

- Endangered Species Act;
- The Noise Control Act of 1972, as amended;
- Environmental Justice (EO 12898);
- Pollution Prevention Act;
- Resource Conservation and Recovery Act; and
- Comprehensive Environmental Response, Compensation and Liability Act.

1.5 AGENCY COORDINATION

DOE coordinated with the following agencies through agency consultation letters and/or notification of the availability of the Draft EA:

- U.S. Environmental Protection Agency (USEPA) – Region 6
- U.S. Fish and Wildlife Service (USFWS) – Austin Ecological Services Field Office
- U.S. Army Corps of Engineers (USACE) – Fort Worth District
- Texas Historical Commission
- Texas Parks and Wildlife Department
- Texas Commission on Environmental Quality (TCEQ)
- Railroad Commission of Texas
- State of Texas
- City of San Antonio, Office of Sustainability
- Indian Tribes

Copies of agency correspondence are included in Appendix A of this EA.

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CHAPTER 2 PROPOSED ACTION AND ALTERNATIVES

2.0 INTRODUCTION

This chapter describes the Proposed Action and No-Action Alternative analyzed in this EA, as well as those alternatives dismissed from further consideration. As described in Chapter 1, CEQ's regulations direct all federal agencies to use the NEPA process to identify and assess the reasonable alternatives to proposed actions that would avoid or minimize adverse effects of these actions upon the quality of the human environment (40 CFR 1500.2[e]).

2.1 PROPOSED ACTION

DOE proposes to provide cost-shared funding to a project team led by GTI, SwRI, and General Electric Global Research (GE-GR) for the proposed 10-MWe sCO_2 Pilot Plant Test Facility Project at the SwRI, an existing research facility in San Antonio, Texas. The proposed sCO_2 Test Facility Project would involve the construction and 3-year operation of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

The proposed sCO_2 Test Facility Project would demonstrate the potential for higher efficiency and reduced cost-of-electricity for power cycles based on sCO_2 working fluids, compared to state-of-the-art steam cycles. Supercritical carbon dioxide is CO_2 held above its critical temperature and pressure so that it is in a fluid state. When used as a working fluid for fossil fuel based applications, sCO_2 power cycles can enable a power plant to generate the same amount of electricity from less fuel, thus decreasing CO_2 emissions. Furthermore, because sCO_2 has a high fluid density relative to steam, sCO_2 power plants may be fitted with compact turbomachinery, which would reduce capital costs.

Under the Proposed Action, DOE's sCO_2 Crosscut Initiative, composed of the DOE Offices of Energy Efficiency and Renewable Energy, Fossil Energy, and Nuclear Energy, would provide GTI with up to $79.9 million of cost-shared financial assistance. DOE's contribution would constitute about 70 percent of the estimated $113.3 million total project cost. See Section 2.4 for detailed discussion of the proposed project.

2.2 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not provide cost-shared funding to the proposed project. The sCO_2 Test Facility Project would not be constructed and the sCO_2 technology would not be validated in an operational system. Consequently, the power and other related industries would not have access to the facility to test various component configurations. Without pilot scale validation of this technology, it is unlikely that industry would scale it for use in various applications.

2.3 ALTERNATIVES CONSIDERED BUT DISMISSED

NEPA requires DOE to assess the range of reasonable alternatives to the Proposed Action. Because DOE's Proposed Action is limited to providing financial assistance in cost-sharing arrangements to selected applicants in response to a competitive funding opportunity, DOE's decision is limited to either accepting or rejecting the project as proposed by the proponent, including its proposed technology and selected sites. The range of reasonable alternatives is therefore limited to the Proposed Action, other projects proposed in response to DOE's Funding Opportunity Announcement, and the No-Action Alternative.

DOE received and evaluated multiple projects that proposed to fulfill DOE's objective of a project to plan, design, build and assemble, and operate a nominally 10-MWe sCO_2 Test Facility. In accordance with 10 CFR 1021.216, DOE evaluated the project applicants considering the potential environmental effects

including direct and indirect effects, short-term and long-term effects, and unavoidable adverse effects for environmental resource areas. The results of that review are summarized in an Environmental Synopsis found in Appendix B. The Proposed Action and No-Action Alternative are the only alternatives specifically addressed in this EA. The Proposed Action is to implement the proposed project as detailed in Section 2.1.

2.4 sCO_2 TEST FACILITY PROJECT DESCRIPTION

2.4.1 Project Location

SwRI is a non-profit applied research and development facility with the headquarters campus located in western San Antonio, Bexar County, Texas (see Figure 2-1). The SwRI campus is an approximately 1,200-acre facility with over 200 buildings containing greater than 2 million square feet of laboratory and office space. SwRI consists of nine technical divisions that offer multidisciplinary, problem-solving services in a variety of areas in engineering and the physical sciences. More than 4,000 projects were active at SwRI at the close of fiscal year 2016. These projects were funded almost equally between the government and commercial sectors.

Research areas at SwRI include the following: antennas and propagation; automation, robotics, and intelligent systems; avionics and support systems; bioengineering; chemistry and chemical engineering; communications systems; corrosion and electrochemistry; earth and planetary sciences; emissions research; engineering mechanics; fire technology; fluid systems and machinery dynamics; and fuels and lubricants. Additional areas include geochemistry and mining engineering; hydrology and geohydrology; space science and engineering; materials sciences and fracture mechanics; modeling and simulation; nondestructive evaluation; oil and gas exploration; pipeline technology; surface modification and coatings; training systems and simulators; and vehicle, engine, and powertrain design, research, and development.

The sCO_2 Test Facility Project would be located in the central-western portion of the SwRI campus in an approximately 16.54-acre area. The proposed project would be integrated into the SwRI campus by utilizing available developed and undeveloped campus property for the proposed sCO_2 Test Facility equipment and structures, construction laydown, equipment staging, upgrades to utilities, and use of an existing building for office space during construction and operations. Figure 2-2 presents the proposed project area for the proposed sCO_2 Test Facility. Existing SwRI facilities nearby the proposed project area include contractor equipment storage, an Outdoor Area Test Site facility, pilot plant test facilities, and a less than 90-day hazardous waste storage area.

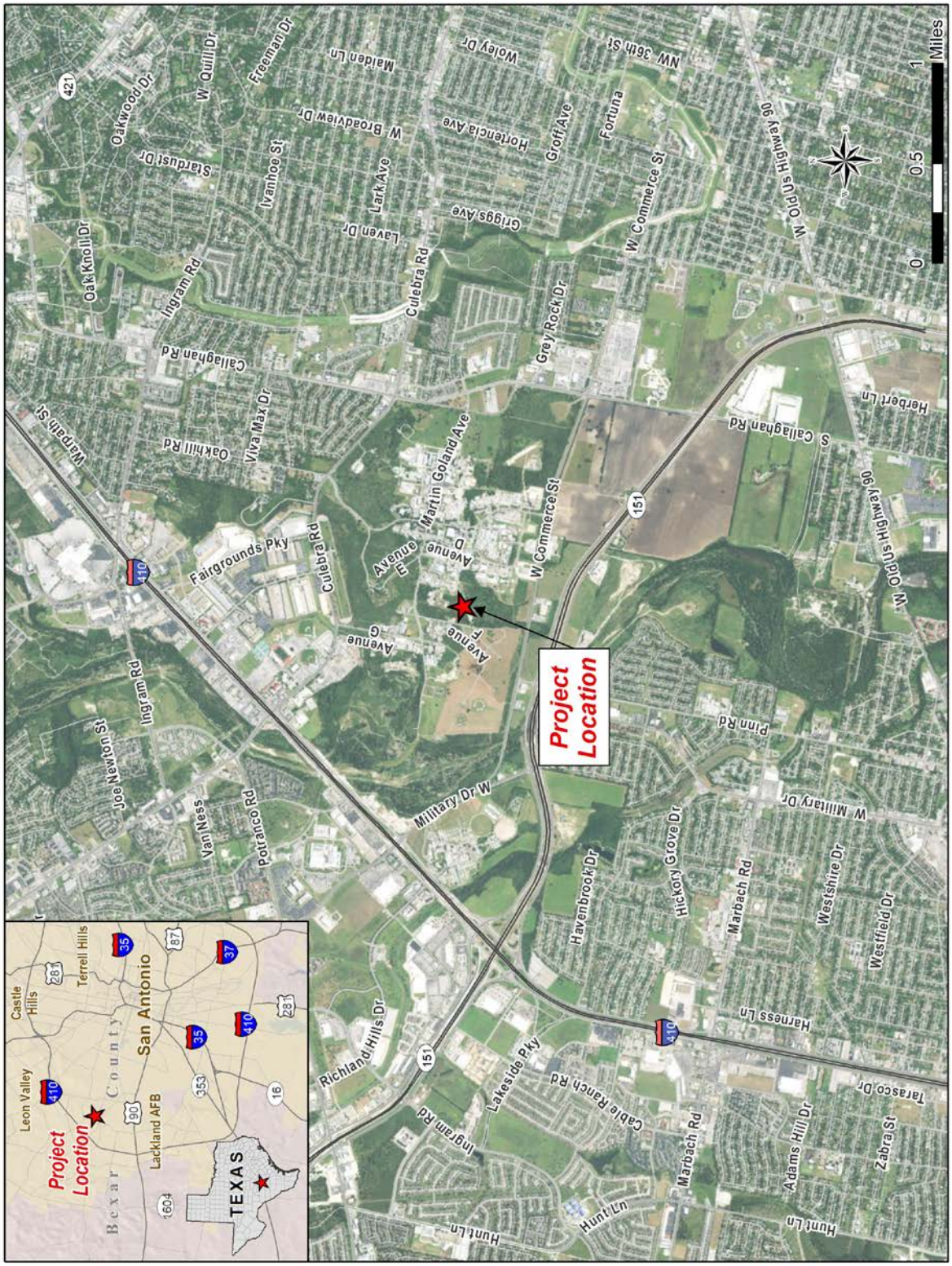


Figure 2-1. Proposed sCO_2 Test Facility Project Location

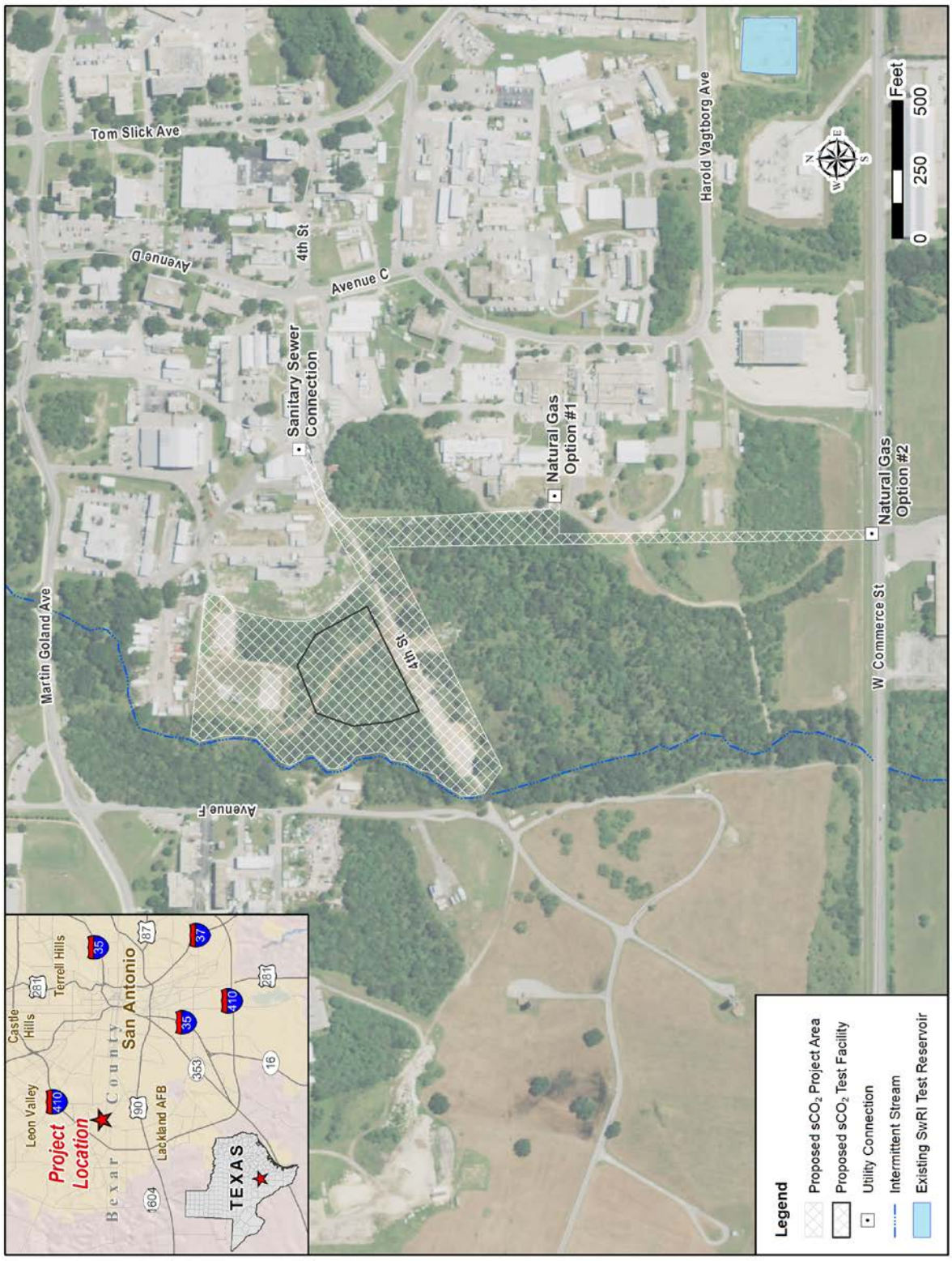


Figure 2-2. Proposed sCO_2 Test Facility Project Area

2.4.2 sCO_2 Test Facility Project Configuration

The sCO_2 Test Facility configuration would consist of a natural-gas fired process heater, compressor, turbine, recuperators, heat exchanger, cooling tower, backup generators, emissions stack, and balance of plant components. The sCO_2 Test Facility would require utility and infrastructure upgrades including a new natural gas line to supply the fuel for the proposed project and a sanitary sewer force main. Other infrastructure upgrades within the project area would include tie-ins to the water line and electrical supply. Figure 2-3 shows the potential location of the proposed sCO_2 Test Facility components within the proposed project area. The final general arrangement will depend on final project design. Table 2-1 provides details about the components of the proposed project including the sCO_2 Test Facility equipment, building, and balance of plant equipment.

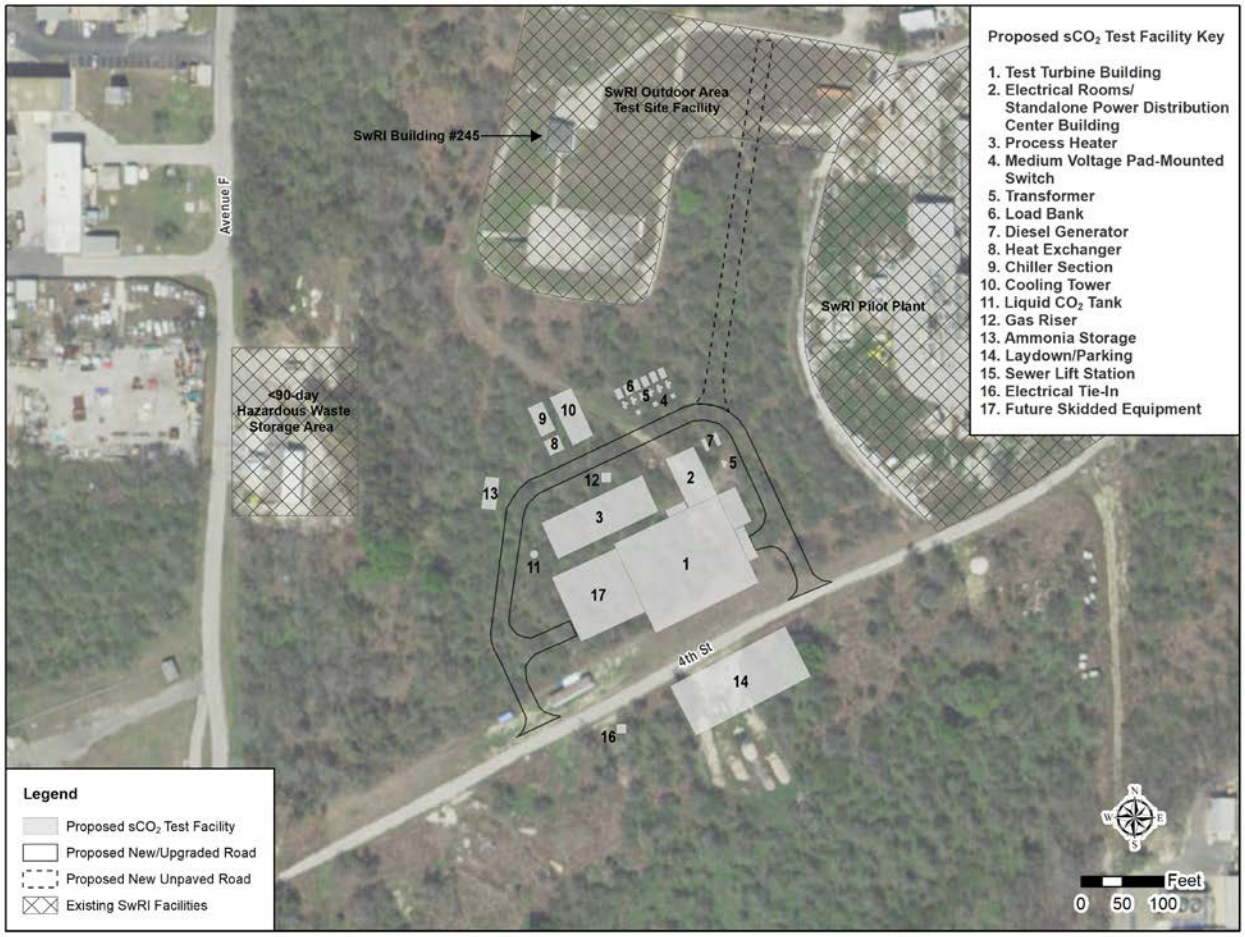


Figure 2-3. Proposed sCO_2 Test Facility General Arrangement Plan

Table 2-1. Proposed sCO_2 Test Project Equipment Components

Component/Equipment	Details
	BUILDING
sCO_2 Test Turbine Building	A new building would house the sCO_2 turbine, the control room, maintenance/machine shop, and associated turbine components. The building would include a Direct Expansion cooling system and heat pumps. The building would be approximately 55 feet high and contain 12,000 square feet of space.
	sCO_2 TEST FACILITY EQUIPMENT
Primary Heater	An air-blown, natural gas-fired heater would increase the CO_2 temperature to supercritical levels. Includes an exhaust stack for heater emissions. The stack would be approximately 75 feet high and the process heater equipment would have a footprint of approximately 50 feet by 130 feet.
Recuperator	High- and low-temperature recuperators recover heat in the process and increase cycle efficiency. This also includes a process cooler heat exchanger which serves to remove excess heat from the sCO_2 downstream of the high and low temperature recuperators.
Turbine	A turbine would be used to evaluate the ability of the turbine and components to operate reliably in the sCO_2 environment. Electricity generated by the turbine would be captured by a load bank or for potential use within the SwRI campus.
Turbine Stop Valve	Valve which prevents high-temperature sCO_2 from entering the turbine in emergency situations.
Compressor	Main compressor and recompressor that increase the pressure of the sCO_2.
Load Bank	Used to dissipate the electrical load generated by the turbine.
	BALANCE OF PLANT EQUIPMENT
Cooling Tower	One cooling tower cell designed for a load of 88 mmBTU per hour to maintain proper scale, microbiological, and corrosion control.
Natural Gas Pipeline	A new 4- or 8-inch natural gas pipeline would provide fuel for the sCO_2 heater. The size of the pipeline will depend on final project design and vendor selection. The pipeline would be routed in one of two options (see Figure 2-2). Option 1 would extend approximately 0.2 mile to the existing 8-inch line on the SwRI campus. Option 2 would extend approximately 0.4 mile to the existing CPS Energy 20-inch diameter natural gas main pipeline located along West Commerce Street. The proposed project demand would be approximately 11,000 lbs/hr. The line would operate at approximately 95 psig.
Electrical	The sCO_2 Test Facility would derive its electrical supply from a 15-kV circuit routed through a new underground electrical line to connect an existing junction cabinet.
Sanitary/Industrial Sewer System	The sCO_2 Test Facility would install a new sanitary lift station and 2-inch diameter force main discharging to the northeast of the proposed project area into an existing 6-inch diameter SwRI gravity sanitary sewer line that flows into an existing City of San Antonio sanitary sewer line. The wastewater would be discharged under SwRI's Industrial Wastewater Permit (No. HV-17484) issued by the San Antonio Water System.
Diesel Generator	Two 500 kV diesel emergency generators would provide backup power for the sCO_2 Test Facility. Use of the generators would be limited to backup power during an outage. SwRI would either use existing campus generators or purchase new generators for the sCO_2 Test Facility.

Table 2-1. Proposed sCO_2 Test Project Equipment Components

Component/Equipment	Details
Liquid CO_2 Storage Tank	Permanent storage tank would hold up to 20 tons of liquid CO_2.
Process Piping	Pipe system including high temperature pipes, valves, and fittings necessary to operate in a sCO_2 environment at anticipated temperatures and pressures.
Control Room	Central location for operation of the sCO_2 Test Facility would be located in the sCO_2 test turbine building and include control systems and work stations.
Controls System	A Distributed Access Control System (DACS) would accomplish reliable health-and-safety-critical data acquisition and system control.
Inventory Management	Manages the flow of the sCO_2 into and out of the closed Brayton cycle to support operation and off-design operation.
Data Acquisition System and Instrumentation	High accuracy data acquisition system (DAQ) used for measuring system and component performance, separate from facility control system (i.e., DACS). This system would include facility DAQ hardware and related instrumentation.

Source: SwRI 2017a

CO_2 = carbon dioxide; DACS = Distributed Access Control System; DAQ = Data Acquisition System; kV = kilovolt; lbs/hr = pounds per hour; mmBTU = million metric British Thermal Units; psig = pounds per square inch gauge; sCO_2 = supercritical carbon dioxide; SwRI = Southwest Research Institute

The sCO_2 Test Facility Project would demonstrate at least 700°C turbine inlet temperature or higher design point, and produce a Recompression Closed Brayton cycle (RCBC) configuration that would be used to demonstrate and evaluate system and component design and performance capabilities (including turbomachinery and recuperators in steady state, transient, load following, and limited endurance operation), and demonstrate the potential and pathway for a thermodynamic cycle efficiency greater than 50 percent. The proposed project would feature three phases including the Simple Cycle Configuration Operation, RCBC Reconfiguration, and RCBC Operation (see Section 2.4.4). The facility would also be capable of being reconfigured to accommodate potential future testing of system/cycle upgrades, new cycle configurations, and new or upgraded components (compressor, recuperators, and heat exchangers). Therefore, the design basis for this facility includes the flexibility (footprint accessibility considerations, standardized component flanging, standardized fittings, standardized data acquisition systems and components) to accommodate future facility utilization to support continued development of sCO_2 power cycle technologies.

2.4.3 Construction

SwRI Campus

The proposed sCO_2 Test Facility Project would be constructed on currently developed and undeveloped land to the south of Martin Goland Avenue in an approximately 16.54-acre area within the SwRI campus (see Figure 2-2). The sCO_2 Test Facility components and building would be located within the primarily undisturbed area north of 4th Street. To support construction staging and laydown, the proposed project would use the adjacent property to the south of 4th Street (a gated access road). Additional workspace in the northern portion of the proposed project area would be used during construction for temporary offices and control rooms, temporary construction trailers, and potentially an additional access road, if necessary. In addition, utility upgrades would be constructed including a new 4- or 8-inch natural gas pipeline extension, 2-inch sanitary sewer force main, and an underground electrical line to connect to an existing junction box.

Construction of the sCO_2 Test Facility would last approximately 16 months. Variations in the exact timing of construction could occur due to design and contracting timing. Construction would involve vegetation removal, grading, installation of access roads and utilities (natural gas line, sanitary sewer line, and tie-ins for water and electricity), and assembly of equipment and structures. Construction would be completed in two phases. Phase 1 of construction would start in spring 2018 with approximately 6 to 8 weeks of site clearing and grading. This phase of construction would begin with: the installation of erosion control protection measures; construction of site construction access and laydown/construction equipment storage area; clearing of the existing site and grubbing of stumps and roots; stripping of existing topsoil; mass site grading; extension of sanitary sewer, potable and fire protection water connection piping, electric and communication lines to the site; natural gas piping to the site; and construction of access road improvements.

Phase 2, facility construction, would require approximately 14 months. This phase of construction would involve construction of foundations and pads for buildings and site equipment, site improvement construction including parking, sidewalks, and driveway areas, and construction of the buildings and installation of equipment. Construction contractors would maintain a minimum 100-foot buffer along the tributary of Leon Creek located to the west of the proposed project area. SwRI anticipates that construction would be completed by approximately August 2019.

The majority of the proposed sCO_2 Test Facility equipment and components would be located within the primarily undisturbed area north of 4th Street (see Figure 2-2). Construction of the proposed sCO_2 Test Facility would involve the phases previously described and result in the conversion of approximately 10.74 acres of primarily vegetation and trees, to developed, impervious and pervious surface. The remaining 5.80

acres required for construction of the proposed project area is already disturbed due to existing roads, structures, maintained disturbed land, and equipment storage.

During the construction period, the proposed project would utilize the adjacent property to the south of 4th Street for contractor staging, laydown, and parking, along with the ability to provide flexibility in operational workspace (e.g., temporary storage). The area to the south of 4th Street is historically used as equipment storage and an area for dirt and material stockpiles from remedial actions. SwRI removes the stockpiles for offsite disposal or use within the SwRI campus. It is not anticipated that the entire area to the south of 4th Street would be cleared for the proposed project. Depending on the final project design, SwRI would only clear the area necessary to support the proposed project. Cleared areas would be converted to a pervious surface, such as gravel.

The northern portion of the proposed project area would be used during construction for temporary office space and control rooms in Building 245, temporary office trailers, construction laydown, and potentially an additional unpaved access road, if necessary. The area to the north is currently used for the Outdoor Area Test Site facility, contractor parking, and equipment storage. No modifications to existing structures or buildings would be required. Depending on final project design, SwRI could construct an unpaved access road within this area to serve as a secondary route for large trucks or personnel to access the site during construction and operations. The access road would be designed to avoid land disturbance, but it is anticipated that vegetation clearing and tree removal would be required to accommodate the new access road within the northern portion of the proposed project area (see Figure 2-3).

During construction, deliveries would be routed through Martin Goland Avenue onto Avenue F and into the construction site via 4th Street. Fourth Street is currently gated and infrequently used by campus personnel. Fourth Street would be closed to campus traffic during construction. The haul route also includes use of Harold Vagtborg Avenue which connects to West Commerce Street and Martin Goland Avenue. SwRI plans to expand the corner of Avenue F and 4th Street to allow for increased turning radius needed for large vehicles and equipment potentially required for future projects. Additional discussion of planned SwRI projects is presented in Section 3.9, *Cumulative Impacts*. If project design determines a secondary haul route is required, it would be constructed in the northern portion of the proposed project area and connect to the existing roadway off of Martin Goland Avenue to the northeast portion of the proposed project area (see Figure 2-3).

Infrastructure and Utilities

SwRI would construct infrastructure and utility upgrades to support the proposed project including a natural gas pipeline, sanitary sewer force main, and electrical connections.

Natural Gas Pipeline

SwRI would construct a new 4- or 8-inch diameter natural gas pipeline extension to supply natural gas for the sCO_2 Test Facility Project. The size of the pipeline will depend on final project design and vendor selection. The new natural gas pipeline extension is anticipated to have an operating pressure of 95 pounds per square inch gauge (psig). Figure 2-2 presents the disturbance area for the two route options proposed for the new natural gas pipeline extension. Option 1 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.2 mile to the existing 8-inch line on the SwRI campus. Option 2 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.4 mile to the existing CPS Energy 20-inch diameter natural gas main pipeline located along West Commerce Street.

SwRI anticipates installing the new line using trenching techniques along the entire distance. The natural gas pipeline would require a 30-foot construction right-of-way (ROW) (15 feet of disturbance from center line) to accommodate installation of the pipeline including construction equipment working area, storage

of topsoil, and trench workspace. The minimum trench width for the 4- to 8-inch diameter pipe would likely be 3 feet with an additional 12 feet on one side of the trench for excavated soils and pipe laydown. Approximately 15 feet on the other side of the trench would be used for equipment, trucks, and work area. The anticipated trench depth would be roughly 4 feet, depending on soil conditions, obstructions along the route, and burial depth required under roadways. The installation contractor would likely use a chain or wheel trencher for most of the route or a conventional excavator if rock is found, and would construct using hand excavation in areas of close proximity to existing underground utilities. The natural gas pipeline would result in a new operational ROW of 20 feet (wide).

Sanitary Sewer

SwRI would construct a new sanitary lift station within the proposed project area and a new 2-inch diameter sanitary force main. Construction of the new sanitary force main would take place along 4th Street to the existing manhole to the east of the proposed project area and require temporary closure of the roadway between Building 90 and Building 90b. SwRI personnel would use existing alternatives routes to access Buildings 90 and 90b during the temporary closure.

SwRI anticipates all underground utility work would use trenching techniques along the entire distance. The analysis conservatively uses an upper limit of 30-foot construction ROW for all utility construction that requires trenching. As a result, it is assumed that the sanitary sewer main line would be constructed using the maximum disturbance area described for the natural gas pipeline extension, which would be a 4- to 6-foot trench depth, a 30-foot wide construction ROW, and a 20-foot operational ROW (see *Natural Gas* discussion above).

Electrical

The proposed project would derive its electrical supply from a 15 kilovolt (kV) circuit. The circuit would be routed from the sCO_2 Test Facility in a new underground duct bank to an existing manhole located within the proposed project area to the south of 4th Street. From the manhole, new cabling would run through the existing duct bank to an existing junction cabinet. Since the new electrical infrastructure would be constructed within the proposed project disturbance area, no land disturbance outside of the project area would be required for the electrical supply line.

2.4.4 sCO_2 Test Facility Operations

The sCO_2 Test Facility Project would operate for an approximately 3-year period (2019 – 2022). The sCO_2 Test Facility would first conduct a Simple Cycle Test. Once complete, SwRI would reconfigure the Test Facility for the RCBC Operations Test, and then commence the RCBC Operations Test. Operational testing would total at least 2,400 test hours (800 hours for Simple Cycle testing and 1,600 hours for RCBC testing) and involve cycling of high temperatures and pressures over 8- to 24-hour test periods.

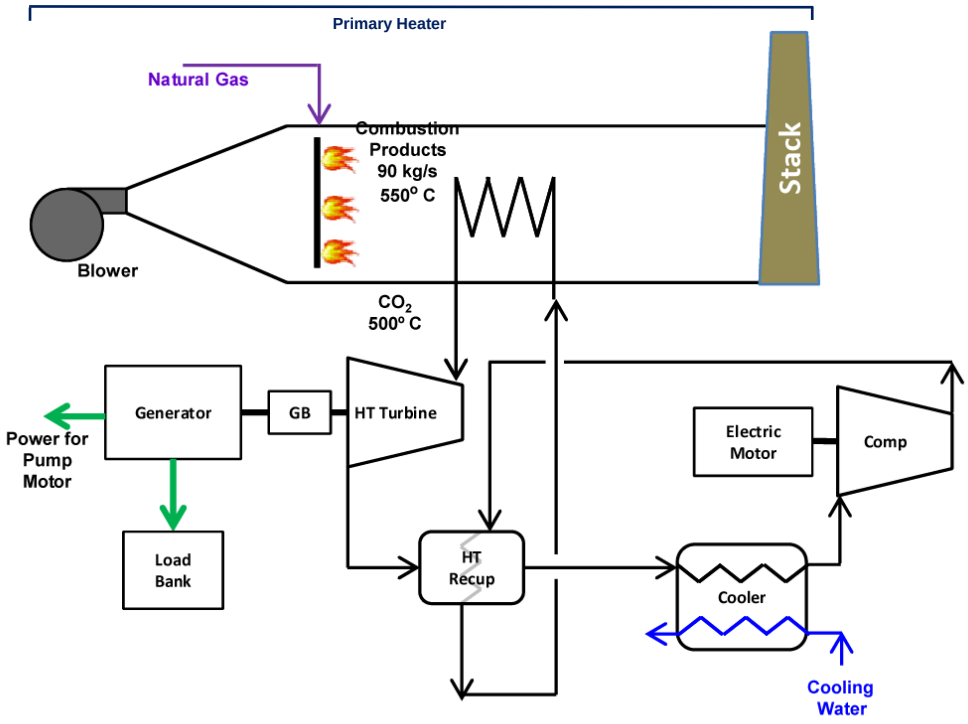
Operation of the sCO_2 Test Facility would involve variations in temperature, equipment, and energy generation but the operational test phases would generally involve the following process: A natural-gas fired heater would indirectly heat the sCO_2 working fluid through a 'primary' heat exchanger. The sCO_2 would go to the turbine where it would expand, and energy would be extracted. A generator would convert the mechanical energy from the turbine into electrical energy, with the output varying (5 MWe and 10 MWe) depending on the applicable phase of the proposed project. The energy would either be dissipated in a load bank or potentially used, during the latter RCBC Operations Test phase, for the SwRI campus. Remaining heat from the turbine would be recovered from the sCO_2 working fluid post-expansion via recuperators and used to preheat the compressed sCO_2 returning to the primary heat source. During the RCBC Operations Test, the flow would split after exiting the low-pressure side of the high-temperature recuperator. A portion of that flow would be compressed and re-joined with the high-pressure fluid downstream of the low-temperature recuperator. The other portion of that flow would be routed through

the low-pressure side of the low-temperature recuperator to recover as much heat as possible. Splitting the flow upstream of the low-temperature recuperator is the key to maximizing the effectiveness of the low-temperature recuperator and realizing the benefits of the RCBC configuration. Upon exiting the recuperators, the lower-temperature sCO_2 would be further cooled, via the process cooler, and compressed before returning to the recuperators for pre-heating upstream of the primary heat source. This cycle would operate as a closed loop system, therefore the balance of the sCO_2 would be maintained throughout the operation.

Simple Cycle Test

During the Simple Cycle Test, the assembled power cycle and balance of plant hardware would be commissioned in phases starting with the component level, advancing to the subsystem level, and progressing in a logical manner through a simple recuperated cycle power cycle configuration at a turbine inlet temperature of up to 500°C and producing greater than 5 MWe. These tests are intended to demonstrate basic operation and control of the simple recuperated sCO_2 Brayton power cycle while obtaining data for the key cycle components (e.g., sCO_2 turbine, recuperator, primary heater, and compressor) necessary to validate performance predictions. All electrical energy generated during the Simple Cycle Test would be sent to a load bank to dissipate the electrical load. Operability and baseline performance testing would be performed at the component, subsystem, and system levels.

Figure 2-4 depicts a simplified process flow diagram for the Simple Cycle Test of the sCO_2 Test Facility Project.



°C = degrees Celsius; CO_2 = carbon dioxide; GB = generator block; HT = high temperature; kg/s = kilograms/second

Figure 2-4. Simplified Process Flow Diagram of the sCO_2 Test Facility Project – Simple Cycle Test

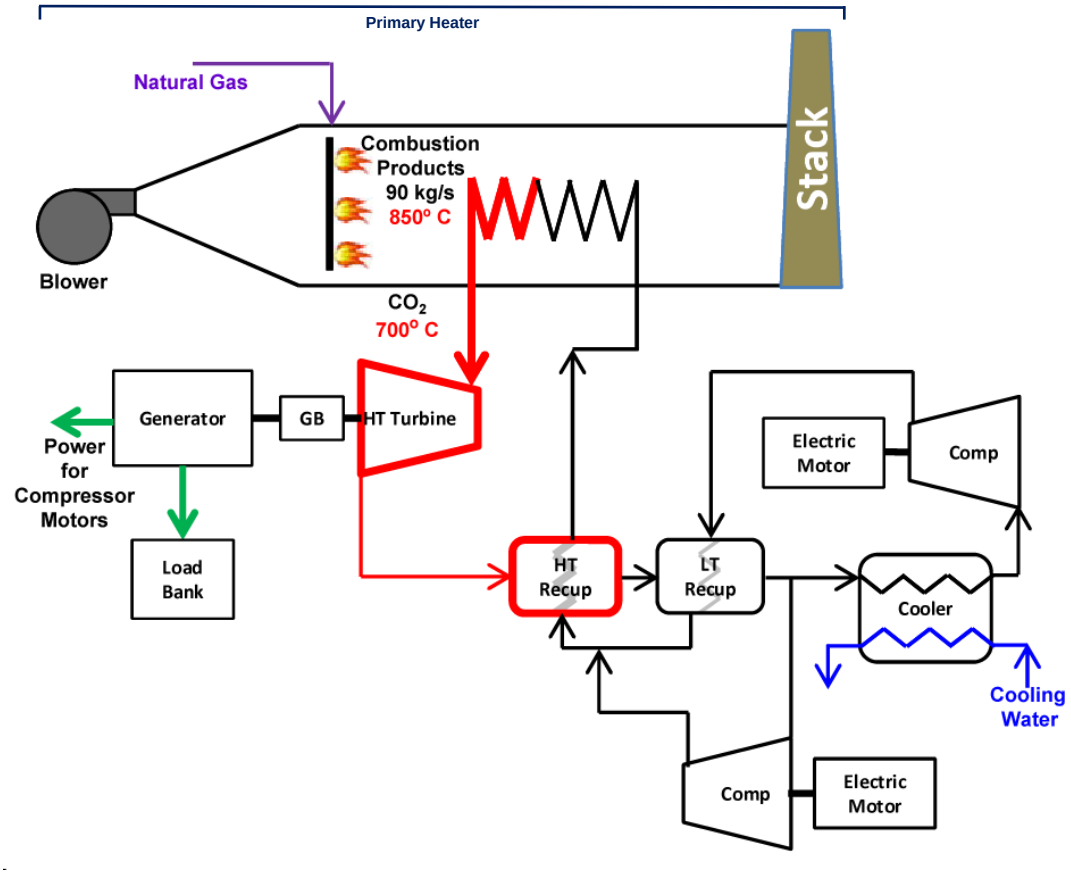
RCBC Reconfiguration

The RCBC Reconfiguration would involve a transition from the simple recuperated cycle configuration to the recompression configuration including updates to the controls system to accommodate dual compressors and a flow split, connecting the bypass compressor, and opening valves or replacing blind flanges with pipe spools to allow flow to the low-temperature recuperator and bypass compressor.

RCBC Operations Test

The RCBC Operations Test would include operability and transient testing of the reconfigured cycle starting with a turbine inlet temperature of 500°C and working up to the cycle performance testing at turbine inlet temperatures of at least 700°C. Following operability and performance testing, the facility also would perform endurance testing of the recompression cycle at the 700°C turbine inlet temperatures. Ultimately, the objectives of this test are to demonstrate safe component operation, controllability, and performance of a recompression cycle with high inlet temperature producing greater than 10 MWe. This testing would ultimately produce greater than 10 MWe for potential use by the SwRI campus during the final stages of the RCBC Operations Test phase.

The RCBC Operations Test would utilize additional equipment including an additional recuperator, compressor and electric motor. Figure 2-5 depicts a simplified process flow diagram for the RCBC Operations Test of the sCO_2 Test Facility Project.



°C = degrees Celsius; CO_2 = carbon dioxide; Comp = compressor; GB = generator block; HT = high temperature; kg/s = kilograms/second; LT = low temperature; Recup = recuperator

Figure 2-5. Simplified Process Flow Diagram of the sCO_2 Test Facility Project – RCBC Operations Test

2.4.5 Post-Test Use of sCO_2 Test Facility

After the 3-year operation of the sCO_2 Test Facility Project, the facility could support future testing beyond the needs of the proposed project. As a result, a formal decommissioning process would not occur and it is anticipated that all project infrastructure and equipment would remain at SwRI upon completion of the proposed project. Currently, the post-test use of the sCO_2 Test Facility is not finalized. Depending on the final decision regarding the future use of the sCO_2 Test Facility, SwRI could go through a formal disposition process with the government. The process would maintain compliance with all applicable regulations, such as 2 CFR 200.310 and 2 CFR 910.360. If the formal disposition process is pursued and completed, SwRI would own, manage, and continue testing operations the sCO_2 Test Facility.

Since the sCO_2 Test Facility is designed to be reconfigurable to accommodate future testing needs, all site infrastructure would remain in place and test hardware could be re-used or modified as needed for future testing activities. Additional future testing activities could include the following:

- Endurance testing of the system as installed
- Reconfiguration into a new cycle configuration
- Demonstration of thermal storage systems
- Demonstration of new hardware in a recompression cycle configuration
- Control system operational testing

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CHAPTER 3 ENVIRONMENTAL SETTING AND CONSEQUENCES

3.1 INTRODUCTION

This section provides relevant environmental, cultural, and socioeconomic baseline information, and identifies and evaluates the individual or cumulative environmental and socioeconomic changes likely to result from constructing and operating the proposed sCO_2 Test Facility at SwRI. The Region of Influence (ROI) for this EA includes the SwRI campus and the immediately adjoining properties.

CEQ regulations encourage NEPA analyses to be as concise and focused as possible, consistent with 40 CFR Part 1500.1(b) and 1500.4(b): "…NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail … prepare analytic rather than encyclopedic analyses." Consistent with the NEPA and CEQ Regulations, this EA focuses on those resources and conditions potentially subject to effects.

The methodology used to identify the existing conditions and to evaluate potential impacts on the physical and human environment involved the following: review of documentation and project information provided by SwRI and their consultants, searches of various environmental and agency databases, agency consultations, and a site visit conducted on October 18, 2017. All references are cited, where appropriate, throughout this EA.

Wherever possible, the analyses presented in this chapter quantify the potential impacts associated with the Proposed Action and the No-Action Alternative. Where it is not possible to quantify impacts, the analyses presents a qualitative assessment of the potential impacts. The following descriptors qualitatively characterize impacts on each resource area analyzed:

- Beneficial – impacts would improve or enhance the resource.
- Negligible – no apparent or measurable impacts expected.
- Minor – the action would have a barely noticeable or measurable adverse impact on the resource.
- Moderate – the action would have a noticeable or measurable adverse impact on the resource. This category could include potentially significant impacts that could be reduced to a lesser degree by the implementation of mitigation measures.
- Significant – the action would have obvious and extensive adverse impacts that could result in potentially significant impacts on a resource despite mitigation measures.

3.1.1 Resource Areas Screened from Detailed Analysis

Table 3-1 identifies and describes the resources that DOE determined would either not be affected or would sustain negligible impacts from the Proposed Action and not require further evaluation. The resource areas dismissed from further analysis are community services; land use and aesthetics; noise; materials and wastes; socioeconomics and environmental justice; and traffic and transportation. The subsections presented throughout the remainder of this chapter provide a concise summary of the current affected environment within the ROI, and an analysis of the potential effects to each resource area considered from implementation of the No-Action Alternative and the Proposed Action.

Table 3-1. Resource Areas Screened from Further Analysis

Resource Area	Rationale
Community Services	The EA does not include a detailed analysis of community services. Construction of the proposed sCO_2 Test Facility would be short-term and most likely rely on the current local workforce, and operation of the project would use existing SwRI personnel to fulfill the approximately seven operational worker positions (two Operators, two Test Engineers, one Supervisor, and two Technicians). Therefore, neither construction nor operations would result in a noticeable increase in population to the region, and the Proposed Action would not increase demand for community services (e.g., emergency, fire and police services, schools, libraries, churches).
Land Use and Aesthetics	The Proposed Action would not affect land use planning or zoning. The sCO_2 Test Facility Project would be located in a developed and undeveloped area entirely within the existing SwRI campus. SwRI has been designated as Heavy Industrial (I-2) zoning district by the City of San Antonio. Immediately surrounding properties to the SwRI facility have been designated as Commercial, General Industrial, Residential, and Multi-Family zoning districts by the City of San Antonio. No changes to land use or land use designations would result from implementing the Proposed Action; therefore, land use was not analyzed further. The Proposed Action would be consistent with the visual characteristics of the existing infrastructure within the SwRI campus, which is primarily research and laboratory facilities and corporate offices. There are no aesthetically sensitive areas within the viewshed of the sCO_2 Test Facility; therefore, no impacts to visual and aesthetic resources are anticipated, and this resource area was not analyzed further.
Noise	Construction activities would produce noise associated with tree clearing, excavation and grading, drilling for piers and foundations, installation of structural elements, and assembly of materials. These activities would be consistent with normal construction activities and would be conducted during normal business hours. Variation from normal construction hours may occur due to unforeseen circumstances (e.g., weather) or for specific tasks. Operational noise would result from operation of the sCO_2 Test Facility and truck deliveries, which are similar to the existing site activities and would occur at ground level where propagation offsite would not be expected to occur. Major process hardware would be enclosed within buildings, and silencers would be used, as required, to mitigate noise from process relief valves. The City of San Antonio Noise Ordinance (Chapter 21 Article III Noise) limits noise emissions to no more than 63 decibels on residential zoned property when measured from the property under separate ownership (i.e., the facility property line). The closest property line is over 2,000 feet from the sCO_2 Test Facility property boundary, and any noise is anticipated to attenuate to levels below those required by the City of San Antonio noise ordinance. Because noise impacts would be negligible, this resource was not analyzed further.
Materials and Waste	The EA does not include a detailed analysis of materials and wastes. Aside from construction materials and waste and small quantities of cutting fluids used during facility system fabrication and assembly, the Proposed Action would require negligible amounts of materials to operate and generate negligible amounts of solid waste. Lubrication oils would be used during system operation. Other wastes would include general waste from personnel and packaging from received hardware. All solid waste would be collected onsite in satellite accumulation areas and transferred to SwRI's central accumulation area. SwRI is a large quantity generator of hazardous waste (USEPA ID TXD007936842; TCEQ IHW No. 69046) and maintains an onsite less than 90-day hazardous waste storage area. Wastes are transferred to the central accumulation area in accordance with regulatory requirements and internal procedures. SwRI utilizes a

Resource Area	Rationale
	third party to manifest, transport, and dispose of wastes. All records and waste storage locations are maintained in accordance with TCEQ and USEPA requirements. There are no known compliance issues or notices of violation.
Socioeconomics and Environmental Justice	This EA does not include a detailed analysis of socioeconomic conditions. Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly population and economic activity. The Proposed Action would not result in any appreciable effects to the local or regional socioeconomic environment. The proposed sCO_2 Test Facility Project would have minor beneficial effects associated with temporary employment of construction personnel and transportation of goods and materials to the construction sites. No new operational personnel would be hired to support the project since existing SwRI personnel would fulfill the seven operational worker positions (two Operators, two Test Engineers, one Supervisor, and two Technicians). There would be no permanent change in sales volume, income, employment, or population because of the Proposed Action. There would be no effects on environmental justice or the protection of children, as the Proposed Action would not result in disproportionate adverse environmental or health effects on low-income or minority populations or children. As such, no socioeconomic or environmental justice impacts would result from implementation of the proposed sCO_2 Test Facility Project.
Traffic and Transportation	The Proposed Action would result in increased truck traffic during construction and operations. Construction activities would require trucks for the different stages of construction including: 1) 4 to 6 trucks per day for approximately 2 weeks during the site clearing and grading phase, and 2) 2 to 4 trucks per day (average) for approximately a year during facility construction, with a peak of 10 trucks per day for a 6-week period during the year of facility construction. Operations would require approximately 3 trucks per week for hardware delivery, approximately 1 to 2 trucks per week for CO_2 refill, and approximately 1 truck every 2 weeks for aqueous ammonia refill. The increased truck traffic to support the proposed sCO_2 Test Facility Project would result in negligible to minor impacts due to the increased truck transport. Road closures and improvements would be limited and would only occur within the SwRI campus. Access to the portion of 4th Street between Avenue F and Building 90 is currently restricted and would not result in a change to public access during construction and operation of the sCO_2 Test Facility. Installation of the new sanitary sewer force main from the proposed project area to the sanitary sewer manhole located near Building 90 would require a temporary closure of the roadway between Building 90 and Building 90b. This closure would not impact access to buildings. As a result, negligible impacts would be anticipated to roadways. No new operational personnel would be hired to support the Proposed Action since existing SwRI personnel would fulfill the seven operational worker positions (two Operators, two Test Engineers, one Supervisor, and two Technicians). The facility would include additional parking spaces to meet the needs of operational personnel and visitors. Impacts to the local traffic pattern or transportation routes are not anticipated, and this resource was not analyzed further.

CO_2 = carbon dioxide; EA = Environmental Assessment; sCO_2 = supercritical carbon dioxide; SwRI = Southwest Research Institute; TCEQ = Texas Commission on Environmental Quality; USEPA = U.S. Environmental Protection Agency

3.2 AIR QUALITY

3.2.1 Affected Environment

3.2.1.1 Air Quality Management

The purpose of the air quality analysis is to determine whether emissions from a proposed new or modified source of air pollution, in conjunction with emissions from existing sources, would or would not cause or contribute to the deterioration of the air quality in the area. The USEPA Region 6 and the TCEQ regulate air quality in Texas. The CAA (42 USC 7401-7671q), as amended, gives the USEPA the responsibility to establish the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR 50) that set acceptable concentration levels for the following seven criteria pollutants:

- Fine particulate matter of diameter 10 micrometers or less (PM_{10})
- Very fine particulate matter of diameter 2.5 micrometers or less ($PM_{2.5}$)
- Sulfur dioxide (SO_2)
- Carbon monoxide (CO)
- Nitrogen oxides (NO_x)
- Ozone (O_3)
- Lead (Pb)

NAAQS include two types of air quality standards (40 CFR 50.1(e)). Primary standards protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Short-term standards (1-, 8-, and 24-hour periods) have been established for pollutants that contribute to acute health effects, while long-term standards (annual averages) have been established for pollutants that contribute to chronic health effects. Texas accepts the federal standards (30 Texas Administrative Code (TAC) 101.21). Table 3-2 presents the NAAQS.

In addition to the seven criteria pollutants outlined in the CAA, several other substances raise concerns with regard to air quality and are regulated through the CAA Amendments of 1990. These substances include hazardous air pollutants, and toxic air pollutants such as metals and volatile organic compounds (VOCs). Nitrogen oxides and VOCs are precursors for ozone.

The USEPA designates airsheds that are in violation of the NAAQS as nonattainment areas and those in accordance with the NAAQS as attainment areas. Maintenance areas are attainment areas that were formerly designated nonattainment, and have implemented a plan to maintain their attainment status. Attainment and nonattainment areas are typically defined by county. The CAA requires states that contain nonattainment areas to submit to the USEPA a State Implementation Plan, which is a compilation of goals, strategies, schedules, and enforcement actions designed to lead the state into compliance with all NAAQS. The General Conformity Rule (40 CFR Part 51, Subpart W, and 40 CFR Part 93) ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not impede the state's ability to achieve the NAAQS in a timely fashion. Bexar County is in Air Quality Control Region 217 Metropolitan San Antonio Intrastate, which is in attainment for all NAAQS criteria pollutants (USEPA 2017a).

SwRI operates under the facility's Title V, Federal Operating Permit Number O1469 (TCEQ 2012). The current Title V permit provides air emissions limitations and standards, and requirements for monitoring, testing, recordkeeping, and reporting. It also includes requirements for new source review authorization and compliance.

Table 3-2. National Ambient Air Quality Standards

Pollutant	Primary/Secondary	Averaging Time	Level	Form
Carbon Monoxide	Primary	1-hour	35 ppm	Not to be exceeded more than once per year
	Primary	8-hours	9 ppm	
Lead	Primary and Secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide	Primary and Secondary	1 year	53 ppb	Annual mean
	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Ozone	Primary and Secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
PM_{10}	Primary and Secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
$PM_{2.5}$	Primary	1 year	12.0 µg/m^3	Annual mean, averaged over 3 years
	Secondary	1 year	15.0 µg/m^3	Annual mean, averaged over 3 years
	Primary and Secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
Sulfur Dioxide	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: USEPA 2017b
PM_{10} = particulate matter with a diameter of 10 microns or less; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; ppb = parts per billion; ppm = parts per million; µg/m^3 = microgram per cubic meter

3.2.1.2 Air Quality Monitoring Network

Texas has a network of strategically placed outdoor air quality monitoring stations throughout the state. The air monitoring stations are composed of instrumentation owned and operated both by state agencies and by cooperating local agencies. The monitoring stations typically measure concentrations of the specific air pollutants relevant to that regional area; however, some stations only measure for meteorological conditions like wind speed and temperature. The monitoring stations measure characteristics of ambient air quality levels to determine major sources of criteria pollutants, track concentrations of air pollution over time, and determine compliance with NAAQS and the state ambient air quality standards, thus assisting in the designation of nonattainment areas. TCEQ manages the air monitoring network in Texas including 26 monitoring sites in San Antonio that monitor particulate matter, CO, O_3, nitrogen dioxide, and SO_2 (TCEQ 2017a). The two closest air monitoring sites to the Proposed Action are the Old Hwy 90 site and the San Antonio Northwest site. The Old Hwy 90 site (480290677) has been operational since October 2006 and measures particulate matter, temperature, and wind speed. The San Antonio Northwest site (480290032)

has been operational since July 1981 and measures nitrogen oxides (i.e., nitric oxide and nitrogen dioxide), ozone, particulate matter, temperature, and wind speed.

3.2.1.3 Climate

Regional climate and meteorological conditions can influence the transport and dispersion of air pollutants that affect air quality. According to the National Weather Service, the climate in the San Antonio, Texas region is characterized as hot in the summer with average monthly temperatures in the 80's (degrees Fahrenheit [°F]) and cool in the winter with average monthly temperatures in the 50's°F. The warmest month of the year is August with an average maximum temperature of 96.0°F. The coldest month of the year is January with an average minimum temperature of 40.7°F. The average annual precipitation is 32.3 inches. Rainfall occurs throughout the year with peaks in the spring and fall. The wettest month is in June with an average rainfall of approximately 4.1 inches (NWS 2017). Refer to Section 3.9, *Cumulative Effects*, for details about greenhouse gases.

3.2.1.4 Class I Areas

Under the CAA, the "Class I" area designations were given to 158 areas that met certain criteria (e.g., national parks greater than 6,000 acres, national wilderness areas and national memorial parks greater than 5,000 acres, and one international park) (40 CFR 81.400). The purpose of the Class I areas is to provide a visibility protection program. These areas are granted special air quality protections under Section 162(a) of the CAA. Two Class I areas are located in Texas: Big Bend National Park and Guadalupe Mountains National Park, which are approximately 275 miles and 400 miles away from the project area, respectively (NPS 2017).

3.2.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. Implementation of the No-Action Alternative would result in no increased potential for adverse impact to air quality, and existing conditions would remain unchanged.

3.2.3 Proposed Action – Environmental Consequences

Construction would cause minor short-term impacts to air quality from a temporary increase of criteria pollutants from equipment used to construct the sCO_2 Test Facility and associated utility and infrastructure upgrades (including a new natural gas pipeline and sanitary sewer line), by trucks making deliveries, and by construction worker vehicles. In addition to tailpipe emissions from heavy equipment, ground surface disturbances during excavation and grading activities could potentially generate fugitive dust. Fugitive dust, such as dirt stirred up from construction sites, can affect public health through inhalation of fine particles that can accumulate in the respiratory system. The total acreage that could potentially be disturbed by construction is conservatively estimated as 16.5 acres.

Table 3-3 presents the estimated emissions associated with the construction of the proposed project based on estimated types of construction equipment and hours of usage, acreage of land disturbance, and estimated number of and distance traveled for worker vehicles and delivery trucks.

DOE expects the overall impacts to air quality from construction of the proposed sCO_2 Test Facility and new natural gas pipeline extension to be short term and minor. Since Bexar County is in attainment, the requirements of the General Conformity Rule are not applicable. However, the emissions associated with construction of the proposed project would not exceed the conformity *de minimis* emissions threshold levels of 100 tons per year (tpy). Therefore, air emissions during construction would not be regionally significant or contribute to a violation of any federal, state, or local air regulation.

Table 3-3. Estimated Emissions during Construction of sCO_2 Test Facility Project

Construction Activity	Construction Emissions (tons)				
	VOC	CO	NO_x	SO_x	PM[a]
Construction – sCO_2 Test Facility[b]	5.2	22.3	34.3	0.1	18.0
Construction – Natural Gas Pipeline[c]	0.1	0.3	0.4	0.0	0.0
Construction Worker Vehicles[d]	0.12	1.07	0.11	0.0	0.02
Delivery Trucks[e]	0.12	0.79	0.85	0.0	0.03
Total Construction Emissions	**5.54**	**24.46**	**35.66**	**0.1**	**18.05**

Source: CEQA 2017; USEPA 2005, 1995a; SCAQMD 2017

sCO_2 = supercritical carbon dioxide; CO = carbon monoxide; NO_x = nitrogen oxide; PM = particulate matter; SO_x = sulfur oxides; VOC = volatile organic compounds

[a] Includes PM with a diameter of 10 microns or less (PM_{10}) and with diameter of 2.5 microns or less ($PM_{2.5}$). PM includes equipment tailpipe emissions plus land disturbance PM emissions. DOE estimates 16.5 acres could be disturbed during construction.

[b] Emissions associated with construction of the sCO_2 Test Facility includes all components of the site, except for construction of the natural gas line which is calculated separately.

[c] Emissions associated with construction of the natural gas pipeline were estimated based on information obtained for other, similar projects.

[d] Estimates for emissions from construction worker vehicles assumes an average of 20 workers per day during 16.5 months of construction, assuming an average of 30 miles per each one-way trip.

[e] Estimates for emissions from delivery trucks assumes an average of 4 trucks per day during 16.5 months of construction, assuming an average of 60 miles per each one-way trip.

Operations

Operations of the sCO_2 Test Facility would result in minor impacts to air quality from direct and fugitive air emissions from proposed project components. As described in Chapter 2, Proposed Action and Alternatives, an air-blown, natural gas-fired heater would be used in the sCO_2 Test Facility to increase the liquid CO_2 temperature to supercritical levels, which will ultimately generate electricity. This unit is referred to as the electric generating unit. Emissions from the heater would be released through a 75-foot tall exhaust stack. The sCO_2 Test Facility process would also incorporate a cooling tower to lower the temperature of the CO_2, which would emit water vapor that includes particulate matter. Other potential sources of air emissions during operations include the combustion turbine lube oil vent, backup generators, and fugitive emissions of natural gas and aqueous ammonia. Additional minor air emissions would result from the seven operational worker vehicles and delivery truck tail pipe emissions during operations. It is anticipated that truck delivery of liquid CO_2 would occur 1 to 2 times per week and delivery of aqueous ammonia would occur every other week, resulting in an insignificant amount of air emissions. Air emissions at the SwRI main research campus are regulated under the facility's Title V, Federal Operating Permit Number O1469 (TCEQ 2012). On August 12, 2016, SwRI applied for a renewal and update of their Title V permit to include the proposed sCO_2 Test Facility Project (TCEQ 2016). TCEQ is currently reviewing this renewal application. On July 11, 2017, TCEQ issued SwRI an Air Quality Standard Permit for Electric Generating Units authorizing the proposed emissions of the sCO_2 Test Facility, effective May 16, 2017 (TCEQ 2017b). The standard permit was issued under the Texas Clean Air Act pursuant to 30 TAC Section 116.602. Table 3-4 presents the authorized emission limits of this standard permit for the project.

The sCO_2 Test Facility Project is expected to operate 120 hours per month, which equals 1,440 hours per year. Table 3-4 presents the estimated project emissions in tpy during operations. As shown in Table 3-4,

project emissions during operations of the sCO_2 Test Facility Project would not exceed the authorized limits stipulated in the facilities TCEQ standard permit (TCEQ 2017b) for electric generating units. Therefore, emission from the Proposed Action would not exceed any permit limits or federal or state regulations, and would not significantly affect air quality.

Table 3-4. Estimated Emissions during Operation of sCO_2 Test Facility Project

Emission Source	Pollutant	Authorized Emissions[a] (tpy)	Estimated Project Emissions[b] (tpy)
Electric Generating Unit	VOC	6.43	6.43[d]
	CO	98.13	19.64
	NOx	5.54	5.54
	SO_2	8.76	1.76
	PM/PM_{10}	8.88	6.71 [c]
	$PM_{2.5}$	6.66	1.33
	H_2SO_4[d]	1.34	1.34[d]
	$(NH_4)_2SO_4$	1.81	1.81[d]
	NH_3	14.69	14.69[d]
Combustion Turbine Lube Oil Vent	VOC	0.13	0.13[d]
	$PM/PM_{10}/PM_{2.5}$	0.13	1.13[d]
Natural Gas Fugitives[e]	VOC	0.59	0.59[d]
Aqueous Ammonia Fugitives[e]	NH_3	8.27	8.27[d]

Source: TCEQ 2017b

sCO_2 = supercritical carbon dioxide; CO = carbon monoxide; CO_2-eq = carbon dioxide equivalent; EGU = Electric Generating Unit; H_2SO_4 = sulfuric acid; NH_3 = ammonia; $(NH_4)_2SO_4$ =ammonium sulfate; NO_x = nitrogen oxide; PM = particulate matter; PM_{10} = particulate matter equal to or less than 10 microns in diameter; $PM_{2.5}$ = particulate matter equal to or less than 2.5 microns in diameter; SO_x = sulfur oxides; tpy = tons per year; VOC = volatile organic compounds

[a] Emission limits authorized for the sCO_2 Test Facility in TCEQ Air Quality Standard Permit #147262 dated July 11, 2017 (TCEQ 2017b).

[b.] Estimated proposed project emissions for normal operations are based on an estimated 1,440 hours of operation per year.

[c.] PM_{10} estimates for proposed project include emissions from EGU (PM_{10}=1.79 tpy) plus estimated cooling tower emissions (PM_{10}=4.92). Cooling tower PM emissions estimated using AP-42, Section 13.4 (USEPA 1995b).

[d.] Emission estimates for these compounds are based on standard permit emission limits (TCEQ 2017b).

[e.] TCEQ's Standard Permit states, "Fugitive emission limits are an estimate only and should not be considered as a maximum allowable."

3.3 BIOLOGICAL RESOURCES

3.3.1 Affected Environment

The proposed sCO_2 Test Facility Project would occur entirely within the South Texas Plains ecoregion, which encompasses the majority of South Texas. This ecoregion is characterized by a dominance of thorny shrubs and trees (including mesquite, acacia, and prickly pear) and grassland, along with scattered areas of palms and subtropical woodland in the Rio Grande Valley (TPWD 2017a). Table 3-5 summarizes the tree and plant species common to the South Texas Plains ecoregion.

Table 3-5. Common Plant Species of the South Texas Plains Ecoregion

Group	Species
Trees	Pecan, sugarberry, brasil, anaqua, great leadtree, Texas ebony, plateau liveoak, Sabal palm, black willow, coma, Texas persimmon, Texas kidneywood, honey mesquite, lotebush, huisache, desert willow, Texas wild olive
Shrubs	Fiddlewood, desert yaupon, Rio Grande abutilon, bee bush, agarita, American beauty-berry, chile pequin, lantana, cenizo, Barbados cherry, Turk's cap, rose pavonia, autumn sage
Conifers	Ashe juniper, Montezuma bald cypress
Succulents	Agave, huaco, yucca
Vines	Marsh's pipevine, old man's beard, coral honeysuckle
Grasses	Sideoats grama, slender grama, buffalograss, inland sea-oats, plains lovegrass, little bluestem
Wildflowers	Lila de los llanos, Englemann daisy, heartleaf hibiscus, scarlet sage, red prickly poppy, red gaillardia, purple phacelia

Source: TPWD 2017b

The sCO_2 Test Facility Project would be constructed on a 16.54-acre portion of the SwRI campus, of which 10.74 acres (65 percent) currently supports undeveloped wooded habitat. Existing disturbance at the site consists of access roads and existing structures, and adjacent properties have been developed to the northwest, north, and east, and roads form the western and southern site boundaries. Due to the presence of undeveloped land, a variety of birds, small mammals, reptiles, and insects likely inhabit the site. Per a Master Tree Plan Delineation completed by SwRI in April 2015, the dominant tree species found across the SwRI campus include live oak (*Quercus virginiana*), cedar elm (*Ulmus crassifolia*), Texas persimmon (*Diospyros texana*), Ashe juniper/mountain cedar (*Juniperus ashei*), and mountain laurel (*Dermatophyllum secundiflorum*). Within the proposed project area itself, a tree survey completed in October 2017 identified significant trees based on their diameters at breast height (DBH), including elm (*Ulmus* spp.), hackberry (*Celtis* spp.), mesquite (*Prosopis* spp.), and oak (*Quercus* spp.). The threshold measurement for a significant elm or oak tree is 6 inches DBH, while the threshold for mesquite and hackberry is 10 inches DBH under San Antonio, Texas Unified Development Code, Section 35-523(f)(1)(A).

A *Jurisdictional Waters of the United States Wetland Determination and Delineation* was completed to support planned infrastructure upgrades at SwRI. Refer to Section 3.9, *Cumulative Effects*, for additional details about the infrastructure upgrades. Completed on October 23, 2017, the survey evaluated a portion of the proposed project area for wetlands and jurisdictional waters of the U.S. This report classified the vegetation in the surveyed area as live oak hackberry woodland. In addition to the trees identified above, this report identified the following species: Chinese tallow (*Triadica sebifera*), chinaberry (*Melia azedarach*), and huisache (*Vachellia farnesiana*). Understory species consisted of frostweed (*Verbesina virginica*), lotebush (*Ziziphus obtusifolia*), inland sea oats (*Chasmanthium latifolium*), agarita (*Berberis trifoliolata*), whitebush (*Aloysia gratissima*), Johnson grass (*Sorghum halepense*), King Ranch bluestem

(*Bothriochloa ischaemum*), and straggler daisy (*Calyptocarpus vialis*) (Medina Consulting Company, Inc. 2018).

San Antonio's Unified Development Code Section 35-523 (Tree Preservation) states that if the final stipulated tree canopy, measured as a percentage based on land use (for example, nonresidential sites must provide a minimum final tree canopy cover of 25 percent), is smaller than the calculated tree canopy existing at the proposed site, then additional preservation, planting, or payment to the tree mitigation fund is necessary (Section 35-523(d) and (e)). To comply with the minimum final tree canopy cover requirements, SwRI identified trees for preservation using a tree stand delineation. SwRI identified a tree save area of 131.8 acres, which accounts for 38.6 percent of the existing tree canopy cover of the SwRI campus. The City of San Antonio has approved the delineation, including the mapped tree save area as well as trees located in areas to be developed.

The diverse plant community of the South Texas Plains ecoregion (dominated by low-growing vegetation) provides habitat for a variety of wildlife species. Bird species common to the South Texas Plains include green jay (*Cyanocorax yncas*), ferruginous pygmy-owl (*Glaucidium brasilianum*), elf owl (*Micrathene whitneyi*), grooved-billed anis (*Crotophaga sulcirostris*), redwing blackbird (*Agelaius phoeniceus*), plain chachalaca (*Ortalis vetula)*, crested caracara (*Caracara cheriway*), and greater road runner (*Geococcyx californianus*). Mammals typical of the ecoregion include spotted ocelots (*Leopardus pardalis*), black-tailed jackrabbit (*Lepus californicus*) and collared peccary (*Dicotyles torquatus*), although of these, only the jackrabbit is likely to occur within the project area. Common reptile species include Texas tortoise (*Gopherus berlandieri*), Texas horned lizard (*Phrynosoma cornutum*), indigo snake (*Drymarchon couperi*), and Texas longnose snake (*Rhinocheilus lecontei tessellatus*) (TPWD 2017b, 2017c).

The proposed project is situated within the Central Flyway, a bird migration route that generally follows the Great Plains in the United States and Canada. The main endpoints of the flyway include central Canada and the region surrounding the Gulf of Mexico, including Bexar County, Texas. In addition, the proposed project occurs within an important flyway for the monarch butterfly, which funnels through Texas both in the fall and the spring. The flyway is situated along the Texas coast and lasts roughly from the third week of October to the middle of November.

A search of the USFWS Endangered Species database for potential threatened and endangered species identified a total of 13 species listed under the Endangered Species Act with the potential to occur within Bexar County. However, based on the habitat requirements of each of these species, the proposed project area does not support suitable habitat for any of these protected species (USFWS 2017). Table 3-6 summarizes these federally listed species and their habitat requirements.

A consultation response received from the USFWS on January 9, 2018 identified Bexar County as a Karst Zone 3 area. While Karst Zone 3 areas probably do not contain endangered karst invertebrates, the USFWS requested that an assessment be conducted to determine whether there are potential features within the proposed project area that could support listed kart invertebrate species. Per the survey protocol provided by the USFWS, surveys should be conducted by a qualified karst geologist or karst biologist with demonstrated experience (USFWS 2015). A qualified karst Geologist conducted a Geologic Assessment at the site according to the USFWS protocol. Based on the geology underlying the site and a field survey conducted by these geologists, the Geologic Assessment concluded that "there are no karst or cave features present at the Site that may provide habitat for karst invertebrate endangered or threatened species" (Lewis and Green 2018).

Table 3-6. Federally Listed Species in Bexar County, Texas

Species Name (Scientific name)	Status	Preferred Habitat / Potential for Occurrence
Cokendolpher Cave harvestman (*Texella cokendolpheri*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Government Canyon Bat Cave spider (*Neoleptoneta microps*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Madla's Cave meshweaver (*Cicurina madla*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Robber Baron Cave meshweaver (*Cicurina baronia*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Government Canyon Bat Cave meshweaver (*Cicurina vespera*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Braken Bat Cave meshweaver (*Cicurina venii*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Beetle (*Rhadine exilis*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Beetle (*Rhadine infernalis*)	Endangered	Karst features in northwestern Bexar County and northeastern Medina County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Helotes mold beetle (*Batrisodes venyivi*)	Endangered	Karst features in north and northwest Bexar County. A Geologic Assessment concluded that no karst or cave features are present at the site.
Black-capped vireo (*Vireo atricapilla*)	Endangered	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer. The proposed project area lacks evergreen (juniper) component.
Golden-cheeked warbler (*Setophaga chrysoparia*)	Endangered	Juniper-oak woodlands; depended on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer. The proposed project area lacks evergreen (juniper) component.
Whooping crane (*Grus americana*)	Endangered	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. The proposed project area lacks presence of water preferred by this species.

Species Name (Scientific name)	Status	Preferred Habitat / Potential for Occurrence
Piping plover (*Charadrius melodus*)	Endangered	Wide, flat, open, sandy beaches or lakeshores with little grass or other vegetation. Nesting territories often include small creeks or wetlands. The proposed project area lacks presence of habitat preferred by this species.

Source: Lewis and Green 2018; NatureServe Explorer 2017; USFWS 2017

An additional 14 species are listed as state-protected by the State of Texas and may occur within Bexar County. These species, all listed as threatened, include one mollusk, two fish, two amphibians, four reptiles, four birds, and 1 mammal. Only three of these state-protected species have habitat requirements that may exist at the site: zone-tailed hawk (*Buteo albonotatus*), Texas tortoise (*Gopherus berlandieri*), and timber rattlesnake (*Crotalus horridus*). Table 3-7 summarizes the state-listed species in Bexar County as well as their respective habitat requirements.

Table 3-7. State-Listed Species in Bexar County, Texas

Species Name (Scientific Name)	State Status	Preferred Habitat / Potential for Occurrence
Cascade Caverns salamander (*Eurycea latitans complex*)	Threatened	Springs and caves in Medina River, Guadalupe River, and Cibolo Creek watersheds within Edwards Aquifer area. The proposed project area lacks caves.
Comal blind salamander (*Eurycea tridentifera*)	Threatened	Found in springs and waters of caves. The proposed project area lacks caves.
White-faced ibis (*Plegadis chici*)	Threatened	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats. The proposed project area lacks suitable wetland habitat.
Wood stork (*Mycteria americana*)	Threatened	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.
Zone-tailed hawk (*Buteo albonotatus*)	Threatened	Arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions. Although this species has not been observed on the site, there is potential for suitable habitat to occur within the proposed project area due to presence of open woodland.
American peregrine falcon (*Falco peregrinus anatum*)	Threatened	Nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands. The proposed project area lacks suitable habitat.
Widemouth blindcat (*Satan eurystomus*)	Threatened	Blind catfish endemic to the San Antonio Pool of the Edward's Aquifer, which is not present within the proposed project area.

Species Name (Scientific Name)	State Status	Preferred Habitat / Potential for Occurrence
Toothless blindcat (*Trogloglanis pattersoni*)	Threatened	Blind catfish endemic to the San Antonio Pool of the Edward's Aquifer, which is not present within the proposed project area.
Black bear (*Ursus americanus*)	Threatened	Bottomland hardwoods and large tracts of inaccessible forested areas, which are not found within the proposed project area.
Texas tortoise (*Gopherus berlandieri*)	Threatened	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus, sometimes in underground burrows or under objects; longevity greater than 50 years; active March-November; breeds April-November. Although this species has not been observed on the site, there is potential for suitable habitat to occur within the proposed project area due to presence of open brush with a grassy understory.
Texas horned lizard (*Phrynosoma cornutum*)	Threatened	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September. The proposed project area contains too much vegetation to serve as preferred habitat for this species.
Texas indigo snake (*Drymarchon melanurus erebennus)*	Threatened	Texas south of the Guadalupe River and Balcones Escarpment; thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter. The proposed project area lacks dense riparian corridors.
Timber rattlesnake (*Crotalus horridus*)	Threatened	Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover (i.e., grapevines or palmetto). Although this species has not been observed on the site, there is potential for suitable habitat to occur within the proposed project area due to presence of upland woodlands.
Golden orb (*Quadrula aurea*)	Threatened	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins. The proposed project area lacks suitable habitat.

Source: TPWD 2017d

3.3.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. Implementation of the No-Action Alternative would result in no increased potential for adverse impact to biological resources and existing conditions would remain unchanged.

3.3.3 Proposed Action – Environmental Consequences

The proposed sCO_2 Test Facility Project would result in overall minor impacts on vegetation, wildlife, and threatened and endangered species. Long-term, minor impacts to vegetation would occur during construction of the proposed sCO_2 Test Facility Project from land clearing and ground disturbance required for construction of the proposed project as well as emplacement of proposed utilities. While the construction activities themselves would be temporary, the clearing of the existing trees in construction areas outside of the proposed operational footprint still represents a long-term impact due to the length of time required for regeneration. Current plans include the removal of identified significant elm, oak, mesquite, and hackberry trees in areas proposed for development; however, no trees located within the designated tree save area would be removed as part of this proposed project.

Approximately 10.74 acres would be cleared of vegetation. Vegetation outside of the operational footprint would be allowed to regrow or be replanted with native vegetation, but would likely be mowed and maintained as lawn as opposed to returning to the existing community of thorny shrubs and trees. Ground disturbance and clearing of native vegetation can lead to the introduction and spread of non-native or invasive species. The implementation of standard best management practices (BMPs) could reduce potential for this to occur. Potential BMPs include washing construction vehicles before arriving onsite, revegetating with native species, minimizing the area of disturbance to the extent possible, and monitoring for the presence of (and removing) non-native or invasive plant species after the conclusion of construction activities.

As discussed in Section 3.8, *Water Resources*, an unnamed tributary of Leon Creek is located on property adjacent to the proposed sCO_2 Test Facility Project. Even though the tributary does not fall within the proposed project area, SwRI would maintain a minimum 100-foot vegetation buffer from the tributary. The buffer would reduce potential erosion runoff and sedimentation in the tributary that could impact aquatic species present.

DOE sent consultation letters to the USFWS – Austin Ecological Services Field Office on December 13, 2017 and the Texas Parks and Wildlife Department on December 14, 2017. DOE received an email response from USFWS on January 9, 2018 requesting the conduct of surveys for suitable habitat for listed karst invertebrate species since Bexar County and the SwRI are located in a Karst Zone 3 area. As discussed in Section 3.3.1, a qualified karst Geologist conducted a Geologic Assessment at the site according to the USFWS protocol and determined that "there are no karst or cave features present at the Site that may provide habitat for karst invertebrate endangered or threatened species" (Lewis and Green 2018). At the time of this Draft EA, no response has been received from the Texas Parks and Wildlife Department.

As no federally protected species are expected to occur within the site, no effects to these species would be anticipated. Potential effects to state-listed species (i.e., zone-tailed hawk, Texas tortoise, and timber rattlesnake) could occur if present at the site. Temporary impacts could occur to wildlife species residing in the areas within and adjacent to the construction areas from noise and fugitive dust. More mobile species may relocate and avoid direct effects, while the introduction of heavy equipment and trenching activities could result in mortality for a limited number of individual animals. Overall, construction-related impacts, however, would be short-term and minor.

To limit potential impacts to migratory birds, if present within the proposed project area, the USFWS and Texas Parks and Wildlife Department recommend that ground disturbance and vegetation removal occur outside of the general nesting season (i.e., March 15th through September 15th) in accordance with the Migratory Bird Treaty Act. If clearing outside this timeframe is unavoidable, the Texas Parks and Wildlife Department may recommend a trained biologist with bird identification experience survey the proposed disturbance areas for nesting birds to avoid the inadvertent destruction of nests and eggs. The conversion of forested habitat to an industrial facility and associated grounds would represent a permanent, minor adverse effect to wildlife currently inhabiting the area, leading to displacement.

Due to the susceptibility of small wildlife to fall into open construction pits and trenches, the Texas Parks and Wildlife Department recommends excavated areas be covered at the end of the work day or be equipped with escape ramps (e.g., fashioned from boards or soil). Any pits or trenches left open overnight should be inspected the following morning for trapped wildlife. If any state-listed species are trapped, removal should be performed by personnel permitted by the Texas Parks and Wildlife Department.

Operation of the proposed sCO_2 Test Facility Project would have negligible impacts to biological resources, including federally and state-listed species and migratory birds. No land disturbing activities are currently planned during operations. The sCO_2 Test Facility, including the 75-foot heater stack, would be consistent with the existing infrastructure within the SwRI campus, which includes tall structures associated with existing research facilities. To the extent practicable, construction areas not utilized for operational project area would be restored, revegetated and maintained to avoid impacts to biological resources.

3.4 CULTURAL RESOURCES

The National Historic Preservation Act (NHPA) of 1966 (36 CFR Part 800) provides for the identification, evaluation, and preservation of cultural resources. Section 106 of the NHPA requires federal agencies to consider effects of undertakings on resources listed in, or eligible for inclusion in, the National Register of Historic Places (NRHP) through a process of consultation. The process for compliance with Section 106 consists of the following steps:

1. Establishment of an Area of Potential Effect (APE). This is defined as the area in which eligible properties may be affected by the proposed undertaking, including direct effects and indirect effects (such as visual, audible, and changes which affect the character and setting of the property).
2. Identification of cultural resources located within the APE of a proposed undertaking. This is accomplished through review of existing documentation and field surveys.
3. Conduct a cultural resources evaluation using NRHP criteria. Properties that meet the criteria are considered eligible for listing in the NRHP and are subject to further review under Section 106. Properties that do not meet the criteria are considered not eligible for inclusion in the NRHP and are generally not subject to further Section 106 review.
4. Determination of effect of the proposed undertaking by assessing properties that meet the NRHP criteria. One of the following effect findings would be made: No Historic Properties Affected, No Adverse Effect, or Adverse Effect.
5. Resolution of adverse effects/mitigation occurs when adverse effects are found. Consultation continues between the federal agency and consulting parties to attempt resolution. Successful consultation results in an agreement of the efforts to be taken to avoid or mitigate adverse effects.

The significance of historic properties is judged against a property's ability to meet any of the four criteria for inclusion on the NRHP (36 CFR 60.4):

- Criterion A: Association with events that have made a significant contribution to the broad patterns of our history; or
- Criterion B: Association with the lives of persons significant in our past; or
- Criterion C: That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Criterion D: That has yielded, or may be likely to yield, information important in prehistory or history.

Properties may be eligible for the NRHP for contributions at the national, state, or local level. Ordinarily, properties achieving significance within the last 50 years are not considered eligible unless they are integral parts of historic districts or unless they are of exceptional importance. The most common types of properties less than 50 years old listed on the NRHP are works of modern architecture or scientific facilities. In practice, Criterion A through C generally apply to historic structures and districts, while Criterion D generally pertains to archaeological resources. Additionally, in order for a structure or building to be listed in the NRHP, it must possess historic integrity of those features necessary to convey its significance (i.e., location, design, setting, workmanship, materials, feeling, and association; see National Register Bulletin #15, *How to Apply the National Register Criteria for Evaluation)* (NPS 1990).

3.4.1 Affected Environment

3.4.1.1 Area of Potential Effects (APE)

The APE for direct effects (archaeological resources) is limited to the areas of ground disturbance. The potential areas of ground disturbance are those of the greater proposed project area as shown in Figure 2-2. Construction would involve vegetation removal, grading, installation of access roads and utilities (sanitary sewer, water and electric tie-in, natural gas pipeline), and assembly of equipment and structures. Construction of infrastructure and utilities would involve trenching techniques to install the new natural gas pipeline and sanitary sewer line. The trench would require a maximum width of 30 feet and depth of 4 feet. Refer to Section 2.4.3 for more details about proposed construction activities. As project plans and design are finalized, it is expected that the APE will become more focused.

The APE for indirect/visual effects (historic structures) has been determined to be limited to a 500-foot buffer beyond the proposed aboveground structures of the proposed sCO_2 Test Facility. Visual impacts would be the most likely impacts to have adverse effects to NRHP-eligible aboveground historic properties within the proposed project area. No long-term impacts to historic structures would occur at the proposed staging/laydown areas.

3.4.1.2 Historic Structures and Districts

Description

SwRI was originally created in 1947 for scientists and engineers to conduct research, such as automotive testing, environmental research, and radio direction finding. An online review of the Texas Historical Commission's Texas Historic Sites Atlas was conducted on December 3, 2017 (THC 2017). No aboveground historic properties have previously been identified in the proposed project area. A review of aerial imagery was conducted to identify structures within the APE for visual effects that were present on or before 1973 (45 years) (NETR 2017). Two structures were identified within the APE that are over 45 years of age. Building Number 91 (1411 4th Street) is a one-story, concrete and concrete block building with flat built-up roof utilized for storage. It measures approximately 22 by 65 feet and was constructed in 1971. It is located approximately 475 feet from the proposed sCO_2 Test Facility. There is an adjacent storage yard to the west side of the building. Building Number 112 is located approximately 495 feet east of proposed sCO_2 Test Facility. Constructed in 1966, it is a one-story, metal maintenance shop with gabled metal roof with shed roofed addition on the east side. The building is set on a concrete slab. It measures approximately 32 by 36 feet.

There are two additional buildings over 45 years of age were identified just outside the 500-foot APE for indirect/visual effects. Although the exact dates of construction are not known, both appear on aerial imagery beginning in 1963. One is a vacant metal Quonset hut with large overhead door on the north side and corrugated metal cladding, while the other is an unused concrete block structure with a shallow-pitched shed roof that has mostly collapsed. None of these four structures possess sufficient architectural or historical significance to be considered eligible for the NRHP. There are no other structures within the APE for indirect/visual effects that are over 45 years of age.

NRHP Evaluation

None of the four buildings identified within the project area as being over 45 years of age are noteworthy examples of a type, period, or method of construction or the work of a master nor are they associated with significant historical events or persons. The buildings are common maintenance and storage buildings of standard design. They lack sufficient historical or architectural significance to be listed on the NRHP.

3.4.1.3 Archaeological Resources

It is anticipated that ground disturbing activities would be limited to the proposed project area (see Figure 2-2). DOE is not aware of any archaeological resources present within the APE for direct effects. DOE submitted a *Request for SHPO Consultation* form along with required attachments to the Texas Historical Commission on December 14, 2017. The Texas Historical Commission recommended an archaeological survey of the proposed project area in their response letter dated January 9, 2018. Per the Texas Historical Commission recommendation, an archaeological survey is being conducted. The results of this archeological survey will be included in the Final EA.

3.4.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. The existing conditions would remain unchanged. Under this alternative, there would be no direct or indirect impacts to historic resources.

3.4.3 Proposed Action – Environmental Consequences

Consistent with the CEQ regulations for implementing the NEPA, impacts to cultural resources are described in terms of type, context, duration, and intensity. These impact analyses are intended, however, to comply with the requirements of both the NEPA and Section 106 of the NHPA. In accordance with the Advisory Council on Historic Preservation's (ACHP) regulations implementing Section 106 (36 CFR Part 800, *Protection of Historic Properties*), a determination of either Adverse Effect or No Adverse Effect must be made for affected NRHP-eligible cultural resources. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the NRHP. A determination of No Adverse Effect means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the NRHP.

A Section 106 summary is included in the impact analysis sections for cultural resources. The Section 106 summary is intended to meet the requirements of Section 106 and is an assessment of the effect of the undertaking (implementation of the alternative) on cultural resources, based upon the criterion of effect and criteria of adverse effect found in the ACHP's regulations.

Consistent with the CEQ

For purposes of analyzing potential impacts to cultural resources, the thresholds of change for the intensity of an impact are defined as follows:

- *negligible:* Impact(s) is at the lowest levels of detection - barely measurable with no perceptible consequences, either adverse or beneficial. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- *minor* adverse impact: Impact would alter a feature(s) of a structure or building, but would not diminish the overall integrity of the resource. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- *minor* beneficial impact: Stabilization/ preservation of features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- *moderate* adverse impact: Impact would alter a feature(s) of the structure or building, diminishing the overall integrity of the resource. For purposes of Section 106, the determination of effect would be *adverse effect*.
- *moderate* beneficial impact: Rehabilitation of a structure or building in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. For purposes of Section 106, the *determination* of *effect* would be *no adverse effect*.

- *major* adverse impact: Impact would alter a feature(s) of *the structure or building, diminishing the overall integrity of the resource.* For purposes of Section 106, the determination of effect would be *adverse effect.*
- *major* beneficial impact: Restoration of a structure or bui*lding in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties*. For purposes of Section 106, the de*termination of effect w*ould be *no adverse effect*.
- *short-term duration*: Effects lasting for the *duration of the construction activities (less than 1 year).*
- *long-term duration*: Effects lasting longer than the duration of the construction *(longer than 1 ye*ar).

3.4.3.1 Historic Structures and Districts

As there are no historic structures located within the APE of the proposed sCO_2 Test Facility Project, there would be no impacts. Therefore, DOE has made a determination of No Historic Properties Affected for Historic Structures and Districts. DOE submitted a *Request for SHPO Consultation* form along with required attachments to the Texas Historical Commission on December 14, 2017. On January 9, 2018, the Texas Historical Commission concurred with this finding (refer to Appendix A).

3.4.3.2 Archaeological Resources

It is anticipated that ground disturbing activities would be limited to the proposed project area presented in Figure 2-2. DOE is not aware of any archaeological resources present within the APE for direct effects. As part of the December 14, 2017 submission of the *Request for SHPO Consultation* form to the Texas Historical Commission, DOE made a preliminary determination of No Historic Properties Affected within the APE for direct effects to archaeological resources. The Texas Historical Commission response letter dated January 9, 2018 recommended an archaeological survey of the proposed project area. Currently, planning and coordination for an archaeological survey is underway. The survey will be completed by a professional archeologist in accordance with the minimum survey standards of the Texas Historical Commission. Prior to construction of the proposed project, a survey report will be submitted to the Texas Historical Commission and conform with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation. DOE will continue to work with the Texas Historical Commission to identify and avoid/mitigate effects to archaeological resources.

On December 13, 2017, DOE submitted consultation letters to 43 Indian Tribal leaders within the region that could potentially have an interest in the project. DOE received a response from three Indian Tribes (Comanche Nation, Quapaw Tribe of Oklahoma, and Poarch Band of Creek Indians). Refer to Appendix A to view the Tribal response letters. The response letter from Comanche Nation dated January 10, 2018 stated that their review indicated "***No Properties***" potentially containing prehistoric or historic archeological materials have been identified within the proposed project area. The response letter from Quapaw Tribe of Oklahoma dated January 10, 2018 stated that the sCO_2 Test Facility Project is outside of the current area of interest for the Tribe; therefore, they do not desire to comment on the project. The response letter from Poarch Band of Creek Indians dated January 12, 2018 stated that they are not aware of any cultural or historical resources located within the project site that could be impacted by the proposed project. The response from Poarch Band of Creek Indians also stated that the proposed project is not in a geographical area identified as part of their Tribal ancestral homelands and they defer to Tribes historically associated with the site.

3.5 GEOLOGY AND SOILS

3.5.1 Affected Environment

Geology involves the earth's physical structure and substance. Geologic processes formed the earth's crust, creating the natural surface contours of the earth and the variety of parent rock materials, sediments, and deposits. Soil is the unconsolidated mineral or organic parent material on the immediate surface of the earth formed by weathering of the geologic parent material.

The proposed sCO_2 Pilot Plant Test Facility would be constructed in an area identified as USFWS Karst Zone 3, indicating areas that probably do not contain karst features. Per the recommendation of the USFWS in the agency's January 9, 2018 emailed consultation response, qualified Professional Geologists familiar with the proposed project site conducted a survey for karst features within the project area. According to this Geologic Assessment, the proposed sCO_2 Test Facility Project would be constructed within an area overlying Quaternary-age Fluviatile terrace deposits. Terrace deposits from the Quaternary period (i.e., the geologic period encompassing the Pleistocene and Holocene Epochs and spanning a time frame ranging from approximately 2,588,000 years ago to today) contain unconsolidated gravel, sand, silt, and clay derived from limestone and are found above flood level along streams and rivers. Available geologic data and a field survey conducted by Professional Geologists found that there are no karst or cave features present at the site (Lewis and Green 2018).

Soils underlying the areas proposed for disturbance during the project's construction phase include the following map units (Medina Consulting Company, Inc. 2018; USDA 2017a):

- Houston Black gravelly clay, 1-3 percent (HuB) and 3-5 percent slopes (HuC) – This soil, clayey residuum weathered from calcareous mudstone, is classified as moderately well-drained, prime farmland, and non-hydric with a very high runoff class. The capacity of the most limiting layer to transmit water (Ksat) is very low to moderately low, and the depth to water table is more than 80 inches. The shrink-swell potential is very high.
- Lewisville silty clay, 1-3 percent slopes (LvB) – This soil, formed from a parent material of calcareous, clayey alluvium derived from mudstone, is classified as well drained, prime farmland, and not hydric. The runoff class is listed as low, and this soil has a Ksat of moderately low to moderately high. The depth to water table is more than 80 inches, the shrink-swell potential is high, and the organic matter content in the surface horizon is approximately 2 percent.
- Eddy gravelly clay loam, 1-8 percent slopes (Tb) – From the ground surface to a depth of 4 inches, this soil is comprised of gravelly clay loam, while deeper depths consist of residuum weathered from Austin chalk. This well-drained soil is not considered prime farmland, is not hydric, and has a Ksat of moderately low to high. The depth to water table is more than 80 inches, and the shrink-swell potential is low. Organic matter content in the surface horizon is approximately 1 percent.
- Tinn and Frio soils, 0-1 percent slopes, frequently flooded (Tf) – This soil association, comprised of approximately 60 percent Tinn soils and 39 percent Frio soils, is not considered prime farmland. Parent material includes clayey (Tinn) or loamy (Frio) alluvium of Holocene age derived from mixed sources. Tinn soils are moderately well drained and have a Ksat of very low to moderately low. Frio soils are well drained and have a Ksat of moderately high. Both soil types have a depth to water table of more than 80 inches, and neither is hydric, though this soil is frequently flooded. The shrink-swell potential is very high.

3.5.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. Implementation of the No-Action Alternative would result

in no increased potential for adverse impacts to geological or soil resources currently existing at the site and the existing conditions would remain unchanged.

3.5.3 Proposed Action – Environmental Consequences

While the proposed sCO_2 Test Facility would include the emplacement of underground utilities, no blasting activities are anticipated during construction. Operation of the proposed sCO_2 Test Facility is also not expected to result in any disturbance to bedrock, geology, or karst features. As such, no bedrock is expected to be disturbed during construction and operation of the Proposed Action.

Construction of the proposed sCO_2 Test Facility Project would disturb approximately 10.74 acres of currently undeveloped land and approximately 5.80 acres of developed land across the site, including areas for site clearing, building construction, construction laydown, and emplacement of underground utilities. Specific disturbance activities would encompass ground clearing (vegetation removal), grading, leveling, trenching, and introduction of vehicles (including heavy equipment), all of which would disturb soils and potentially mix soil horizons. Construction of the natural gas pipeline extension would require an approximately 4-foot deep trench and 30-foot wide construction ROW through developed and undeveloped land. To the extent practicable, SwRI would manage topsoil to prevent mixing of topsoils and subsoils. At the end of construction of the natural gas pipeline extension, the soils would be restored, revegetated, and maintained as operational ROW.

While no portion of the site is currently used for agricultural purposes, up to 11.52 acres of Houston Black gravelly clay and Lewisville silty clay prime farmland soils would be disturbed through implementation of the Proposed Action. This total includes 5.86 acres within permanent ROW or permanent impact areas and 5.66 acres within temporary ROW or temporary disturbance areas. These prime farmland acreages reflect the most current design and layout of the proposed sCO_2 Test Facility at the time of this analysis. Disturbance of the existing prime farmland soils could remove these soils from future potential agricultural use or otherwise alter the soil's ability to support plant life, resulting in a loss of function. These impacts would be minimized by limiting conversion of these areas to impervious surface to the extent practical. These impacts are considered minor as these soils represent only a small fraction of prime farmland (0.003 percent of the 314,086.5 acres of prime farmland soils in Bexar County) and are not actively used or planned to be used for agricultural purposes since they are located within the SwRI campus which is zoned as Heavy Industrial (I-2) land use (USDA 2017b).

Soil disturbance can also increase the likelihood of soil erosion and runoff, and soil compaction could occur which would decrease water infiltration and inhibit the soil's ability to support plant life as a result of vehicle traffic and heavy machinery. SwRI would implement established programs and plans (e.g., SwRI's Stormwater Pollution Prevention Plan (SWPPP) and Spill Prevention, Control, and Countermeasure (SPCC) Plan) to minimize potential impacts to soil resources. Section 3.8, *Water Resources*, further discusses BMPs related to erosion and siltation. With proper implementation of recommended BMPs, minor adverse impacts to soil resources would be expected during construction of the Proposed Action. These BMPs could include limiting construction areas to the extent possible to reduce disturbance, avoiding the use of heavy equipment during periods of ground saturation to avoid rutting, use of erosion control devices (i.e., silt fences, earthen berms, etc.), and revegetating disturbed areas with native vegetation following completion of construction activities.

Lastly, the operation of construction vehicles and equipment can result in accidental leaks of fuels, oils, and other lubricants that could result in and potential contamination of soils. The potential for these types of impacts would be minimized through the use well-maintained equipment, and compliance with SwRI's established pollution prevention and spill response procedures.

Operation of the proposed sCO_2 Test Facility Project would have negligible impacts to soils. No land disturbing activities are currently planned during operations. To the extent practicable, construction areas not utilized for operational project area would be restored and maintained to avoid disturbance and erosion of soils.

3.6 HEALTH AND SAFETY

3.6.1 Affected Environment

SwRI conducts all construction and operational activities according to existing safety practices and guidelines. As discussed in Section 2.4.1, SwRI conducts a wide variety of research projects (e.g., corrosion and electrochemistry, emissions research, fire technology, fuels and lubricants, oil and gas exploration, etc.) that abide by safety protocols. SwRI maintains a safety policy that contains its plans, procedures, and standards. The current SwRI Safety Policy and Procedures Manual (SPPM) serves as the primary document governing facility activities, details general safety rules, and discusses safety related to the environment and to the health of employees and the public. The SPPM contains detailed chapters specific to potential hazards associated with activities conducted at SwRI. Topics covered by the SPPM include, but are not limited to, laboratory safety, personal protective equipment, environmental safety, machinery and material handling, traffic safety, industrial hygiene, fire prevention, and general safety. Each chapter includes details about the specific hazard, legal requirements, program requirements, training requirements, standard operating procedures requirements, and references to the Environmental and Safety System (ESS) procedure to implement the SPPM requirements. Specific hazards associated with the Proposed Action include cryogenic fluids, high-voltage electrical systems, and venting of CO_2 (see Section 3.6.3), which are addressed in SPPM sections SPPM-1.8 (Standard Operating Procedure for Hazardous Operations) and SPPM-9.8 (Compressed Gas Cylinders and Pressure Vessels).

In addition to the SPPM, the following facility instructions and procedures would apply to the proposed project:

- ESS-Guidance Document-11.2 – Emergency Action and Fire Prevention Planning
- ESS-Guidance Document-11.1 – Emergency Response Planning
- ESS-Work Instruction-18.1 – Performing and Documenting Job Safety Assessments
- ESS-Work Instruction-18.2 – Performing and Documenting Hazard Assessments

In addition, all project-related personnel would receive training in the following areas:

- Hazard Communication/Right-to-Know
- Hazardous Materials General Awareness/Familiarization
- Job Safety Assessment
- Waste Management Training

3.6.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. Implementation of the No-Action Alternative would result in no increased potential for adverse impacts to public or employee health and safety. SwRI would continue to operate under existing conditions and would continue to adhere to existing safety practices, procedures, and standards.

3.6.3 Proposed Action – Environmental Consequences

Construction and operation of the proposed sCO_2 Test Facility Project would introduce minor potential for health and safety impacts. Primary concerns to human health and safety regarding the proposed project would include accidental injuries during construction and operation; electric shock hazards related to high-voltage electrical systems; injuries related to cryogenic liquids; asphyxiation hazards from venting CO_2;

exposure to aqueous ammonia through inhalation of vapors or contact with the skin or eyes; and scalding, explosive, or fire hazardous associated with the combustion of natural gas. Adherence to Occupational Safety and Health Administration (OSHA) requirements and the safety practices listed below would minimize these potential risks to health and safety. Detailed hazard assessments and safety procedures would be developed after the design phase and an operational analysis are completed. During operations, prevention is the first step in dealing with incidents where equipment, the environment, or personnel may be harmed by errors or accidents. For this reason, the minimum requirements of OSHA standards would be met or exceeded in the design of equipment, buildings, and access. Safety training shall be given to employees and a safety orientation to visitors. As the proposed project would implement robust safety procedures, the potential for impacts to human health and safety would be minor.

Potential occupational health and safety risks during construction are expected to be typical of risks for any industrial or commercial construction site. These include, but are not limited to: the movement of heavy objects, including construction equipment; slips, trips, and falls; risk of fire or explosion from general construction activities; and spills and exposures related to the storage and handling of chemicals and disposal of hazardous waste. According to the Bureau of Labor Statistics, approximately 3.2 nonfatal occupational injuries occurred for every 100 workers throughout the construction industry in 2016. The rate among nonresidential building construction workers was 2.4 nonfatal injuries per 100 workers (BLS 2016). The health and safety of construction workers would be protected by adherence to accepted work standards and regulations set forth by OSHA (29 CFR 1910). During construction, safety measures, such as providing fencing around the construction site, establishing contained storage areas, and controlling the movement of construction equipment and personnel, would reduce the potential for accidents to occur.

As the Proposed Action would result in the generation of approximately 5 to 10 MWe of electricity during operation of the new facility, there exists the potential for employees to become exposed to high-voltage systems and associated hazards from electrical shock. Electrical shock occurs when a human body becomes part of a live electric circuit through contact with live wires, energized metal, or another conductor. While the severity of an electrical shock depends upon the current flowing through a victim's body, the path the current takes through the body, the length of time a victim remains part of the electrical circuit, and the current's frequency, general reactions range from a faint tingle or shock, to respiratory arrest, muscular contractions, nerve damage, cardiac arrest, burns, and death (electrocution) (OSHA 2002).

Burns are among the most common electrical shock-related injuries and may take one, or a combination, of three forms (OSHA 2002):

- **Electrical burns** are among the most serious burns and occur when the electric current travels through tissue or bone. These burns may cause tissue damage.
- **Arc or flash burns** result from high temperatures caused by a nearby electric arc or explosion.
- **Thermal contact burns** arise from skin contact with hot surfaces of overheated electric conductors, conduits, or other energized equipment, or when clothing catches on fire from an electric arc, etc.

In 2015, the most recent year for which such data is available, 134 (approximately 2.8 percent) of 4,836 total workplace fatalities were caused by exposure to electricity. The majority (63.4 percent) of these electricity-related fatalities occurred while a worker was constructing, repairing, or cleaning equipment. Approximately 30 percent of these fatalities occurred in industrial settings (BLS 2017a). Nonfatal workplace injuries caused by exposure to electricity accounted for 1,640 (1.2 percent) of 133,020 total nonfatal injuries in 2016 (BLS 2017b).

Employees can be protected from electrical hazards through proper installation and maintenance of grounding or insulation, maintenance of electrical systems, and proper training, all of which would be incorporated into the sCO_2 Test Facility Project through implementation of existing facility safety policies, industry standard OSHA practices, and routine procedures. Project-specific safety features and policies would be developed following completion of the design phase.

Cryogenic liquids are extremely cold liquids stored at high pressure; under normal temperature and pressure, these liquids would exist in gaseous form. The liquid CO_2 used for the proposed project would be stored in this manner. Specific health hazards associated with cryogenic liquids include (University of California Riverside 2017):

- **Burns** – direct contact with the skin can lead to cold burns and frostbite. Prolonged contact may lead to blood clots.
- **Adhesion** – skin may stick to the surface of equipment and/or piping containing cryogenic liquid.
- **Boiling and splashing** may occur when a cryogenic liquid is added to a warm container.
- **Oxygen deficiency and asphyxiation** – cryogenic liquids have a large liquid-to-gas volume displacement ratio. Displacing oxygen can cause an oxygen-deficient environment.
- **Pressure and explosion** – large liquid-to-gas ratios can lead to rapid pressure changes as cryogenic liquids vaporize. These liquids may also condense moisture from the air and cause it to freeze around the opening of storage containers, blocking the opening. The buildup of trapped gases in the container can lead to an explosion.
- **Flammability and explosion** – certain cryogenic liquids are considered flammable and reactive.

Safety precautions related to the storage, handling, and use of cryogenic liquids include having a proper understanding of the behavior of and the hazards associated with the material as well as proper use of safety equipment (i.e., safety goggles, face shield, cryogen gloves) (University of California Riverside 2017). This information would be included in the hazard communication and hazardous materials general awareness training required for all facility personnel.

The potential release of CO_2 during a normal shutdown procedure (controlled release or venting) or an accidental (uncontrolled) release could result in an asphyxiation hazard for employees. The proposed onsite permanent storage of approximately 20 tons of liquid CO_2, and the potential weekly refill by tanker truck, presents additional opportunities for the leak of CO_2. This gas is colorless, odorless, and denser than air, which could lead to oxygen displacement and allow released product to pool in low-lying or below-grade areas, or accumulate in confined spaces. Concentrations of 10 percent or more may result in unconsciousness or death in less than 15 minutes. Smaller concentrations could lead to headache, sweating, rapid breathing, increased heartbeat, shortness of breath, dizziness, mental depression, visual disturbances, or shaking, but these symptoms vary by individual and depend on concentration and length of exposure (Mallinger 1996). In 2015, a total of nine workplace fatalities attributed to depletion of oxygen (i.e., asphyxiation, strangulation, suffocation) occurred in confined spaces (BLS 2017a).

SwRI would take precautions to ensure adequate ventilation and monitoring in areas containing CO_2 lines or tanks, especially near points where venting, storage, or tank refilling would occur. Specific measures planned by SwRI at this time include venting CO_2 through a vent manifold to an exhaust stack during a controlled release. Since released CO_2 may range in temperature from 0°C (32°F) to over 700°C (1,292°F), the vent stack will mix vented CO_2 with ambient air to ensure adequate oxygen content and to cool the CO_2. To account for the relative density of CO_2, the vented gas would be drawn out of the building through an

exhaust system located at a lower level (at-grade exhaust), and an elevated fan would draw ambient air into the building at a higher point.

Safety systems that SwRI plans to install in order to mitigate risk in the event of an uncontrolled release may include: 1) programming the process control system to alarm on sudden or unanticipated system pressure change; and 2) gas detection systems to monitor CO_2 and oxygen levels within the building. These systems could shut off the building heating, ventilation, and air conditioning system and activate a building purge system to pull outside air into the building to dilute the released CO_2 and flush the mixed gases out of the building. In addition, personnel would be required to don personal protection equipment to mitigate thermal burn risks from process hardware and potential CO_2 release as well as asphyxiation due to an unanticipated release. Further details regarding personal protective equipment will be determined after completion of the system design and a process hazard assessment.

Under the Proposed Action, the sCO_2 Test Facility would store either 900 gallons or 3,800 gallons (depending on the vendor selected) of aqueous ammonia in a single onsite storage tank. Exposure to aqueous ammonia from a leak during tank filling or an accidental release during site operations could cause adverse human health effects for site personnel. Health effects from this corrosive substance depend on the exposure duration, concentration, and pathway (i.e., whether the exposure occurs through inhalation of vapors or contact with the skin or eyes). However, general symptoms of inhalation potentially include a burning sensation, headache, nausea, coughing, shortness of breath, chest pain, or suffocation. Ocular contact may result in blurred vision, redness, or blindness, while symptoms of dermal contact may include irritation or burns (Contra Costa Health Services 2018).

To evaluate whether an accidental release could result in exposure to off-site receptors, DOE calculated the maximum distance to the toxic endpoint from an accidental release of aqueous ammonia. The toxic endpoint represents the distance beyond which concentrations are expected to be below the level to which nearly all individuals could be exposed for one-half to one hour without any serious health effects (USEPA 2018). The worst-case analysis is unlikely and uses very conservative assumptions including a release of the entire contents from the aqueous ammonia storage tank and unfavorable atmospheric conditions. Based on this analysis, the toxic endpoint from a worst case accidental release of aqueous ammonia would be limited to 0.4 mile from the storage tank and thus fully contained within the SwRI campus (USEPA 2018). SwRI personnel within this distance could be exposed to harmful concentrations of aqueous ammonia in the unlikely event of a worst-case release. However, all applicable SwRI personnel would receive awareness training regarding the potentially hazardous substances stored onsite and all associated hazards. In addition, personnel would routinely inspect the aqueous ammonia storage tank and associated piping, as well as perform all required and recommended maintenance activities in order to further reduce the potential for an accidental release. Further details regarding specific safety measures regarding aqueous ammonia will be determined after completion of the system design and a process hazard assessment.

Utility Lines

Construction of the proposed natural gas pipeline extension, installation of a new sanitary sewer force main, and construction of a new electrical tie-in would introduce minor potential for health and safety impacts. As with most construction activities, primary concerns for health and safety would include accidental injuries from use of heavy equipment and from slips, trips, and falls around the construction site. Similar potential for impacts to health and safety would occur during maintenance and repair activities during operation of the utility lines. All responsible utility companies would follow their respective safety protocols to protect the health and safety of their workers and the public during construction, maintenance, and repair activities.

During operation, the proposed new pipeline would transport natural gas to the facility, which could cause adverse impacts to humans and the environment if there were to be an accidental release of natural gas from

a rupture or leak of the pipeline; however, such an accident is very unlikely. Natural gas is a naturally odorless substance, but utility companies add odorant (e.g., mercaptan) to alert people to the presence of gas and the existence of a potential release. Mercaptan is a non-toxic substance with a strong smell, similar to rotten eggs, which makes it very noticeable even in small concentrations. If a natural gas leak is suspected, people should avoid the area and alert the responsible utility company.

While exposure to small amounts of natural gas is not likely to result in measurable adverse health effects, especially when in the open outdoor environment, exposure in high concentrations could cause dizziness, fatigue, nausea, headache, and irregular breathing (U.S. National Library of Medicine 2017). Further, natural gas is highly flammable and explosive, presenting additional risk of potential adverse health and safety impacts to the surrounding areas. Over recent years, consequences from ruptures of natural gas pipelines have resulted in injuries and fatalities as well as destruction of property and the environment (NTSB 2008, 2010, 2011). However, based on annualized incident rate data from the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA), the likelihood of an incident occurring on the proposed underground natural gas pipeline extension would be very unlikely. For 2016, 34 unintentional incidents (releasing a measurable volume of product) occurred along natural gas pipelines in the United States measuring 4 to 8 inches in diameter. For this same year, a total of 161,353.7 miles of natural gas pipeline measuring between 4 and 8 inches in diameter existed across the country. This resulted in 0.0002 incident per mile for 2016, or a potential likelihood of 0.00008 incident per year occurring along the proposed 0.4-mile natural gas pipeline Option #2 (PHMSA 2017a, 2017b). Natural gas pipeline Option #1 would be approximately 0.2-mile long and result in a lower potential likelihood of incident than Option #2.

The utility companies responsible for each proposed utility line would be responsible for conducting inspections, integrity management, and ensuring safe operation of the utilities in compliance with federal and state regulations. Given the very low probability of an incident occurring and the safety protocols in place, DOE assesses the overall potential for impact to human health and safety to be minor.

3.7 INFRASTRUCTURE AND UTILITIES

3.7.1 Affected Environment

3.7.1.1 Water and Wastewater

SwRI obtains water for all campus needs, including process, potable, and fire water, from three Edwards Aquifer wells that extend to depths of more than 600 feet below ground surface. The main well is the primary water source, and the two remaining wells provide backup water supply. The well water is treated (i.e., chlorinated) and stored in one of two water tanks at SwRI, depending on the water's future use. Potable and process water is stored in an approximately 417,000-gallon tank, and fire water is stored in an approximately 380,000-gallon tank. SwRI maintains the wells as a public water system (PWS) (PWS No. TX0150309) in accordance with all applicable regulations and TCEQ requirements for non-transient non-community water system (NTNC). NTNC water systems are defined as PWSs that are not a community water system and regularly serve at least 25 of the same persons at least 6 months out of the year (30 TAC 290.38(51)). The wells are operated and monitored in accordance with all TCEQ requirements for NTNC water systems, including the applicable regulations in 30 TAC 290 Subchapter D. SwRI maintains an Integrated Water Plan to detail water conservation, operation, maintenance, monitoring, and emergency preparedness of the SwRI PWS to comply with all applicable regulations and requirements (SwRI 2017b). According to the Integrated Water Plan, SwRI has a minimum water system capacity of 21.6 million gallons per month (SwRI 2017b). Currently SwRI uses an average of approximately 10.4 million gallons per month of water, with peak demand of approximately 16.9 million gallons per month.

SwRI discharges wastewater to the San Antonio Water System (SAWS). SAWS is a publicly owned treatment works owned by the City of San Antonio that provides water supply and wastewater management. SAWS serves more than 1.6 million people in Bexar County, as well as parts of Medina and Atascosa counties. SAWS manages more than 12,000 miles of water and sewer mains buried under more than 560 square miles of coverage area (SAWS 2017a). SAWS maintains the following three water recycling centers: Dos Rios Water Recycling Center, Leon Creek Water Recycling Center, and Medio Creek Water Recycling Center. The wastewater flows from SwRI to the SAWS Leon Creek Water Recycling Center for treatment. Leon Creek Water Recycling Center treats wastewater with an average daily flow of 33.1 million gallons per day, a permitted annual average flow of 46 million gallons per day, and a 2-hour peak flow of 92 million gallons per day (SAWS 2017b). SAWS aging water and wastewater infrastructure is nearing the end of its useful life, so SAWS is undertaking a comprehensive Capital Improvement Program to meet the city's long-term needs (SAWS 2017a).

SwRI maintains an Industrial Wastewater Permit (No. HV-17484) with SAWS. The permit authorizes discharges of non-categorical process and/or sanitary effluent and provides pretreatment requirements, discharge prohibitions, and discharge limits for concentrations of certain contaminants in industrial wastewater. SwRI has three monitoring points that are sampled on a quarterly basis. The Industrial Wastewater Permit does not permit the discharge of stormwater, surface water, subsurface drainage, or groundwater to the sanitary sewer system, unless authorized by SAWS (SAWS 2017c).

3.7.1.2 Stormwater

Stormwater management systems provide the benefit of reducing amounts of sediments and other contaminants that would otherwise flow directly into surface waters. Nonpoint pollutant loading comprises a wide variety of sources not subject to point source control via National Pollutant Discharge Elimination System (NPDES) permits. The most significant nonpoint sources are those associated with precipitation, runoff, and erosion, which may move pollutants from the land surface to waterbodies.

The TCEQ was delegated the authority by the USEPA through the NPDES to implement requirements pertaining to the prevention of stormwater pollution. TCEQ delegated enforcement of these requirements

to local Municipal Separate Storm Sewer Systems (MS4). In San Antonio, the MS4 is SAWS. The TCEQ Texas Pollutant Discharge Elimination System (TPDES) program has federal regulatory authority over discharges of pollutants to Texas surface water, with the exception of discharges associated with oil, gas, and geothermal exploration and development activities, which are regulated by the Railroad Commission of Texas.

SwRI is authorized for coverage (TXR15MW11, May 2013) under a TPDES General Permit (TXR150000), issued February 19, 2013 from TCEQ for construction stormwater. The TPDES General Permit provides eligible discharges, discharge authorization procedures, and other provisions to ensure that discharges do not impact water quality or human health. In accordance with the TPDES General Permit, SwRI maintains a Construction SWPPP that covers all construction activities within the SwRI campus. The SWPPP outlines pollution controls for various anticipated construction activities for SwRI. The pollution controls are site-specific and based on the judgement and direction of SwRI's Facilities Engineering and/or Environmental and Safety Systems departments and the designer (SwRI 2017c).

SwRI's SWPPP describes potential pollutants and sources associated with construction activities at SwRI including soil erosion; oil, grease, fuel, or hydraulic fluid contamination from construction equipment or vehicles; miscellaneous general waste; unused paints, solvents, sealants, or miscellaneous chemicals; and construction debris. The SWPPP outlines overall SwRI BMPs to minimize the possibility of adverse impacts on water quality during construction, including permanent onsite basins to provide a means of retention, detention, and distribution of stormwater. SwRI also maintains vegetation throughout the campus to provide sediment removal and maximize stormwater infiltration. In accordance with the SWPPP, SwRI maintains a 100-foot vegetation buffer zone from critical areas, including the tributary of Leon Creek. If a project cannot avoid the buffer zone, then supplemental temporary BMPs would be used to protect the critical area (e.g., silt fencing). The SWPPP details erosion control and stabilization measures, including temporary and permanent control measures and practices. Temporary controls include covering exposed native soil in heavy traffic areas, placing structural erosion controls, and protecting established natural vegetation areas. Permanent stormwater controls include flow diversion mechanisms, sod and vegetation stabilization, slope texturing and stabilization, the three existing detention basins at SwRI, and the regional stormwater detention area along Leon Creek (SwRI 2017c).

3.7.1.3 Electricity

CPS Energy currently provides electricity to SwRI. CPS Energy is the nation's largest municipally owned energy utility providing both natural gas and electric service to Bexar County and portions of its seven surrounding counties. CPS Energy serves more than 800,000 electric customers (CPS Energy 2017a) with approximately 7,866 miles of overhead electrical lines, 5,476 miles of underground lines, and 1,530 miles of transmission lines, and has more than 8,000 megawatts (MW) of generation capacity (CPS Energy 2017b). CPS Energy has a diverse fuel mix, including nuclear power, coal, natural gas, and renewable energy. Currently SwRI uses approximately 10,484 megawatt-hours (MWh) of electricity per month, with peak demand of approximately 13,106 MWh per month.

3.7.1.4 Natural Gas

CPS Energy currently provides natural gas to SwRI. See Section 3.7.1.3 for more background about CPS Energy which serves more than 343,000 natural gas customers (CPS Energy 2017a) with approximately 5,515 miles of natural gas distribution mains and 89 miles of transmission mains (CPS Energy 2017b). In 2016, CPS Energy provided a total of approximately 21.5 billion cubic feet of natural gas to residential and commercial customers (CPS Energy 2017b). Currently SwRI uses approximately 15.2 million cubic feet per month of natural gas, with a maximum of 23.6 million cubic feet per month.

3.7.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. Implementation of the No-Action Alternative would result in no increased potential for adverse impact to infrastructure and utilities, and existing conditions would remain unchanged.

3.7.3 Proposed Action – Environmental Consequences

3.7.3.1 Water and Wastewater

Negligible adverse impacts are expected during construction. It is assumed that potable water would be provided by the construction contractor or construction workers would bring their own bottled water. It is also expected that temporary portable toilets would be provided by commercial services for use by the construction workers.

Once operational, the sCO_2 test turbine building would use potable water for the seven employees working each shift. Water would be supplied by the SwRI well system. During any given shift, the seven employees onsite could use approximately 210 gallons per day or 4,515 gallons per month of water for drinking, sink usage, and toilet use, assuming approximately 30 gallons per day per person at the workplace (USGS 2017). Operation of the sCO_2 Test Facility would require approximately 360,000 gallons per month of water for testing operations. Primary water demand would be for process cooling using a cooling tower. Water demand from the sCO_2 Test Facility would result in an approximately 3.5 percent increase in water usage compared to existing SwRI usage. The increase in water usage would have negligible impacts on the SwRI well system's ability to provide water for the SwRI campus.

The sCO_2 Test Facility would discharge approximately 60,000 gallons per month of wastewater for testing operations. This discharge would result in an approximately 1 percent increase in wastewater discharged to SAWS. The increase in wastewater to SAWS would represent a small amount of additional flow compared to the existing campus discharge and would be within the discharge limitations of the Industrial Wastewater Permit; as a result, negligible impacts are anticipated. Wastewater from the sCO_2 Test Facility would be discharged directly from the cooling tower. The cooling tower provides non-contact cooled water to the process (i.e., closed loop). The cooling tower would use typical chemicals to maintain water quality, proper scale, microbiological, and corrosion control (e.g., sulfuric acid, water treatment chemical additives, biocides). The cooling tower would be operated similarly to the existing process cooling towers at SwRI and the wastewater would be discharged to SAWS in accordance with SwRI's current Industrial Wastewater Permit (HV-17484). SwRI would notify SAWS of the new source of wastewater discharge and update the Slug Control Plan.

3.7.3.2 Stormwater

In accordance with the existing TPDES permit, the existing SWPPP described in Section 3.7.1.2 would be used for construction of the proposed project. SwRI submitted a NOI for the overall SwRI campus which covers the proposed project construction. SwRI would follow all applicable permit requirements, such as posting the existing large construction site notice. Construction would involve clearing, grading, and excavation, which would disturb soils causing a temporary increase in soil erosion and stormwater runoff and result in negligible to minor impacts. Earth-disturbing activities during construction would be managed to reduce stormwater runoff using control measures and BMPs described in Section 3.7.1.2. BMPs could include covering exposed soils in heavily trafficked areas; placing structural erosion controls where necessary; and designating and protecting established/existing vegetation buffer areas (i.e., trees, shrubs, and natural vegetation), to the extent practicable (SwRI 2017c).

The proposed sCO_2 Test Facility Project would result in a conversion of up to 10.74 acres of existing vegetated land to developed, impervious and pervious surface for operations. To address the potential

change in stormwater volume and flow during operations, SwRI completed a stormwater evaluation of the proposed project. The evaluation determined that the proposed project would slightly increase the runoff volume but would also decrease the peak flow. This change in stormwater flow and volume would result in a minor impact to stormwater discharge.

During operations, stormwater would be managed and mitigated with low-impact development (LID) features incorporated into facility design. To the extent practicable, stormwater discharges from the proposed project would be retained using onsite LID features to minimize potential impacts to downstream receptors, such as the nearby tributary. Onsite LID features could include a combination of filter strips, bioswales, and small-scale infiltration features, such as planter boxes or rain gardens. In addition, a 100-foot buffer of existing vegetation would be maintained between the proposed project and the nearby tributary. These LID features would be designed to provide water quality treatment and infiltration of the proposed project stormwater runoff prior to discharge to the nearby tributary. The exact LID features would be determined during final project design.

3.7.3.3 Electricity

Negligible adverse impacts are expected during construction since it is assumed that electrical power would be provided by portable generators until construction of electrical infrastructure is completed and operational.

Operation of the sCO_2 Test Facility would tie into existing SwRI electrical infrastructure at an existing manhole within the proposed project area. No significant updates to the SwRI campus electrical system outside of the proposed project footprint are anticipated. As discussed in Section 2.4.3, the proposed project would derive its electrical supply from a 15-kV circuit. The circuit would be routed from the sCO_2 Test Facility in a new underground duct bank to an existing manhole located within the proposed project area to the south of 4th Street. From the manhole, new cabling would run through the existing duct bank to an existing junction cabinet. Since the new electrical infrastructure would be constructed within the proposed project disturbance area, no disturbance outside of the proposed project area would be required for the electrical supply line.

Backup power during operations would be provided by two 500-kV diesel generators. SwRI would either use existing campus generators or purchase new generators for the sCO_2 Test Facility. Use of the generators would be limited to backup power during an outage and periodic testing and maintenance of the generators.

The sCO_2 Test Facility is projected to use approximately 2,400 MWh per month of electricity. The demand for the sCO_2 Test Facility would result in an approximately 20 percent increase in electrical usage compared to existing SwRI usage, but would represent only a small demand increase on CPS Energy's current generating and distribution capacity of electricity. Therefore, it is expected that the proposed project would not have an impact on CPS Energy's ability to provide electrical service to its customers.

Operation of the sCO_2 Test Facility would generate electrical energy. During the Simple Cycle Test phase approximately 5 MWe would be generated and sent to a load bank to dissipate the electrical load. During the RCBC Operations Test phase, at least 10 MWe would be generated and ultimately used by the SwRI campus by the end of the proposed project. Use of self-generated energy could result in a net benefit to the SwRI campus through reduced use to the utility company to support campus needs.

3.7.3.4 Natural Gas

As part of the sCO_2 Test Facility Project, SwRI would construct a new 4- or 8-inch diameter natural gas pipeline extension to connect the proposed project to an existing natural gas pipeline. The size, type, and pressure rating of the pipeline would depend on final project design and vendor selection, but it would meet

all applicable American Society for Testing and Materials standards. The anticipated operating pressure of the new natural gas line extension during the 3-year test period would be 95 psig.

Negligible impacts to natural gas usage and supply would be expected during construction. During operations, natural gas would be required to fuel the primary heater of the sCO2 Test Facility. No natural gas would be required for facility climate control since it would be provided by Direct Expansion cooling and heat pumps. The sCO2 Test Facility is projected to use approximately 5,600 to 11,000 pounds per hour of natural gas. Using the 60°F and 14.7 pounds per square inch absolute as "standard" conditions, this is a maximum volumetric flow of approximately 208,670 cubic feet per hour, which equates to 20.8 million cubic feet per month. The demand for the sCO2 Test Facility would represent an approximately two-fold increase over SwRI's current natural gas usage. Although this represents a significant increase in natural gas usage at SwRI, it represents a small demand increase to CPS Energy's current capacity of natural gas. Since the proposed project would operate at the analyzed capacity for the 3-year test period, it is expected that the proposed project is not expected to affect CPS Energy's ability to provide natural gas to customers.

3.8 WATER RESOURCES

3.8.1 Water Resources Overview

3.8.1.1 Surface Water, Surface Water Quality, and Floodplains

Surface Water

Surface water systems are typically defined in terms of watersheds. A watershed divides the landscape into hydrologically defined areas in which the biotic and abiotic components interact. The watershed boundary generally follows the drainage divide or the highest ridgeline around the stream channels, which meet at the bottom or lowest point of the land where water flows out of the watershed, commonly referred to as the mouth of the waterway. Any activity that affects water quality, quantity, or rate of movement at one location within a watershed has the potential to affect the characteristics of locations downstream. The proposed project falls within the Medina (hydrologic unit code (HUC) 8: 12100302) and San Antonio (HUC6: 121003) watersheds. Figure 2-2 depicts the water features in the project area.

Under the CWA, the USACE regulates "waters of the U.S." because they are important for the preservation of navigable waterways and interstate commerce. Waters of the U.S. include all navigable waterways and their tributaries, as well as wetlands adjacent to and with a significant nexus (connected) to those navigable waterways and tributaries.

An unnamed perennial reservoir and an intermittent tributary of Leon Creek are the only two surface waterbodies that are located within 0.5 mile of the project area. The unnamed reservoir is an existing SwRI test facility (i.e., not a body of water) that encompasses approximately 0.92 acre and is located approximately 0.47 mile from the proposed sCO_2 Test Facility. The tributary of Leon Creek traverses north-south through the SwRI campus to its intersection with Leon Creek south of Highway 151. It is located on adjacent property to the proposed sCO_2 Test Facility Project and does not fall within the proposed project area. A *Jurisdictional Waters of the United States Wetland Determination and Delineation* was completed to support planned infrastructure upgrades at SwRI. Refer to Section 3.9, *Cumulative Effects*, for additional details about the infrastructure upgrades. Completed on October 23, 2017, the survey included an evaluation of a portion of the proposed project area for wetlands and jurisdictional waters of the U.S. The survey determined that the nearby tributary of Leon Creek is considered a jurisdictional water of the U.S. under the USACE classification (Medina Consulting Company, Inc. 2018). Leon Creek traverses through northwestern Bexar County through western portions of San Antonio into its mouth on the Medina River, just west of Cassin, Texas. Leon Creek traverses flat and gently rolling terrain surfaced by clay loam that supports mesquite, liveoak, cacti, and grasses (TSHA 2017).

The National Wild and Scenic Rivers Act was created by Congress in 1968 (16 USC 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and/or recreational values in a free-flowing condition for the enjoyment of present and future generations. Based on a review of the National Wild and Scenic Rivers database, there are no natural or scenic rivers within or adjacent to the SwRI campus.

Surface Water Quality

Water quality standards are issued by TCEQ and the USEPA under the Federal Safe Drinking Water Act and the CWA. Section 303(d) of the CWA requires states to identify and develop a list of impaired waterbodies where technology-based and other required controls have not provided attainment of water quality standards. Section 305(b) of the CWA requires states to assess and report the quality of their waterbodies. The state of Texas has combined its 303(d) and 305(b) lists into one report referred to as the *Texas Integrated Report of Surface Water Quality*.

This report details the quality of water in the streams, lakes, and reservoirs of all major river basins in the state, identifies those waterbodies that are impaired and do not meet designated uses, and establishes total maximum daily loads (TMDLs) for the pollutants of concern.

Leon Creek is an intermittent stream that is included in the *2014 Texas Integrated Report of Surface Water Quality*. Leon Creek is impaired for dissolved oxygen and polychlorinated biphenyls in fish tissue (USEPA 2010). No TMDLs are currently available for this waterbody. Leon Creek has nine discharges regulated by permits (e.g., NPDES permits) for the military activities, wastewater treatment plant, steam electric power plant, and research activities.

Floodplains

Surface waters (such as streams and creeks) that are periodically subject to flooding during intervals of overbank flow create a relatively broad and flat valley area immediately adjacent to the waterbody known as a floodplain. Floodplains are divided into two types: 100-year floodplains and 500-year floodplains. The 100-year floodplain is regulated by the Federal Emergency Management Agency (FEMA) and is defined as typically dry land that has a 1 percent chance of flooding each year; the 500-year floodplain is defined as land that has a 0.2 percent chance of a flooding each year (FEMA 2017a).

EO 11988, Floodplain Management, directs federal agencies to avoid, to the extent possible, adverse impacts associated with the modification of floodplains and to avoid support of floodplain development when there is a practicable alternative. The EO specifies that, in situations where alternatives are impractical, the agency must minimize potential harm to or within the floodplain and take appropriate steps to notify the public.

Floodplain review is achieved through the CWA Section 401/404 permit process. Permit decisions are made by the USACE in conjunction with the involved state, in this case with TCEQ. Applicants for a Section 404 permit are required to obtain Section 401 Water Quality Certification from the TCEQ. As part of the Section 404 permitting process per 33 CFR Part 320.4(l)(2) and 33 CFR Part 320.4(l)(3), USACE is to consider in its approval decision impacts associated with the modification of floodplains and avoid such impacts to the extent practicable.

The sCO_2 Test Facility located at SwRI in San Antonio, Bexar County, Texas is within Zone X, Area of Minimal Flood Hazard (FEMA 2017b). A small portion of the western edge of the SwRI property is within the 100-year floodplain, but it is not located on or near the proposed project area, which is approximately 0.27 mile from the 100-year floodplain. There are no 500-year floodplains within SwRI.

3.8.1.2 Groundwater

The Edwards Aquifer serves as the source of groundwater for SwRI. The Edwards Aquifer is an underground layer of porous, honeycombed, water-bearing rock that is between 300 and 700 feet thick. It is a highly productive karst aquifer made up of Edwards Group limestones.

Recharge to the aquifer is primarily from local precipitation and percolation into the aquifer. But recharge also occurs as stream flow through the recharge zone. The recharge zone is an area of highly faulted and fractured Edwards limestone outcrop at the land surface, allowing large quantities of water to flow into the aquifer. For this reason, the Edwards Aquifer is called a fault-zone aquifer (Edwards Aquifer 2017).

The TCEQ Edwards Aquifer Protection Program establishes Edwards Aquifer protection plans, maps, rules, and technical guidance in accordance with 30 TAC 213, which regulates activities that have the potential to pollute the Edwards Aquifer. SwRI is located outside of the regulated zone of the Edwards Aquifer and is south of the boundary of the Edwards Aquifer Transition Zone (TCEQ 2018). SwRI's location provides hydrological barriers to reduce the downward migration of surface water to the Edwards Aquifer.

The USEPA defines a Sole Source Aquifer as an aquifer that supplies at least 50 percent of the drinking water for its service area. USEPA guidelines also require that these areas have no reasonably available alternative drinking water source(s) should the aquifer become contaminated. After a Sole Source Aquifer is designated, no commitment for federal financial assistance may be provided for any project which the USEPA determines may contaminate the aquifer through its recharge area so as to create a significant hazard to public health. USEPA mapping depicts the portion of the Edwards Aquifer designated as a Sole Source Aquifer to the north and northwest of the City of San Antonio (USEPA 2017c).

The 1986 amendments to the Safe Drinking Water Act established requirements for states to develop a Wellhead Protection Program to protect drinking water wells and drinking water recharge areas. The Texas Groundwater Protection Committee, composed of nine state agencies and organizations, prepared the Texas Groundwater Protection Strategy in 1988 and revised it in 2003. Additionally, the SAWS has a Source Water/Wellhead Protection Program to provide groundwater protection.

SwRI obtains water from three Edwards Aquifer wells with depths of more than 600 feet below ground surface. The main well is the primary water supply well for SwRI, and the two remaining wells provide backup water. The well water is treated and used for all potable, process, and fire water needs on the SwRI campus. Refer to Section 3.7.1.1 for more information about well water usage at SwRI. SwRI stores potable and process water in a 417,000-gallon tank and fire water in a 380,000-gallon tank. Backflow prevention is used throughout the campus to protect the water supplies from contamination due to backflow.

3.8.1.3 Wetlands

As described in Section 3.8.1.1, regulated wetlands are referred to as "waters of the U.S." under the CWA. Wetlands are afforded regulatory protection under Section 404 of the CWA and EO 11990, Protection of Wetlands, because they serve many beneficial functions, including the storage and slow release of surface water, rain, snowmelt, and seasonal floodwaters to surface waters. Additionally, wetlands provide wildlife habitat, stabilize/retain sediment, and perform an important role in the nitrogen cycle. They also help to maintain stream flow during dry periods and provide groundwater recharge functions. Wetlands are among the most productive ecosystems in the world, comparable to rain forests and coral reefs. Many species of wildlife, including a large percentage of threatened and endangered species, depend on wetlands for their survival.

Review of current National Wetland Inventory mapping indicates no wetlands within the proposed project area, but there are three wetland resources within 0.5 mile of the proposed project area. These three wetlands encompass 1.80 acres and are classified as freshwater ponds, though one wetland area is co-located with the existing unnamed SwRI test facility reservoir, which is not a body of water. The USFWS publishes National Wetland Inventory mapping based on remote sensing (e.g., aerial photography and soil mapping) and minor components of field verification.

A *Jurisdictional Waters of the United States Wetland Determination and Delineation* was completed on October 23, 2017 to support planned infrastructure upgrades at SwRI. Refer to Section 3.9, *Cumulative Effects*, for additional details about the infrastructure upgrades. The survey included an evaluation of a portion of the proposed sCO_2 Test Facility project area for wetlands and jurisdictional waters of the U.S. The survey determined that there are no wetlands present and the survey area does not exhibit the criteria required to designate an area as jurisdictional wetlands (Medina Consulting Company, Inc. 2018). The survey considered the three indicator criteria that must be present to be considered wetlands by the USACE which include a prevalence of hydrophytic (water loving) plant species, hydric soils, and wetlands hydrology.

3.8.2 No-Action – Environmental Consequences

Under the No-Action Alternative, construction of the Proposed Action would not occur, and the sCO_2 Test Facility Project would not take place at SwRI. Implementation of the No-Action Alternative would result in no increased potential for adverse impact to water resources and existing conditions would remain unchanged.

3.8.3 Proposed Action – Environmental Consequences

3.8.3.1 Surface Water, Surface Water Quality, and Floodplains

The proposed sCO_2 Test Facility Project would result in negligible to minor impacts to surface water, surface water quality, and floodplains. Minor adverse impacts to surface water and surface water quality and negligible adverse impacts to floodplains would be expected during construction and operations.

The proposed project area is adjacent to the intermittent tributary of Leon Creek which is considered a jurisdictional water of the U.S. (see Figure 2-2). No other water resource features are present in the proposed project area. To minimize potential impacts to this intermittent tributary, SwRI would maintain a minimum 100-foot vegetation buffer during construction. Construction activities would consist of clearing vegetation, grading, and leveling, which would result in the disturbance and exposure of soils (see more information in Section 3.5, *Geology and Soils*). Exposed soils would be more susceptible to erosion from stormwater runoff, which could result in increased sedimentation from runoff and turbidity to receiving waterbodies. However, SwRI would maintain compliance with the existing SWPPP and implement construction BMPs for erosion control, such as covering exposed soils in heavily trafficked areas, placing structural erosion controls where necessary, and designating and protecting established/existing vegetation (i.e., trees, shrubs, and natural vegetation) buffer areas (e.g., the 100-foot buffer zone from the tributary of Leon Creek), to the extent practicable. Additionally, compliance with the SWPPP would minimize any potential surface water contamination related to hazardous material spills that could occur during construction. Refer to Section 3.7.1.2 for more information about the SWPPP and construction BMPs. With implementation of BMPs as a condition of the SWPPP, it is anticipated that construction impacts to surface waters and surface water quality would be temporary and minor.

Upon completion of construction, it is expected that disturbed areas not converted to workspace for the proposed project would be revegetated to reduce or eliminate any long-term effects to water quality. Potential operational impacts to surface water resources would largely be limited to increases in stormwater runoff from new impervious cover. As discussed in Section 3.7.3.2, stormwater would be managed and mitigated with LID features incorporated into facility design to reduce peak runoff and reduce pollutant runoff (e.g., small-scale infiltration features, such as planter boxes or rain gardens). Adherence to applicable laws, regulations, and BMPs would also help to avoid or minimize potential adverse operational impacts to surface waters. BMPs would include maintaining all equipment and vehicles to reduce leakage, adhering to loading/unloading precautions, and maintaining the minimum 100-foot buffer to the adjacent tributary. With adherence to the SwRI's SWPPP and SPCC Plan, spills associated with the handling or use of hazardous materials (e.g., vehicle fuel, oils and lubricants, etc.) would be potentially avoided, or minimized and quickly contained. Therefore, minor adverse impacts to surface water resources and surface water quality would be anticipated during operations.

As discussed in Section 3.8.1.1, the proposed project area is located in an area of minimal flood hazard and does not fall within or near the closest 100-year floodplain. As a result, impacts to floodplains due to construction and operation of the sCO_2 Test Facility would be negligible.

3.8.3.2 Groundwater

The proposed sCO_2 Test Facility project would result in negligible impacts to groundwater from construction and operations. As discussed in Section 3.8.1.2, SwRI is located outside of the regulated zone

of the Edwards Aquifer. SwRI's location provides hydrological barriers to reduce the downward migration of surface water to the Edwards Aquifer. As a result, the proposed project is not anticipated to impact the Edwards Aquifer.

During construction, there would be minor potential for groundwater contamination to occur from the operation and maintenance of construction vehicles and equipment (e.g., accidental fuel spills). The potential for contamination to occur would be minimized through implementation of SwRI's SWPPP and SPCC Plan. Any potential impacts associated with leaking of substances (i.e., fuels, oils, and other lubricants) into soils and entering groundwater aquifers would be avoided through the use of BMPs to prevent spills and leaks; therefore, negligible adverse impacts would be anticipated.

Operation of the sCO_2 Test Facility would increase the water usage at SwRI, resulting in an increase in water demand from SwRI's wells. SwRI would continue to maintain the wells in accordance with all TCEQ requirements for NTNC water systems and would maintain operations in accordance with SwRI's Integrated Water Plan. As discussed in Section 3.7.3.1, the increase in water demand would have negligible impacts on SwRI well's ability to provide water for the SwRI campus and is not anticipated to impact the Edwards Aquifer.

3.8.3.3 Wetlands

As discussed in Section 3.8.1.3, a *Jurisdictional Waters of the United States Wetland Determination and Delineation* was completed on October 23, 2017 and determined that there are no wetlands present within or adjacent to the proposed project area. As a result, construction and operation of the proposed sCO_2 Test Facility would have no impact on wetlands.

3.9 CUMULATIVE EFFECTS

As defined by CEQ, cumulative effects are those that "result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions, without regard to the agency (federal or non-federal) or individual who undertakes such other actions" (40 CFR 1508.7). Cumulative effects analysis captures the effects that result from the Proposed Action in combination with the effects of other actions taken during the duration of the Proposed Action at the same time and place. Cumulative effects may be accrued over time and/or in conjunction with other pre-existing effects from other activities in the area (40 CFR 1508.25); therefore, pre-existing impacts and multiple smaller impacts should also be considered. Overall, assessing cumulative effects involves defining the scope of the other actions and their interrelationship with the Proposed Action to determine if they overlap in space and time.

The NEPA and CEQ regulations require the analysis of cumulative environmental effects of a Proposed Action on resources that may often manifest only at the cumulative level. Cumulative effects can result from individually minor, but collectively significant actions taking place at the same time, over time. As noted above, cumulative effects are most likely to arise when a Proposed Action is related to other actions that could occur in the same location and at a similar time.

3.9.1 No-Action – Environmental Consequences

Implementation of the No-Action Alternative would result in no increased potential for adverse cumulative impacts. Construction of the Proposed Action would not occur, the sCO_2 Test Facility would not take place at SwRI, the proposed project disturbance area and construction laydown area would not be cleared of vegetation, and the proposed utility lines (natural gas line, water line) would not be constructed to support the proposed project. As such, the No-Action Alternative would not contribute to cumulative effects within the SwRI campus or the City of San Antonio.

3.9.2 Proposed Action – Environmental Consequences

This section identifies reasonably foreseeable projects that may have cumulative, incremental impacts in conjunction with the Proposed Action.

Future Operation of the sCO_2 Test Facility

As described in Section 2.4.5, the sCO_2 Test Facility could be used after the 3-year test period is complete. Operation of the sCO_2 Test Facility beyond the test period could be for the following long-term testing needs:

- Endurance testing of the system as installed
- Reconfiguration into a new cycle configuration
- Demonstration of thermal storage systems
- Demonstration of new hardware and components in a recompression cycle configuration
- Control system operational testing

The sCO_2 Test Facility would be designed to be reconfigurable to accommodate future testing needs. Currently, there are no plans to remove hardware unless required to support future testing. If future testing requires large hardware replacement, then it is assumed that construction equipment would be used to support the replacement and reconfiguration activities within the proposed sCO_2 Test Facility project area analyzed in this EA.

Future operation of the sCO_2 Test Facility at SwRI would result in similar operational impacts discussed in Chapter 3 of this EA.

Future Planned Projects at SwRI

SwRI conducts a variety of research in many different disciplines (see Section 2.4.1). Currently, there no known reasonably foreseeable construction projects for new research projects planned at SwRI. Depending on future opportunities, SwRI could obtain the necessary funding to pursue projects that would involve planned construction and future operations, but currently there are no future projects to consider for the cumulative effects analysis.

Infrastructure Projects

SwRI completes infrastructure upgrades to maintain the existing infrastructure and support potential future growth opportunities. Currently, SwRI has the following infrastructure projects planned and funded for fiscal year 2018. Overall, implementation of the infrastructure projects would have negligible to minor cumulative impacts in conjunction with the Proposed Action. Figure 3-1 presents the future projects at SwRI evaluated for cumulative effects.

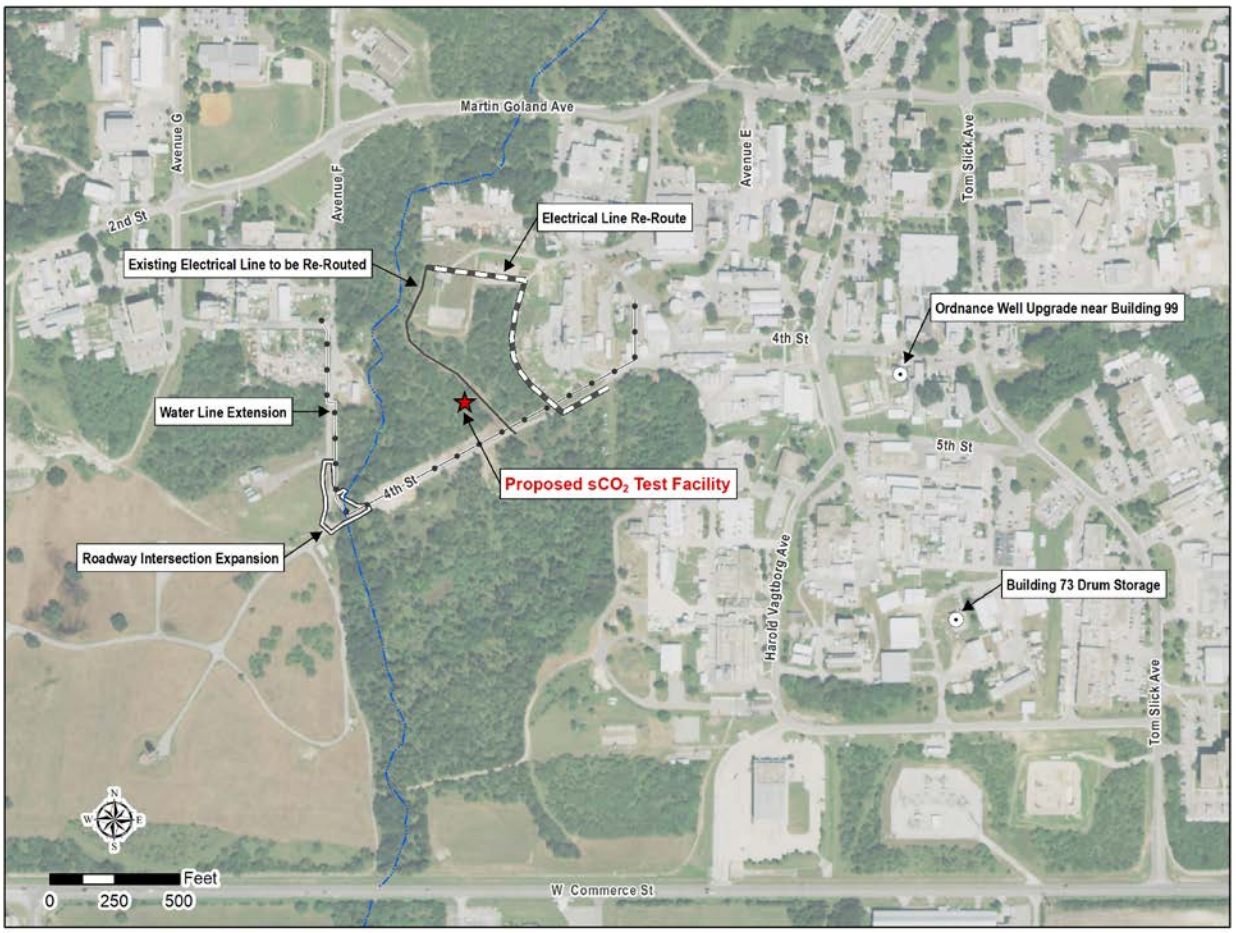

Figure 3-1. Future SwRI Projects Analyzed for Cumulative Impacts

Water Line Extension

SwRI is planning to complete a water line update that would provide a redundant subgrade water loop in the western area of campus. The water line update would facilitate and support the needs of potential future

projects at SwRI. Construction of the new water line extension is an existing planned project by SwRI and would occur without implementation of the Proposed Action. A new 8-inch water line would be constructed along Avenue F to connect to an existing 8-inch SwRI water supply line. The new water line would traverse south along Avenue F from the intersection near Building 182 to the intersection of 4th Street, continue along 4th Street to the northeast, and connect to the existing line near Building 91 to the east of the proposed project area (refer to Figure 3-1). The 8-inch water line extension is estimated to be approximately 0.43 mile in length. SwRI anticipates that trenching techniques would be used to install the new 8-inch water line. The analysis conservatively assumed that construction of the new water line update would require a 4-foot trench depth, a 30-foot wide construction ROW, and a 20-foot wide operational ROW.

Construction of the water line extension would occur in conjunction with the roadway intersection expansion in Spring 2018. The route for the water line extension would be primarily located along existing utility corridor to reduce disturbance to undeveloped land, to the extent practicable. The route would cross a portion of undeveloped land containing vegetation, trees, and a tributary that intersects 4th Street at an existing culvert crossing. Refer to Figure 3-1 to view the location of the tributary.

To support the water line extension and roadway intersection expansion, SwRI completed a *Jurisdictional Waters of the United States Wetland Determination and Delineation* report dated January 15, 2018. The field survey described in the report was completed on October 23, 2017 and evaluated an approximately 15.28-acre area containing the tributary of Leon Creek, the planned water line and roadway infrastructure upgrades, and a portion of the proposed project area for the proposed sCO_2 Test Facility. The survey included an evaluation of the survey area for wetlands and jurisdictional waters of the U.S, including a consideration of vegetation, soils, and floodplains. The survey report describes the project location, applicable regulations, field survey results, and conclusions. The survey determined that the tributary of Leon Creek is considered a jurisdictional water of the U.S. under the USACE classification. The survey also determined that there are no wetlands present, based on the criteria required to designate an area as a jurisdictional wetland (Medina Consulting Company, Inc. 2018). Refer to Section 3.8.1.3 for more information about the evaluation of wetlands.

Minor adverse impacts to the tributary of Leon Creek would occur due to construction of the water line extension. Since the survey determined that the tributary of Leon Creek is jurisdictional, the ordinary high water mark was delineated to calculate the potential impacts to the tributary. The USACE defines the ordinary high water mark for purposes of the CWA as "that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas" (33 CFR 328.3(e)).

Based on the survey report, a total of 0.01 acre of the tributary, considered a jurisdictional water of the U.S., would be impacted by the water line extension and roadway intersection expansion (discussed below). As a result, construction of the new water line extension would fall within an USACE Nationwide Permit (NWP). A NWP is a general permit that authorizes certain activities (e.g., utility lines, road crossings, etc.) that have minimal individual and cumulative adverse environmental effects as determined by the USACE. Construction of the water line extension at SwRI would fall within NWP 12 for "utility line activities." The NWP 12 is applicable to activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the U.S., provided the activity does not result in a loss of greater than 0.5 acre of water of the U.S. for each single and complete project. SwRI would construct the water line extension in accordance with all applicable requirements and regulations including restoring the affected area to pre-construction elevations and contours. The NWP 12 stipulates that pre-construction notification must be submitted to USACE prior to commencing the activity only if certain criteria thresholds are met, such as discharges that result in the loss of greater than 0.1 acre of waters of the U.S., or a utility

line in waters of the U.S. that exceeds 500 feet. Based on the field survey, a total of 0.01 acres would be impacted by the water line extension and roadway intersection expansion, which is below the thresholds for the NWP 12. SwRI would maintain compliance with the specifications provided in the NWP 12, including managing the water line extension such that it does not trigger any pre-construction notification requirements.

Overall, the water line extension would result in temporary, minor cumulative impacts during construction to air quality, noise, transportation and traffic, biological resources, soils, and water resources. Potential effects to the tributary during construction would be minor as SwRI would manage construction according to the NWP 12 and existing SwRI policies (e.g., SWPPP). Operation of the water line extension would have negligible cumulative impacts.

Roadway Intersection Expansion

SwRI would complete a roadway intersection expansion at Avenue F and 4th Street. The expanded roadway intersection would facilitate and support the needs of potential future projects at SwRI within the western area of the SwRI campus. Construction would involve clearing of some vegetation and tree removal, grading, modification of the existing culvert to handle drainage flows, and installation of asphalt pavement to align with the existing paved roadway.

The expansion of the roadway intersection would result in temporary closure of Avenue F. Personnel requiring access to nearby buildings would utilize other existing routes. Since access to 4th Street is currently restricted between Avenue F and Building 90, SwRI would maintain the limited access during construction.

Construction of the roadway intersection expansion would occur in conjunction with the water line extension in Spring 2018, both of which would cross a portion of undeveloped land containing vegetation, trees, and a tributary that intersects with 4th Street at an existing culvert crossing. To support the roadway intersection expansion, SwRI completed a *Jurisdictional Waters of the United States Wetland Determination and Delineation* report dated January 15, 2018. As stated in to the *Water Line Extension* discussion above, the survey determined that the tributary of Leon Creek is considered a jurisdictional water of the U.S. under the USACE classification and that a total of 0.01 acre of the tributary would be impacted by the roadway intersection expansion and water line extension.

Construction of the roadway intersection expansion would fall within a NWP 14 for linear transportation projects. The NWP 14 is applicable to activities required for the construction, expansion, modification, or improvement of linear transportation projects (e.g., roads, highways, railways, trails, airport runways, and taxiways) in waters of the U.S. For linear transportation projects in non-tidal waters, the discharge cannot cause the loss of greater than 0.5 acre of waters of the U.S. and in tidal waters, the discharge cannot cause a loss of greater than 0.33 acre of waters of the U.S. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. The NWP 14 stipulates that pre-construction notification must be submitted to USACE if the loss of waters of the U.S. exceeds 0.1 acre or there is a discharge in a special aquatic site, including wetlands. Based on the field survey, a total of 0.01 acre would be impacted by the roadway intersection expansion and water line extension, which is below the thresholds for the NWP 14. SwRI would maintain compliance with the specifications provided in the NWP 14, including managing the roadway intersection expansion such that it does not trigger any pre-construction notification requirements.

Overall, the roadway intersection expansion would result in temporary, minor cumulative impacts during construction to air quality, noise, biological resources, transportation and traffic, soils, and water resources. Potential effects to the tributary during construction would be minor as SwRI would manage construction

according to the NWP 14 and existing SwRI policies (e.g., SWPPP). Operation of the expanded roadway intersection would have negligible cumulative impacts.

Electrical Line Re-Route

SwRI plans to re-route an existing underground 5-kV electrical line currently located along the gravel access road that traverses diagonally across the proposed sCO_2 Test Facility project area (refer to Figure 3-1). With the increase in development in the western portion of SwRI currently and in the foreseeable future, SwRI determined the need to relocate the line. The new electrical line would connect to an existing electrical box located in the eastern portion of 4th Street and traverse along 4th Street, then follow the perimeter fence line north to an existing step-down transformer at Building 245 (refer to Figure 3-1).

The existing 0.16-mile electrical line infrastructure would be abandoned in place, and the copper lines would be pulled for reuse. As a result, there would be no disturbance to remove the existing line. Relocation of the electrical line along the new 0.22-mile route would result in impacts similar to the infrastructure upgrades required for the proposed sCO_2 Test Facility, including impacts due to trenching activities to place the new electrical line. Construction would take place in conjunction with the water line extension and roadway intersection expansion, discussed within this Cumulative Effects analysis.

Overall, the electrical line re-route would result in temporary, minor cumulative impacts during construction to air quality, noise, soils, and water resources. Operation of the re-routed electrical line would have negligible cumulative impacts.

Ordnance Well Upgrade

In Fiscal Year 2018, SwRI plans to add a domestic water supply storage tank and new booster pump station to service the SwRI PWS. The upgrade would provide redundant backup water storage capacity to maintain water supplies at SwRI. Although the aboveground water tank is not designed yet, it is expected to have a capacity of more than 250,000 gallons. It would be located in proximity to one of the two existing backup supply wells (called Ordnance Well), located west of Building 99 (refer to Figure 3-1). The new storage tank would provide additional storage capacity at SwRI from the Ordnance Well but would not result in an increase in water use.

Overall, the ordnance well upgrade would result in temporary minor adverse cumulative impacts to air quality and noise, as well as beneficial operational impacts to the SwRI water system to support additional storage capacity.

Building 73 Drum Storage

In Fiscal Year 2018, SwRI plans to replace the existing Building 73 with a new approximately 8,000-square foot open air structure for storage of Class 3B petroleum liquids in storage containers and drums (refer to Figure 3-1). Currently Building 73 is approximately 3,430 square feet and used for storage of 55-gallon drums of petroleum products. The new building would continue to house the 55-gallon drums of petroleum products. SwRI is converting to the new building to support the current and future petroleum storage needs of SwRI.

Replacement of Building 73 would result in temporary minor adverse cumulative impacts to air quality, noise, materials and wastes, and health and safety. Operation of the new building would provide a safer and more reliable storage building for the petroleum liquids.

City of San Antonio Projects

The City of San Antonio Transportation and Capital Improvements Department oversees street and drainage maintenance, and capital projects for the City of San Antonio. Review of the future City of San Antonio projects nearby SwRI include improvements to parks and transportation infrastructure (City of San Antonio 2017). Nearby park projects include general park improvements and rehabilitation to Gilbert Garza Park and general park improvements, including parking expansion and outdoor basketball court canopy at Tom Slick Creek Park. Nearby transportation projects include improvements to Enrique M. Barrera Parkway corridor with street drainage and sidewalk improvements; and construction of road extensions of West Military Drive and Ingram Road to include roadway connectors, curbs, sidewalks, bike facilities, traffic signal, and drainage improvements.

The nearby City of San Antonio projects are planned for construction in 2019 and 2020. Construction of the parks and transportation improvements would not impact main transportation routes used to access SwRI. Cumulative impacts with the proposed sCO_2 Test Facility and planned SwRI projects would be negligible.

Greenhouse Gases and Climate Change

Climate change is an inherently cumulative effect caused by releases of greenhouse gases from human activities and natural processes around the world. Greenhouse gases are compounds in the atmosphere that absorb and emit radiation, effectively trapping heat (longwave radiation) and causing what is known as the greenhouse effect. The greenhouse effect causes the Earth's atmosphere to warm and thereby create changes in the planet's climate systems. The primary greenhouse gases in the Earth's atmosphere are water vapor, CO_2, methane, nitrous oxide, and O_3. Scientists quantify and analyze greenhouse gases using the common unit of CO_2-equivalents (CO_2-eq), which is based on the global warming potential of each greenhouse gas. CO_2-eq signifies the functionally equivalent amount or concentration of CO_2 that would have the equivalent global warming impact.

During the construction phase, emissions would result from construction of the sCO_2 Test Facility components, construction of the new natural gas pipeline, and tailpipe emissions from construction worker vehicles and delivery trucks. DOE estimates greenhouse gas emissions would amount to approximately 8,172 tons of CO_2-eq during the construction period of the sCO_2 Test Facility Project.

During operations, the sCO_2 Test Facility is expected to emit approximately 28,680 tpy, which would equal approximately 86,040 tons over the 3-year project. Also, as explained in Section 3.6 Health and Safety, during the course of the project, a CO_2 release may be required for a variety of reasons, including system fill and purge for initial operation, system vent and purge for shutdown and maintenance, or general system operation. These releases would contribute to the total CO_2 emissions. In whole, the proposed project would result in a minor increase of greenhouse gases to the atmosphere. In total the project would emit a total of 94,212 tons of CO_2-eq over the life of the proposed project from both construction and operations.

Because climate change is considered a cumulative global phenomenon, it is generally accepted that any successful strategy to address climate change must rest on a global approach to controlling greenhouse gas emissions. As discussed in Chapters 1 and 2, part of the purpose and need of the research proposed in this project is geared toward development of technologies that increase efficiencies of electricity generation from combustion of fossil fuels, thereby reducing greenhouse gas emissions. Advancement of these technologies would be beneficial in increasing efficiency of power plants, reducing plant emission including greenhouse gases, and ultimately reducing the rate and magnitude of climate change.

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APPENDIX A
AGENCY AND TRIBAL CORRESPONDENCE

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Table of Contents

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APPENDIX A AGENCY AND TRIBAL CORRESPONDENCE

A.1 INTRODUCTION

During preparation of the Draft Environmental Assessment (EA), the United States (U.S.) Department of Energy (DOE) actively maintained communication with government agencies and Indian tribes. This appendix summarizes the records of formal consultation between the DOE and these government agencies and Indian tribes.

This appendix contains copies of correspondence with the following state and federal agencies:

- Texas Historical Commission
- Texas Parks & Wildlife Department – Wildlife Division
- U.S. Fish and Wildlife Service – Austin Ecological Services Field Office

This appendix contains a representative letter used for tribal correspondence with the following Indian tribes. This appendix also contains correspondence from tribes that responded to DOE's consultation letter.

- Absentee Shawnee Tribe of Oklahoma
- Alabama-Coushatta Tribe of Texas
- Alabama-Quassarte Tribal Town
- Apache Tribe of Oklahoma
- Caddo Nation of Oklahoma
- Cherokee Nation of Oklahoma
- Choctaw Nation of Oklahoma
- Comanche Nation of Oklahoma
- Coushatta Tribe of Louisiana
- The Delaware Nation
- Jicarilla Apache Nation
- Kialegee Tribal Town
- Kickapoo Traditional Tribe of Texas
- Kickapoo Tribe of Oklahoma
- Kiowa Tribe of Oklahoma
- Mescalero Apache Tribe
- Muscogee (Creek) Nation
- Osage Nation
- Poarch Band of Creek Indians
- Quapaw Tribe of Oklahoma

- Seminole Nation of Oklahoma
- Thlopthlocco Tribal Town
- Tonkawa Tribe of Oklahoma
- Tunica-Biloxi Tribe of Louisiana
- United Keetoowah Band of Cherokee Indians
- Wichita and Affiliated Tribes
- Ysleta Del Sur Pueblo of Texas

A.2 TEXAS HISTORICAL COMMISSION

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

NATIONAL ENERGY TECHNOLOGY LABORATORY

December 14, 2017

Texas Historical Commission
Attn: Mark Wolfe, State Historic Preservation Officer
108 W. 16th Street
Austin, Texas 78701

RE: Section 106 Review - Project Summary Form and Attachments for Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility, San Antonio, Texas

Dear Mr. Wolfe:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for the Proposed Action of providing cost-shared funding to a project team led by Gas Technology Institute (GTI), Southwest Research Institute (SwRI), and General Electric Global Research (GE-GR) for the 10-megawatt-electric (MWe) Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility Project at the SwRI, an existing research facility in San Antonio, Texas. The EA is being prepared to fulfill DOE's obligations under the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures. The EA will evaluate the potential effects of construction and 3-year operation of this pilot plant test facility. As part of DOE's obligations under Section 106 of the National Historic Preservation Act, DOE is sending this letter, along with a *Request for SHPO Consultation Form* and requisite attachments to initiate consultation with the Texas Historical Commission.

The SwRI campus is an approximately 1,200-acre facility located at 6220 Culebra Road, San Antonio, Bexar County, Texas. Under the Proposed Action, DOE would provide approximately $79.9 million in cost-shared funding to GTI to design, construct, commission, and operate the sCO_2 Pilot Plant Test Facility Project at the SwRI campus. The proposed project would involve the construction and 3-year operation of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

SwRI would construct the proposed sCO_2 Pilot Plant Test Facility south of Culebra Road in the central-western portion of the SwRI campus in an approximately 16.5-acre area. The proposed project would be integrated into the SwRI campus by utilizing available developed and undeveloped campus property for the proposed pilot plant test facility equipment and structures, construction laydown, equipment staging, upgrades to utilities, and use of an existing building for office space during construction and operations. The attached Proposed sCO_2 Test Facility Project Area Map presents the limits of disturbance for construction of the proposed project. The exact location of the equipment and buildings sited within the project area boundaries could change during design finalization, however, all project features would remain within the project area boundaries depicted on in the attached maps.

DOE has made a determination of No Historic Properties Affected within the Area of Potential Effect (APE) for indirect/visual effects to historic properties and anticipates a finding of No Historic Properties Affected within the APE for direct effects to historic properties. We respectfully ask that you provide any

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
pierina.fayish@netl.doe.gov@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

information or comments within 30 days to enable us to complete this phase of the project within the scheduled timeframe, using the following contact information:

National Energy Technology Laboratory M/S 922-342C
P.O. Box 10940
Pittsburgh, PA 15236
Attention: Pierina Fayish
Pierina.Fayish@NETL.DOE.GOV
(412) 386-5428

If you have any questions or require additional information, please do not hesitate to call or email. Thank you for your assistance in this matter.

Sincerely,

Pierina N. Fayish

Attachments:
Texas Historical Commission *Request for SHPO Consultation Form*
Descriptions and Evaluation of Properties Within APEs for Direct and Indirect Effects
Maps, Photographs and Project Plans

TEXAS HISTORICAL COMMISSION

REQUEST FOR SHPO CONSULTATION:
Section 106 of the National Historic Preservation Act and/or the Antiquities Code of Texas

Please see instructions for completing this form and additional information on Section 106 and Antiquities Code consultation on the Texas Historical Commission website at http://www.thc.state.tx.us/crm/crmsend.shtml.

☒ This is a new submission.

☐ This is additional information relating to THC tracking number(s): _____

Project Information

PROJECT NAME **Supercritical Carbon Dioxide (sCO2) Pilot Plant Test Facility, San Antonio, Texas**		
PROJECT ADDRESS **6220 Culebra Road**	PROJECT CITY **San Antonio**	PROJECT ZIP CODE(S) **78238**
PROJECT COUNTY OR COUNTIES **Bexar County**		

PROJECT TYPE (Check all that apply)

- ☐ Road/Highway Construction or Improvement
- ☒ Site Excavation
- ☒ Utilities and Infrastructure
- ☒ New Construction
- ☐ Repair, Rehabilitation, or Renovation of Structure(s)
- ☐ Addition to Existing Structure(s)
- ☐ Demolition or Relocation of Existing Structure(s)
- ☐ None of these

BRIEF PROJECT DESCRIPTION: Please explain the project in one or two sentences. More details should be included as an attachment to this form.
The U.S. Department of Energy (DOE) proposes to provide cost-shared funding to the sCO2 Pilot Plant Test Facility Project which would involve the construction and 3-year operation of a pilot test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

Project Contact Information

PROJECT CONTACT NAME **Melissa Secor**	TITLE **NEPA Project Manager**	ORGANIZATION **Potomac-Hudson Engineering**	
ADDRESS **9801 Washingtonian Boulevard, Suite 350**	CITY **Gaithersburg**	STATE **MD**	ZIP CODE **20878**
PHONE **703.628.0192**	EMAIL **melissa.secor@phe.com**		

Federal Involvement (Section 106 of the National Historic Preservation Act)

Does this project involve approval, funding, permit, or license from a federal agency?

☒ Yes (Please complete this section) ☐ No (Skip to next section)

FEDERAL AGENCY **U.S. Department of Energy (DOE), NETL**	FEDERAL PROGRAM, FUNDING, OR PERMIT TYPE **Supercritical Transformational Electric Power Program**
CONTACT PERSON **Ms. Pierina Fayish**	PHONE **(412) 386-5428**
ADDRESS **P.O. Box 10940** **Pittsburgh, PA 15236**	EMAIL **Pierina.Fayish@NETL.DOE.GOV**

State Involvement (Antiquities Code of Texas)

Does this project occur on land or property owned by the State of Texas or a political subdivision of the state?

☐ Yes (Please complete this section) ☒ No (Skip to next section)

CURRENT OR FUTURE OWNER OF THE PUBLIC LAND	
CONTACT PERSON	PHONE
ADDRESS	EMAIL

VER 0811

REQUEST FOR SHPO CONSULTATION -- PROJECT NAME: Supercritical Carbon Dioxide (sCO2) Pilot Plant Test Facility, San Antonio Bexar County
6220 Culebra Road

Identification of Historic Properties: Archeology

Does this project involve ground-disturbing activity?
☑ Yes (Please complete this section) ☐ No (Skip to next section)

Describe the nature of the ground-disturbing activity, including but not limited to depth, width, and length.
Ground disturbing activities will consist of construction activities within the project site and utility upgrades (natural gas line, sanitary sewer line, utility tie-ins). Construction would involve site clearing and grading, and facility construction (See Attachments for further information).

Describe the previous and current land use, conditions, and disturbances.
The main sCO2 Test Facility project site is currently undisturbed vegetated land. The natural gas extension would be routed through primarily undisturbed land. The sanitary sewer would routed under existing roadway. (See Attachments for further information).

Identification of Historic Properties: Structures

Does the project area or area of potential effects include buildings, structures, or designed landscape features (such as parks or cemeteries) that are 45 years of age or older?
☑ Yes (Please complete this section) ☐ No (Skip to next section)

Is the project area or area of potential effects within or adjacent to a property or district that is listed in or eligible for listing in the National Register of Historic Places?
☐ Yes, name of property or district: ☑ No ☐ Unknown

In the space below or as an attachment, describe each building, structure, or landscape feature within the project area or area of potential effect that is 45 years of age or older.

ADDRESS	DATE OF CONSTRUCTION	SOURCE FOR CONSTRUCTION DATE
(see attachment)		
ADDRESS	DATE OF CONSTRUCTION	SOURCE FOR CONSTRUCTION DATE
ADDRESS	DATE OF CONSTRUCTION	SOURCE FOR CONSTRUCTION DATE

Attachments

Please see detailed instructions regarding attachments.
Include the following with each submission:
☑ Project Work Description
☑ Maps
☑ Identification of Historic Properties
☑ Photographs
For Section 106 reviews only, also include:
☑ Consulting Parties/Public Notification
☑ Area of Potential Effects
☑ Determination of Eligibility
☑ Determination of Effect

Submit completed form and attachments to the address below. Faxes and email are not acceptable.

Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276, Austin, TX 78711-2276 (mail service)
108 W. 16th Street, Austin, TX 78701 (courier service)

For SHPO Use Only

PAGE 2 / VER 0811

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

TEXAS HISTORICAL COMMISSION
REQUEST FOR SHPO CONSULTATION

Attachments

Project Work Description:

The Southwest Research Institute (SwRI) campus is an approximately 1,200-acre facility located at 6220 Culebra Road, San Antonio, Bexar County, Texas. Under the Proposed Action, DOE would provide approximately $79.9 million in cost-shared funding to the Gas Technology Institute (GTI) to design, construct, commission, and operate a Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility Project at the SwRI campus. The proposed project would involve the construction and 3-year operation (August 2019 – September 2022) of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

SwRI is a non-profit applied research and development facility located in western San Antonio, Bexar County, Texas (Figure 1: Project Location). SwRI is an approximately 1,200-acre facility with over 200 buildings containing greater than 2 million square feet of laboratory and office space. SwRI consists of nine technical divisions that offer multidisciplinary, problem-solving services in a variety of areas in engineering and the physical sciences. More than 4,000 projects were active at SwRI at the close of fiscal year 2016. These projects were funded almost equally between the government and commercial sectors.

The sCO_2 Pilot Plant Test Facility would be constructed south of Culebra Road in the central-western portion of the SwRI campus in an approximately 16.5-acre area of currently developed and undeveloped land (Figure 2: Proposed sCO_2 Test Facility Project Area Map). The proposed project would be integrated into the SwRI campus by utilizing available developed and undeveloped campus property for the proposed pilot plant test facility equipment and structures, construction laydown, equipment staging, upgrades to utilities, and use of an existing building for office space during construction and operations.

The majority of the proposed Test Facility equipment and components (main project area) would be situated north of 4th Street (see Figure 2: Proposed sCO_2 Test Facility Project Area Map; Figure 3: Project APE for Indirect Effects and Identified Structures). A new building would house the sCO_2 turbine, the control room, maintenance/machine shop, and associated turbine components. The building would include a Direct Expansion (DX) cooling system and heat pumps. The building would be 55 feet high and contain 12,000 square feet of space. The exact depth of the building foundation is not yet known as final plans are not yet developed.

The area north of the main project area would be used during construction for temporary office space and control rooms, temporary office trailers, construction laydown, parking, and potentially an additional access road, if necessary. The area to the north is currently used as contractor parking and equipment storage. No modifications to existing structures or buildings would be required. Depending on final project design, SWRI could construct an access road within this area to serve as a secondary route for large trucks or personnel to access the site during construction and operations. The access road would be designed to avoid ground disturbance, but it is anticipated that some vegetation clearing and tree removal would be required.

During the construction period, the proposed project would utilize the adjacent property to the south of 4th Street for contractor staging, laydown, and parking, along with the ability to provide flexibility in operational workspace (e.g., temporary storage). The area to the south of 4th Avenue has historically been

used as equipment storage and an area for dirt and material stockpiles from remedial actions. SwRI removes the stockpiles for offsite disposal or use within the SwRI campus.

Utility upgrades would include a natural gas pipeline extension and sanitary sewer line constructed by SwRI within the SwRI campus to connect the proposed pilot plant test facility to existing lines. Figure 2 presents the potential disturbance area for the two route options proposed for the new natural gas pipeline extension. Option 1 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.2 miles to the existing 8-inch pipeline on the SwRI campus. Option 2 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.4 miles to the existing CPS Energy 20-inch diameter natural gas main pipeline located along West Commerce Street. SwRI would also construct an approximately 0.12-mile sanitary sewer line. Depth of trenching, where needed for these utility upgrades, would be between 4 and 6 feet.

Area of Potential Effects:

DOE has determined that the Area of Potential Effect (APE) for direct effects to historic properties is limited to the areas of ground disturbance. The APE for indirect/visual effects is limited to a 500 foot buffer beyond the proposed above-ground structures of the Supercritical Carbon Dioxide Pilot Plant Test Facility (Figure 3: Project APE for Indirect Effects and Identified Structures.).

Maps:

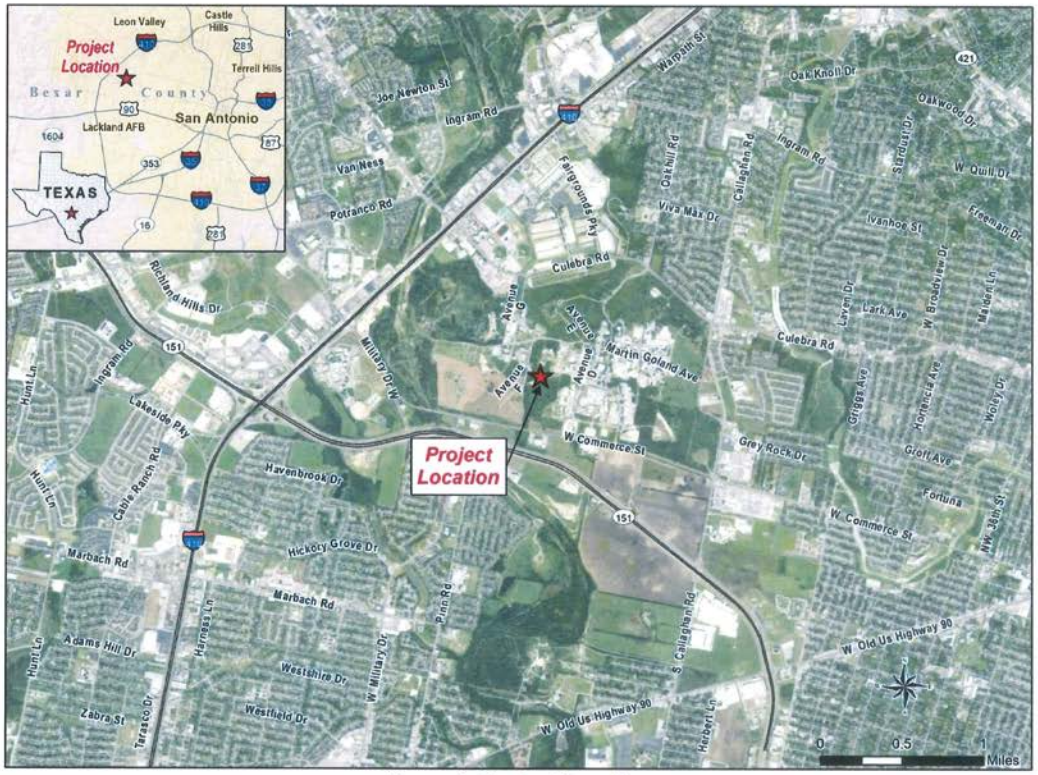


Figure 1: Project Location

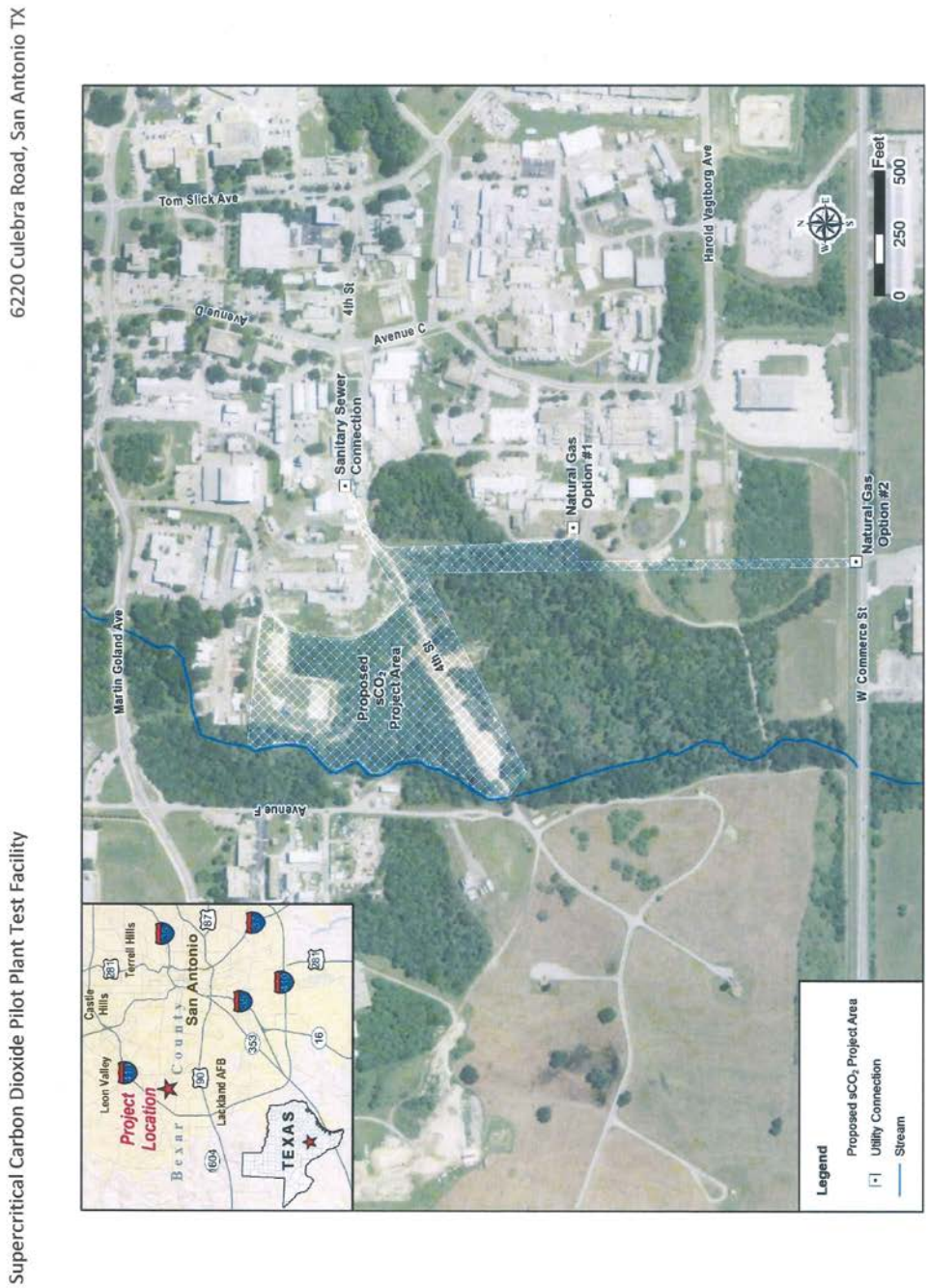


Figure 2: Proposed sCO_2 Test Facility Project Area Map

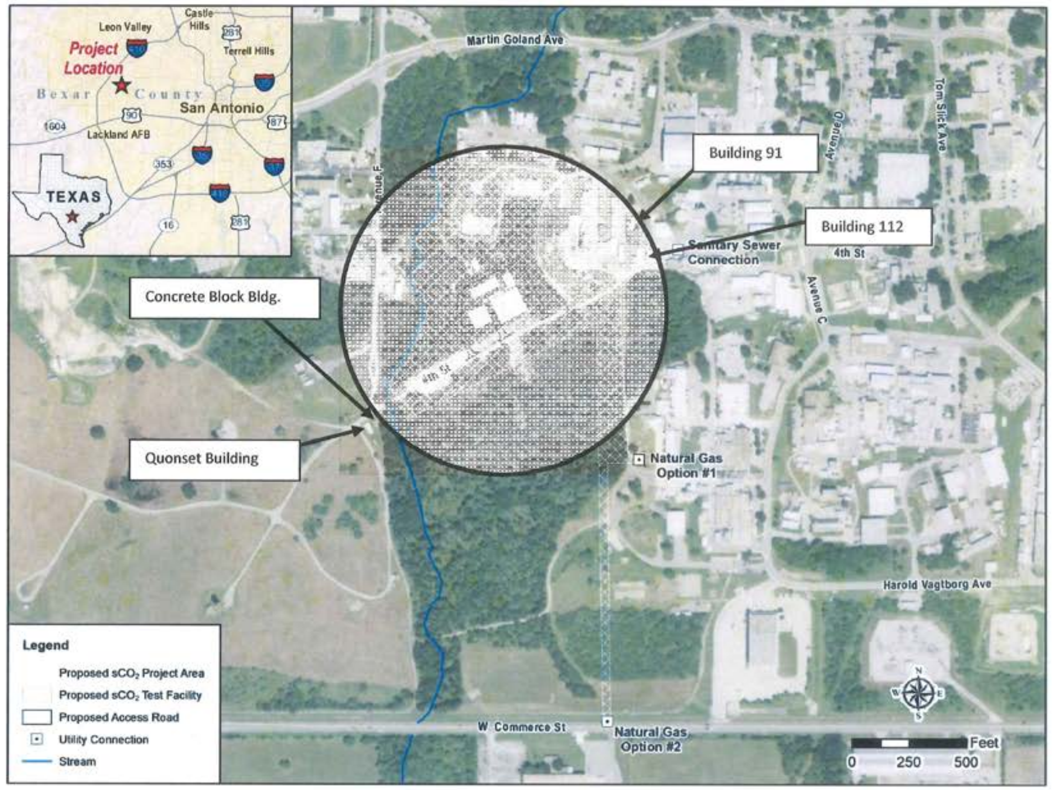
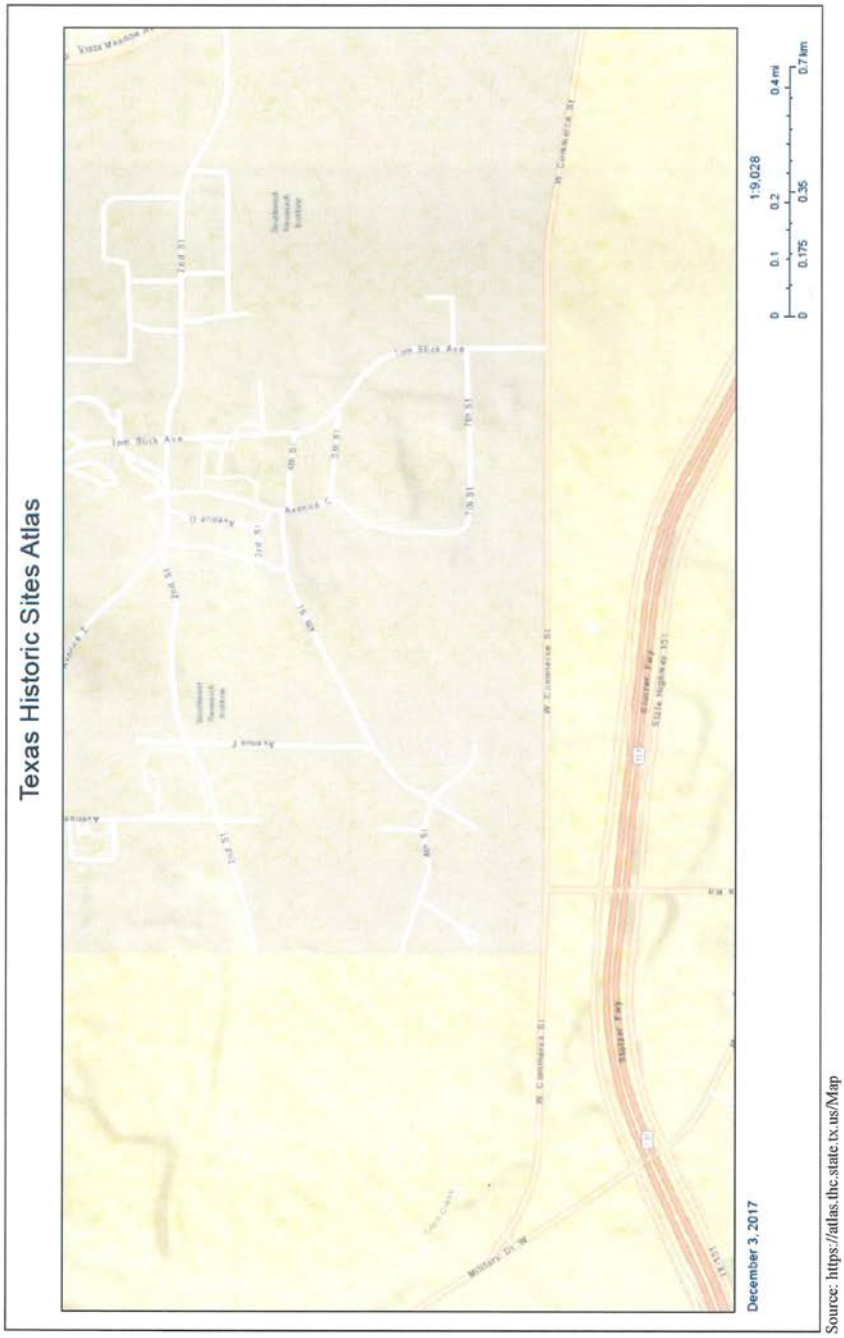


Figure 3: Project APE for Indirect Effects and Identified Structures.

Supercritical Carbon Dioxide Pilot Plant Test Facility

6220 Culebra Road, San Antonio TX



Source: https://atlas.thc.state.tx.us/Map

Figure 4: Texas Historic Sites Atlas Map of Project Vicinity.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

Identification of Historic Properties: Structures

An online review of the Texas Historical Commission's Texas Historic Sites Atlas was conducted on December 3, 2017. No historic properties have been identified in the project area (Figure 4: Texas Historic Sites Atlas Map of Project Vicinity). A review of aerial imagery was conducted to identify structures within the APE for visual effects that were present on or before 1973 (45 years). Two structures were identified within the APE that are over 45 years of age. Building Number 91 (1411 Fourth Street) is a one-story, concrete and concrete block building with flat built-up roof utilized for storage. It measures approximately 22 x 65 feet and was constructed in 1971. It is located approximately 475 feet from the project site. There is an adjacent storage yard to the west side of the building. Building Number 112 is located approximately 495 feet east of the proposed project site. Constructed in 1966, it is a one-story, metal maintenance shop with gabled metal roof with shed roofed addition on the east side. The building is set on a concrete slab. It measures approximately 32 x 36 feet. These buildings are not noteworthy examples of a type, period or method of construction or the work of a master nor are they associated with significant historical events or persons. The buildings are common maintenance and storage buildings of standard design. They lack sufficient historical or architectural significance to be listed on the National Registers of Historic Places.

There are two additional buildings over 45 years of age were identified just outside the 500 foot APE for indirect/visual effects. Although the exact dates of construction are not known, both appear on aerial imagery beginning in 1963. One is a metal Quonset hut with large overhead door on the north side and corrugated metal cladding, while the other is a concrete block structure with a shallow-pitched shed roof that has mostly collapsed. Neither of these structures possess sufficient architectural or historical significance to be considered eligible for the National Register of Historic Places. There are no other structures within the APE for indirect/visual effects that are over 45 years of age.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

Aerial Imagery:

Historic Aerial Imagery from 1963 of Quonset Hut building and concrete block structure to the southwest of project site.

Present imagery (2016) showing Quonset hut building and concrete block structure to the southwest of project site from Google Maps.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

Photographs

1. View of Building 91, facing south.

2. View of Building 112 facing south.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

3. View of concrete block structure and Quonset hut, facing southeast.

4. View of concrete block structure, facing south.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

5. View from Avenue F Access Road, at southeast corner of facility site, facing east.

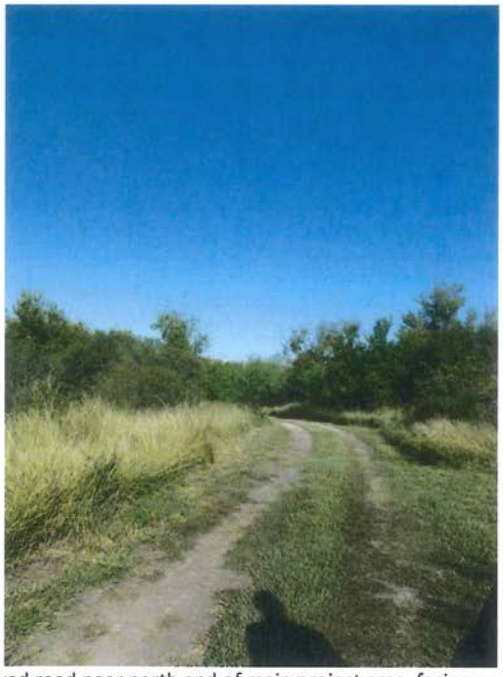
6. View from Avenue F Access Road, at southeast corner of facility site, facing south.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

7. View from Avenue F Access Road, at southwest corner of facility site, showing concrete block structure and Quonset hut in background, facing southwest.

8. View from Avenue F Access Road, at southwest corner of facility site, facing west.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX



9. Unpaved road near north end of main project area, facing northwest.

Supercritical Carbon Dioxide Pilot Plant Test Facility 6220 Culebra Road, San Antonio TX

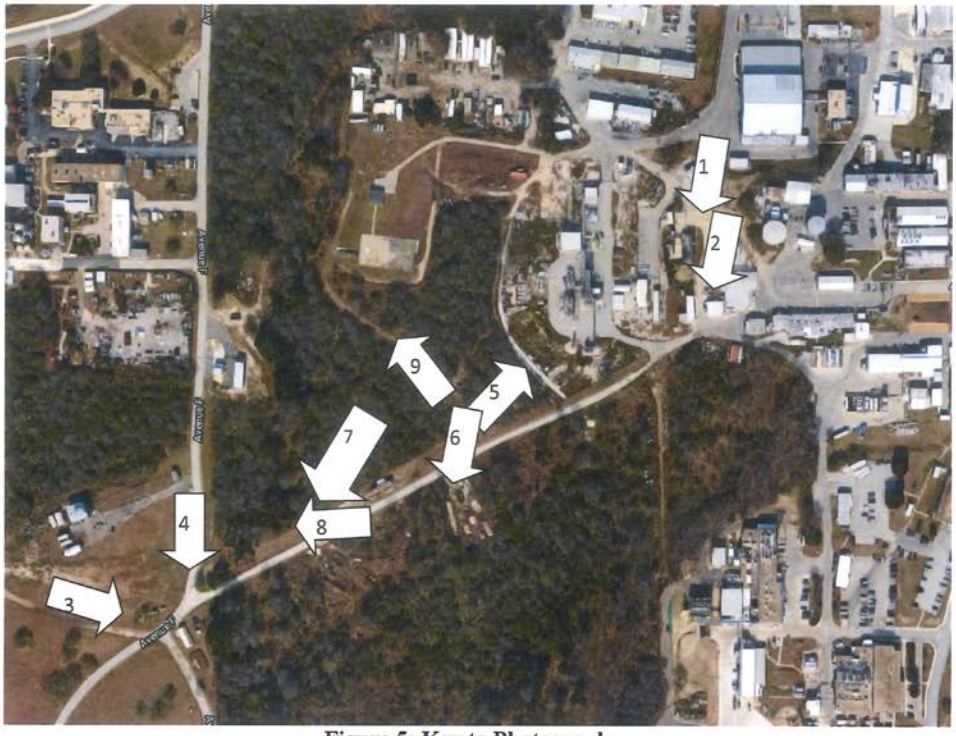


Figure 5: Key to Photographs.

TEXAS HISTORICAL COMMISSION

real places telling real stories

January 9, 2018

Pierina Fayish
National Energy Technology Laboratory M/S 9220342C
P.O. Box 10940.
Pittsburg, PA 15236

Re: Project review under Section 106 of the National Historic Preservation Act of 1966: Supercritical Carbon Dioxide (sCO2) Pilot Plant Test Facility, San Antonio, Texas.

Dear Ms. Fayish:

Thank you for your correspondence describing the above referenced project. This letter serves as comment on the report from the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission.

The Archeology Division (AD) review staff, led by Casey Hanson, has examined our records. Our records show that there are no cultural resources recorded on the tract proposed for development. However, the tract has never been surveyed for cultural resources and a previously recorded archeological site that has been determined to be eligible for listing in the National Register of Historic Places is located in a similar setting within the vicinity of the project area. As a result, we recommend that a professional archeologist should survey the project APE prior to initiation of ground disturbing activities.

The work should meet the minimum archeological survey standards posted on-line at www.thc.texas.gov. A report of investigations should be produced in conformance with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation, and submitted to this office for review. In addition, any buildings 45 years old or older that are located on or adjacent to the tract should be documented with photographs and included in the report. You may obtain lists of archeologists in Texas on-line at: www.counciloftexasarcheologists.org or www.rpanet.org. Please note that other potentially qualified archeologists not included on these lists may be used.

The History Programs Division (HPD) staff, led by Justin Kockritz, has completed its review and concurs with your determination of No Historic Properties Affected within the APE for indirect/visual effects to historic properties.

Thank you for your cooperation in this federal review process, and for your efforts to preserve the irreplaceable heritage of Texas. **If you have any questions concerning our review or if we can be of further assistance, please contact Casey Hanson at 512.463.5915.**

Sincerely,

for
Mark Wolfe, State Historic Preservation Officer
MW/ch/jk

GREG ABBOTT, GOVERNOR • JOHN L. NAU, III, CHAIR • MARK WOLFE, EXECUTIVE DIRECTOR
P.O. BOX 12276 • AUSTIN, TEXAS • 78711-2276 • P 512.463.6100 • F 512.475.4872 • thc.texas.gov

A.3 TEXAS PARKS & WILDLIFE DEPARTMENT – WILDLIFE DIVISION

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

NATIONAL ENERGY TECHNOLOGY LABORATORY

December 14, 2017

Laura Zebehazy
Texas Parks & Wildlife
Wildlife Division: Wildlife Habitat Assessment Program
4200 Smith School Road
Austin, Texas 78744-3291

RE: Environmental Assessment for Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility, San Antonio, Texas

Dear Ms. Zebehazy:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for the Proposed Action of providing cost-shared funding to a project team led by Gas Technology Institute (GTI), Southwest Research Institute (SwRI), and General Electric Global Research (GE-GR) for a proposed 10-megawatt-electric (MWe) Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility Project at the SwRI, an existing research facility in San Antonio, Texas. The EA is being prepared to fulfill DOE's obligations under the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures. The EA will evaluate the potential effects of construction and 3-year operation of this proposed pilot plant test facility. The purpose of this letter is to initiate consultation with the Texas Parks and Wildlife and to request information on any state-listed threatened, endangered, or candidate species, or critical habitat within the vicinity of the project. DOE is also consulting with the U.S. Fish and Wildlife Service's Austin Ecological Services Field Office regarding information on any federally listed species or critical habitat within the vicinity of the proposed project.

The SwRI campus is an approximately 1,200-acre facility located at 6220 Culebra Road, San Antonio, Bexar County, Texas. The campus has been designated as Heavy Industrial (I-2) zoning district by the City of San Antonio. Immediately surrounding properties to the SwRI facility have been designated as Commercial, General Industrial, Residential, Multi-Family zone districts by the City of San Antonio. The SwRI campus is situated at an approximate latitude of 29°27'07.54"N and longitude of 98°36'36.23"W (see attached Figure 1).

Under the Proposed Action, DOE would provide approximately $79.9 million in cost-shared funding to GTI to design, construct, commission, and operate the sCO_2 Pilot Plant Test Facility Project at the SwRI campus. The proposed project would involve the construction and 3-year operation of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

SwRI would construct the proposed sCO_2 Pilot Plant Test Facility south of Culebra Road in the central-western portion of the SwRI campus in an approximately 16.5-acre area of currently developed and undeveloped land. The currently undeveloped portion of the proposed project area supports deciduous trees, brush, herbaceous shrubs, and mowed grass. The proposed project would be integrated into the SwRI campus by utilizing available developed and undeveloped campus property for the proposed pilot

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
pierina.fayish@netl.doe.gov@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

plant test facility equipment and structures, construction laydown, equipment staging, upgrades to utilities, and use of an existing building for office space during construction and operations (see Figure 2). Utility upgrades would include a 4- or 8-inch diameter natural gas pipeline extension and a sanitary sewer line constructed by SwRI within the SwRI campus to connect the proposed pilot plant test facility to existing lines. Figure 2 presents the potential disturbance area for the two route options proposed for the new natural gas pipeline extension. Option 1 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.2 mile to the existing 8-inch diameter pipeline on the SwRI campus. Option 2 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.4 mile to the existing CPS Energy 20-inch diameter natural gas main pipeline located along West Commerce Street. SwRI would also construct an approximately 0.12-mile sanitary sewer line. The attached site map presents the potential boundaries of disturbance for construction of the proposed sCO_2 Pilot Plant Test Facility Project (see Figure 2). The exact location of the equipment and building sited within the project area boundaries could change during design finalization, however, all project features would remain within the project area boundaries depicted on Figure 2.

DOE reviewed the Rare, Threatened, and Endangered Species list for Bexar County as publish on the Texas Parks and Wildlife Department search engine (https://tpwd.texas.gov/gis/rtest/) for potential threatened and endangered species within Bexar County, Texas on November 1, 2017. Refer to Table 1 attached to this letter for federal and state-listed species noted within your database as known or believed to occur within Bexar County, Texas and preferred habitat.

DOE does not anticipate any adverse effects on federal- or state-listed wildlife species based on the proposed construction and operation of the sCO_2 Pilot Plant Test Facility Project. As part of the NEPA process, we are seeking your input on any environmental issues or concerns your agency may have on the Proposed Action and the potentially affected areas as described above. We respectfully ask that you provide any information or comments within 30 days to enable us to complete this phase of the project within the scheduled timeframe, using the following contact information:

National Energy Technology Laboratory M/S 922-342C
P.O. Box 10940
Pittsburgh, PA 15236
Attention: Pierina Fayish
Pierina.Fayish@NETL.DOE.GOV
(412) 386-5428

If you have any questions or require additional information, please do not hesitate to call or email. Thank you for your assistance in this matter.

Sincerely,

Pierina N. Fayish

Attachments:
Table 1 – Threatened and Endangered Species in Bexar County
Figure 1 – General Project Location
Figure 2 – Proposed sCO_2 Test Facility Project Area

Page 2

Table 1. Threatened and Endangered Species within Bexar County

Common Name	Status		Habitat
	Federal	State	
AMPHIBIANS			
Cascade Caverns Salamander *Eurycea latitans complex*	N/A	T	Endemic; subaquatic; springs and caves in Medina River, Guadalupe River, and Cibolo Creek watersheds within Edwards Aquifer area.
Comal Blind Salamander *Eurycea tridentifera*	N/A	T	Endemic; semi-troglobitic; found in springs and waters of caves.
ARACHNIDS			
Government Canyon Bat Cave spider *Tayshaneta microps*[a]	FE	N/A	Small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County.
Cokendolpher Cave Harvestman *Texella cokendolpheri*	FE	N/A	Small, eyeless harvestman; karst features in north and northwest Bexar County.
Madla Cave Meshweaver *Cicurina madla*	FE	N/A	Small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County.
Robber Baron Cave Meshweaver *Cicurina baronia*	FE	N/A	Small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County.
Bracken Bat Cave Meshweaver *Cicurina venii*	FE	N/A	Small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County.
Government Canyon Bat Cave Meshweaver *Cicurina vespera*	FE	N/A	Small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County.
BIRDS			
White-faced Ibis *Plegadis chihi*	N/A	T	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.

Page 3

Common Name	Status		Habitat
	Federal	State	
Wood Stork *Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.
Zone-tailed Hawk *Buteo albonotatus*	N/A	T	Arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions.
Peregrine Falcon *Falco peregrinus*	DL	T	Both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.
American Peregrine Falcon *Falco peregrinus anatum*	DL	T	Year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.
Whooping Crane *Grus americana*	FE	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

Page 4

Common Name	Status		Habitat
	Federal	State	
Red Knot *Calidris canutus rufa*	T	N/A	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knotâs prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.
Interior Least Tern *Sterna antillarum athalassos*	FE	E	Subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc.); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony.
Black-capped Vireo *Vireo atricapilla*	FE	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer.
Golden-cheeked Warbler *Setophaga chrysoparia*[b]	FE	E	Juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer.

Page 5

Common Name	Status		Habitat
	Federal	State	
FISH			
Widemouth blindcat *Satan eurystomus*	N/A	T	Troglobitic, blind catfish endemic to the San Antonio Pool of the Edward's Aquifer.
Toothless blindcat *Trogloglanis pattersoni*	N/A	T	Troglobitic, blind catfish endemic to the San Antonio Pool of the Edward's Aquifer.
INSECTS			
A ground beetle *Rhadine exilis*	FE	N/A	Small, essentially eyeless ground beetle; karst features in north and northwest Bexar County.
A ground beetle *Rhadine infernalis*	FE	N/A	Small, essentially eyeless ground beetle; karst features in north and northwest Bexar County.
Helotes mold beetle *Batrisodes venyivi*	FE	N/A	Small, eyeless mold beetle; karst features in northwestern Bexar County and northeastern Medina County.
MAMMALS			
Red wolf *Canis rufus*	FE	E	Extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies.
Gray wolf *Canis lupus*	FE	E	Extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands.
Black bear *Ursus americanus*	N/A	T	Bottomland hardwoods and large tracts of inaccessible forested areas.
MOLLUSKS			
Golden orb *Quadrula aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.
PLANTS			
Bracted twistflower *Streptanthus bracteatus*	C	N/A	Texas endemic; shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; several known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations; populations fluctuate widely from year to year, depending on winter rainfall; flowering mid-April to late May, fruit matures and foliage withers by early summer
REPTILES			

Page 6

Common Name	Status		Habitat
	Federal	State	
Texas tortoise *Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus, sometimes in underground burrows or under objects; longevity greater than 50 years; active March-November; breeds April-November.
Texas horned lizard *Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September.
Texas indigo snake *Drymarchon melanurus erebennus*	N/A	T	Texas south of the Guadalupe River and Balcones Escarpment; thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter.
Timber rattlesnake *Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto.
C = Candidate; DL = Delisted; E = Endangered; FE = Federally Endangered; N/A = Not Applicable; T = Threatened a. The U.S. Fish and Wildlife lists the Latin name for the Government Canyon Bat Cave Spider as *Neoleptoneta microps*. b. The U.S. Fish and Wildlife lists the Latin name for the Golden-cheeked Warbler as *Dendroica chrysoparia*.			

Page 8

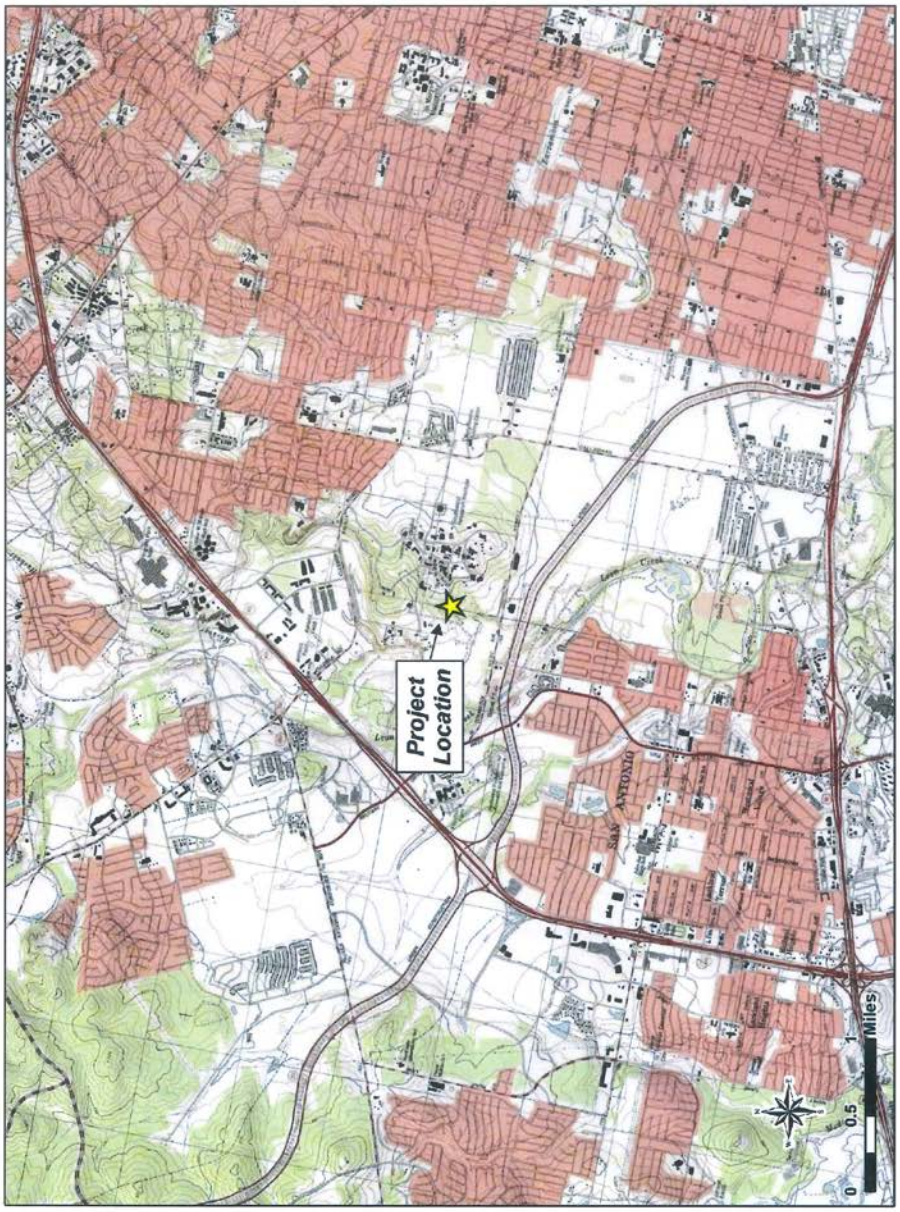


Figure 1. General Project Location

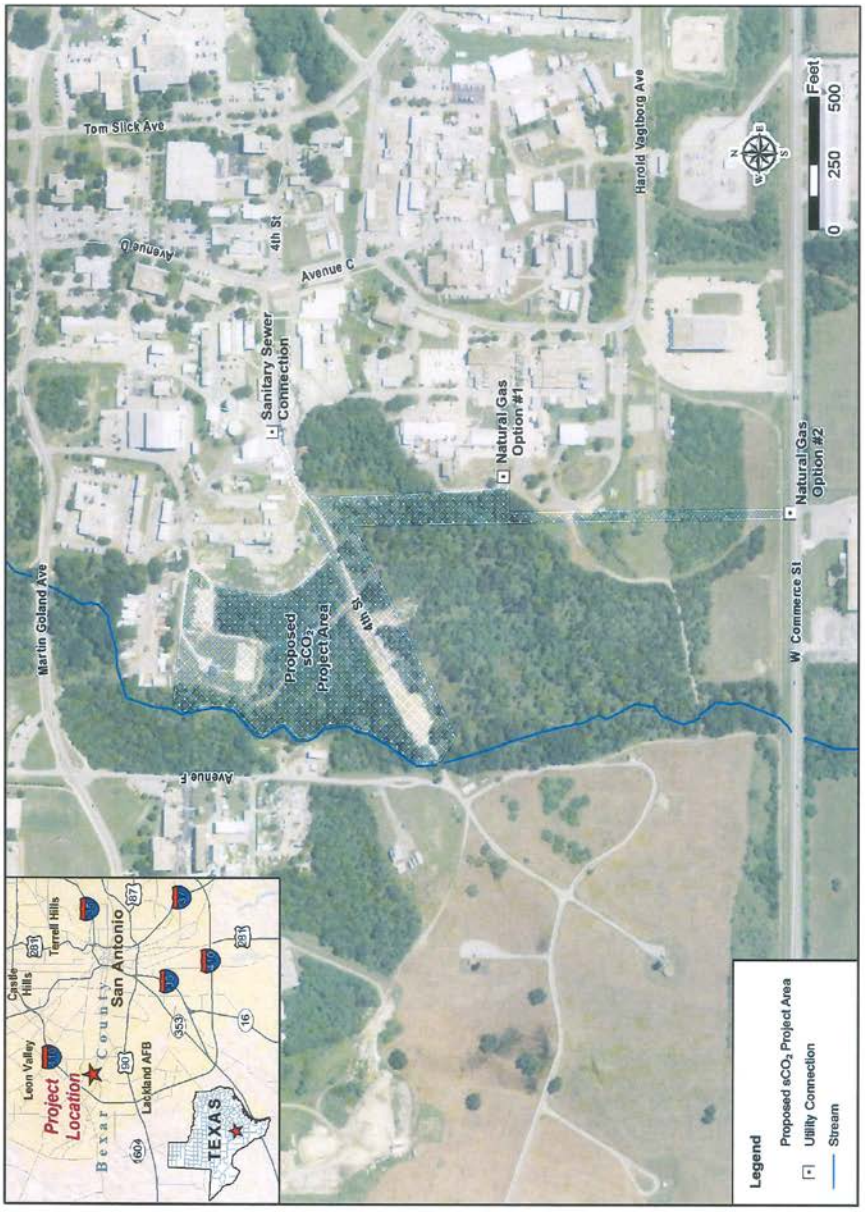


Figure 2. Proposed sCO_2 Test Facility Project Area

Page 9

A.4 U.S. FISH AND WILDLIFE SERVICE – AUSTIN ECOLOGICAL SERVICES FIELD OFFICE

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

NATIONAL ENERGY TECHNOLOGY LABORATORY

December 13, 2017

Ms. Tanya Sommer
U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
10711 Burnet Rd., Suite 200
Austin, Texas 78758

RE: Environmental Assessment for Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility, San Antonio, Texas

Dear Ms. Sommer:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for the Proposed Action of providing cost-shared funding to a project team led by Gas Technology Institute (GTI), Southwest Research Institute (SwRI), and General Electric Global Research (GE-GR) for a proposed 10-megawatt-electric (MWe) Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility Project at the SwRI, an existing research facility in San Antonio, Texas. The EA is being prepared to fulfill DOE's obligations under the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures. The EA will evaluate the potential effects of construction and 3-year operation of this proposed pilot plant test facility. The purpose of this letter is to initiate consultation with the U.S. Fish and Wildlife Service, Austin Ecological Services Field Office and to request information on any federal- or state-listed threatened, endangered, or candidate species, or critical habitat within the vicinity of the project.

The SwRI campus is an approximately 1,200-acre facility located at 6220 Culebra Road, San Antonio, Bexar County, Texas. The campus has been designated as Heavy Industrial (I-2) zoning district by the City of San Antonio. Immediately surrounding properties to the SwRI facility have been designated as Commercial, General Industrial, Residential, Multi-Family zone districts by the City of San Antonio. The SwRI campus is situated at an approximate latitude of 29°27'07.54"N and longitude of 98°36'36.23"W (see attached Figure 1).

Under the Proposed Action, DOE would provide approximately $79.9 million in cost-shared funding to GTI to design, construct, commission, and operate the proposed sCO_2 Pilot Plant Test Facility Project at the SwRI campus. The proposed project would involve the construction and 3-year operation of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

SwRI would construct the proposed sCO_2 Pilot Plant Test Facility south of Culebra Road in the central-western portion of the SwRI campus in an approximately 16.5-acre area of currently developed and undeveloped land. The currently undeveloped portion of the proposed project area supports deciduous trees, brush, herbaceous shrubs, and mowed grass. The proposed project would be integrated into the SwRI campus by utilizing available developed and undeveloped campus property for the proposed pilot plant test facility equipment and structures, construction laydown, equipment staging, upgrades to utilities, and use of an existing building for office space during construction and operations (see Figure 2).

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
pierina.fayish@netl.doe.gov@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

Utility upgrades would include a 4- or 8-inch diameter natural gas pipeline extension and a sanitary sewer line constructed by SwRI within the SwRI campus to connect the proposed pilot plant test facility to existing lines. Figure 2 presents the potential disturbance area for the two route options proposed for the new natural gas pipeline extension. Option 1 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.2 mile to the existing 8-inch diameter pipeline on the SwRI campus. Option 2 would involve construction of a new natural gas pipeline extension that would traverse approximately 0.4 mile to the existing CPS Energy 20-inch diameter natural gas main pipeline located along West Commerce Street. SwRI would also construct an approximately 0.12-mile sanitary sewer line. The attached site map presents the potential boundaries of disturbance for construction of the proposed sCO_2 Pilot Plant Test Facility Project (see Figure 2). The exact location of the equipment and building sited within the project area boundaries could change during design finalization, however, all project features would remain within the project area boundaries depicted on Figure 2.

DOE performed a search of the USFWS Endangered Species search engine (http://www.fws.gov/endangered/) for potential threatened and endangered species within Bexar County, Texas on November 1, 2017. Table 1 below presents those species noted as known or believed to occur within Bexar County, Texas, the preferred habitat, and an assessment of the preferred habitat to occur within the project area. DOE does not anticipate any adverse effects on federal- or state-listed wildlife species based on the location of the project and lack of preferred habitat for these species. As part of the NEPA process, we are seeking your input on any environmental issues or concerns your agency may have on the Proposed Action and the potentially affected areas as described above. We respectfully ask that you provide any information or comments within 30 days to enable us to complete this phase of the project within the scheduled timeframe, using the following contact information:

National Energy Technology Laboratory M/S 922-1W13
P.O. Box 10940
Pittsburgh, PA 15236
Attention: Pierina Fayish

Pierina.Fayish@NETL.DOE.GOV
(412) 386-5428

If you have any questions or require additional information, please do not hesitate to call or email. Thank you for your assistance in this matter.

Sincerely,

Pierina N Fayish

Pierina N. Fayish

Attachments:
Table 1 – Species List
Figure 1 – General Project Location
Figure 2 – Proposed sCO_2 Test Facility Project Area

Page 2

Table 1. Species List				
Group	**Common Name**	**Latin Name**	**Status**	**Preferred Habitat / Potential for Occurrence**
Arachnids	Cokendolpher Cave Harvestman	*Texella cokendolpheri*	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Arachnids	Government Canyon Bat Cave Spider	*Neoleptoneta microps*	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Arachnids	Madla's Cave Meshweaver	*Cicurina madla*	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Arachnids	Robber Baron Cave Meshweaver	*Cicurina baronia*	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Arachnids	Government Canyon Bat Cave Meshweaver	*Cicurina vespera*	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Arachnids	Braken Bat Cave Meshweaver	*Cicurina venii*	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Birds	Whooping crane	*Grus americana*	Endangered	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Project area lacks presence of water preferred by this species.
Birds	Piping Plover	*Charadrius melodus*	Threatened	Wide, flat, open, sandy beaches or lakeshores with little grass or other vegetation. Nesting territories often include small creeks or wetlands. Project area lacks presence of habitat preferred by this species.

Page 3

Table 1. Species List				
Group	**Common Name**	**Latin Name**	**Status**	**Preferred Habitat / Potential for Occurrence**
Birds	Black-capped Vireo	*Vireo atricapilla*	Endangered	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer. Project area lacks evergreen (juniper) component.
Birds	Golden-cheeked warbler (=wood)	*Dendroica chrysoparia*	Endangered	Juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer. Project area lacks evergreen (juniper) component.
Clams	Golden orb	*Quadrula aurea*	Candidate	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins. Project area lacks perennial water source/streambed.
Flowering Plants	Bracted twistflower	***Streptanthus bracteatus***	Candidate	Texas endemic; shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; several known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations; populations fluctuate widely from year to year, depending on winter rainfall; flowering mid-April to late May, fruit matures and foliage withers by early summer. Project area lacks evergreen (juniper) component and preferred soils.

Page 4

Table 1. Species List				
Group	**Common Name**	**Latin Name**	**Status**	**Preferred Habitat / Potential for Occurrence**
Insects	[no common name] Beetle	***Rhadine infernalis***	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.
Insects	Helotes mold beetle	***Batrisodes venyivi***	Endangered	Karst features in northwestern Bexar County and northeastern Medina County. Project area located in central Bexar County and away from karst terrain.
Insects	[no common name] Beetle	***Rhadine exilis***	Endangered	Karst features in north and northwest Bexar County. Project area located in central Bexar County and away from karst terrain.

Page 5

Page 6

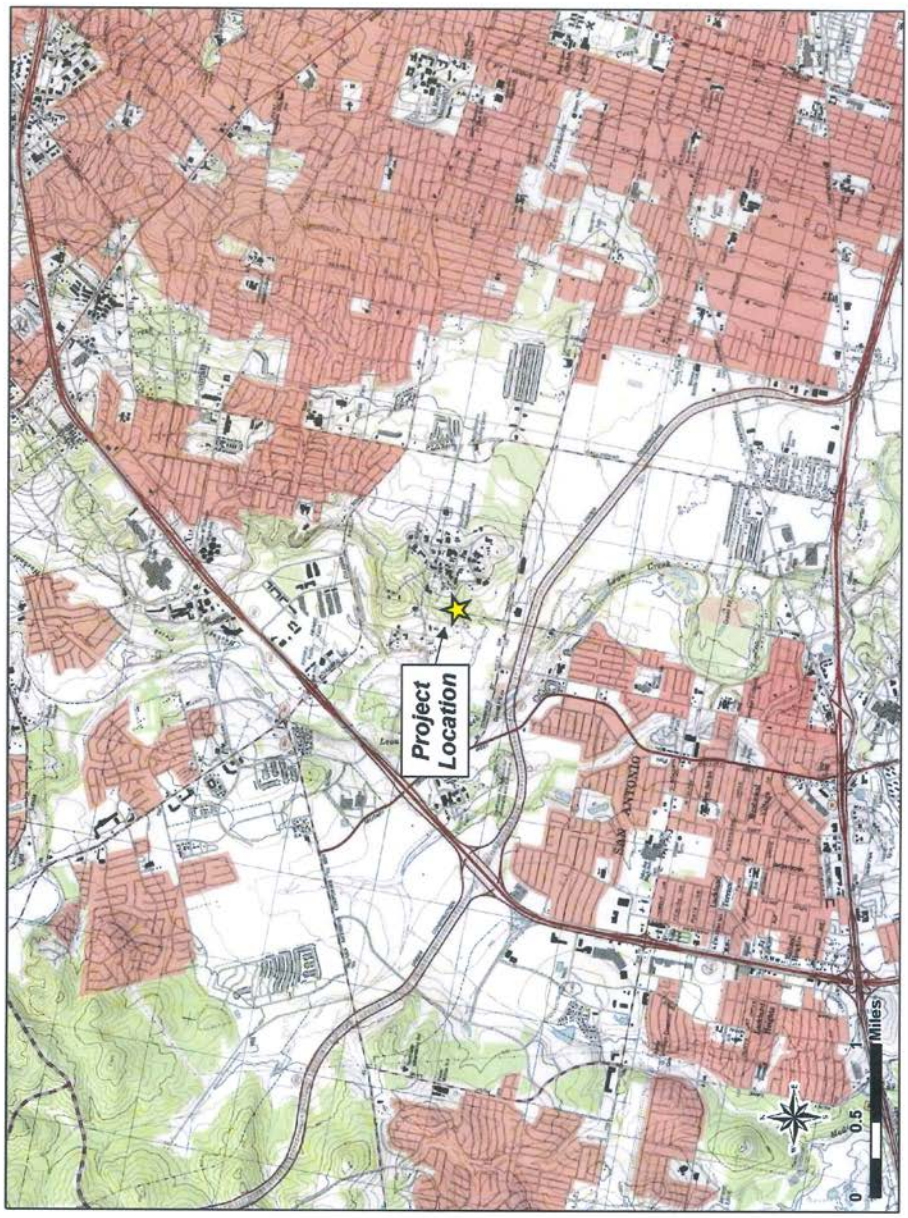


Figure 1. General Project Location

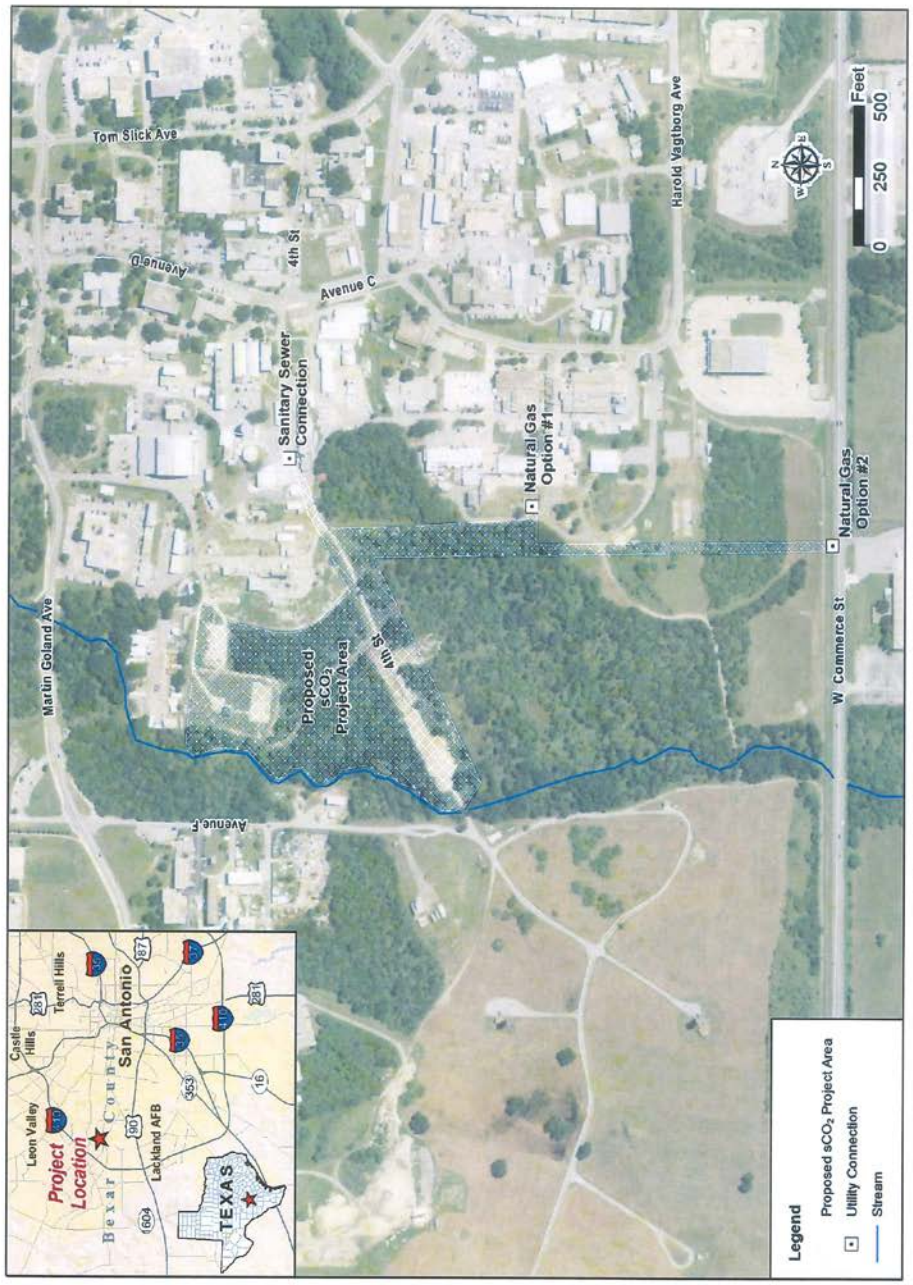


Figure 2. Proposed sCO_2 Test Facility Project Area

Page 7

Melissa Secor

Subject: RE: Carbon Dioxide Pilot Plant, San Antonio, TX

From: Williams, Christina [mailto:christina_williams@fws.gov]
Sent: Tuesday, January 9, 2018 10:23 AM
To: Fayish, Pierina M. <Pierina.Fayish@NETL.DOE.GOV>
Subject: Carbon Dioxide Pilot Plant, San Antonio, TX

Good Morning,

I had a note to reach out to you about this plant, but with the craziness of the holidays I'm not certain whether I did or not. This tract is in karst zone 3, areas that probably do not contain endangered karst invertebrates. A geologic assessment should confirm whether there are potential features within the tract that could support listed species.

Here is a link to our recommended survey protocol for features: https://www.fws.gov/southwest/es/Documents/R2ES/Karst_Survey_Procedures_20150528.pdf

Please let me know if you have any questions.

Christina

Christina Williams
U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
10711 Burnet Road, Ste. 200
Austin, Texas 78758
(512) 490-0057, ext. 235

1

A.5 INDIAN TRIBE CONSULTATION

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

NATIONAL ENERGY TECHNOLOGY LABORATORY

December 13, 2017

Tribe Point of Contact
Tribe
Tribe Point of Contact Title
Tribe Address
Tribe Address

RE: Environmental Assessment for Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility, San Antonio, Texas

Dear Tribe Point of Contact:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for the Proposed Action of providing cost-shared funding to a project team led by Gas Technology Institute (GTI), Southwest Research Institute (SwRI), and General Electric Global Research (GE-GR) for a proposed 10-megawatt-electric (MWe) Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility Project at the SwRI, an existing research facility in San Antonio, Texas. The EA is being prepared to fulfill DOE's obligations under the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures. The EA will evaluate the potential effects of construction and 3-year operation of this proposed pilot plant test facility.

This undertaking and its effects are also being considered under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and implementing regulations at 36 CFR Part 800. As part of compliance with Section 106, DOE is writing to seek your comments on any issues or concerns for traditional cultural properties, sacred sites, or site of traditional religious or cultural importance in the area that might be affected by the proposed project (see attached Figure 1) and would like to know whether you wish to receive a copy of the draft EA.

The SwRI campus is an approximately 1,200-acre facility located at 6220 Culebra Road, San Antonio, Bexar County, Texas. The campus has been designated as Heavy Industrial (I-2) zoning district by the City of San Antonio. Immediately surrounding properties to the SwRI facility have been designated as Commercial, General Industrial, Residential, Multi-Family zone districts by the City of San Antonio. The SwRI campus is situated at an approximate latitude of 29°27'07.54"N and longitude of 98°36'36.23"W. DOE is also consulting with the Texas Historical Commission regarding heritage resources within the vicinity of the project.

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
pierina.fayish@netl.doe.gov@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

Under the Proposed Action, GTI would design, construct, commission, and operate the sCO_2 Pilot Plant Test Facility Project at the SwRI campus (see Figure 2). The proposed project would involve the construction and 3-year operation of a pilot plant test facility to verify the performance and integrity of the components, demonstrate a pathway toward a thermodynamic cycle efficiency greater than 50 percent, and show the potential for cost savings in electricity generation.

DOE anticipates a finding of No Adverse Effect within the Area of Potential Effect (APE) for indirect effects to historic properties and anticipates a finding of No Historic Properties within the APE for direct effects to historic properties. We respectfully ask that you provide any information or comments regarding your tribe's interest within 30 days to enable us to complete this phase of the project within the scheduled timeframe and instruct DOE as to whether your tribe would like to see a copy of the Draft EA, when available. Please direct comments to:

National Energy Technology Laboratory M/S 922-342C
P.O. Box 10940
Pittsburgh, PA 15236
Attention: Pierina Fayish

Pierina.Fayish@NETL.DOE.GOV
(412) 386-5428

If you have any questions or require additional information, please do not hesitate to call or email. Thank you for your assistance in this matter.

Sincerely,

Pierina N. Fayish

Attachments:
Figure 1 – General Project Location
Figure 2 – Proposed sCO_2 Test Facility Project Area

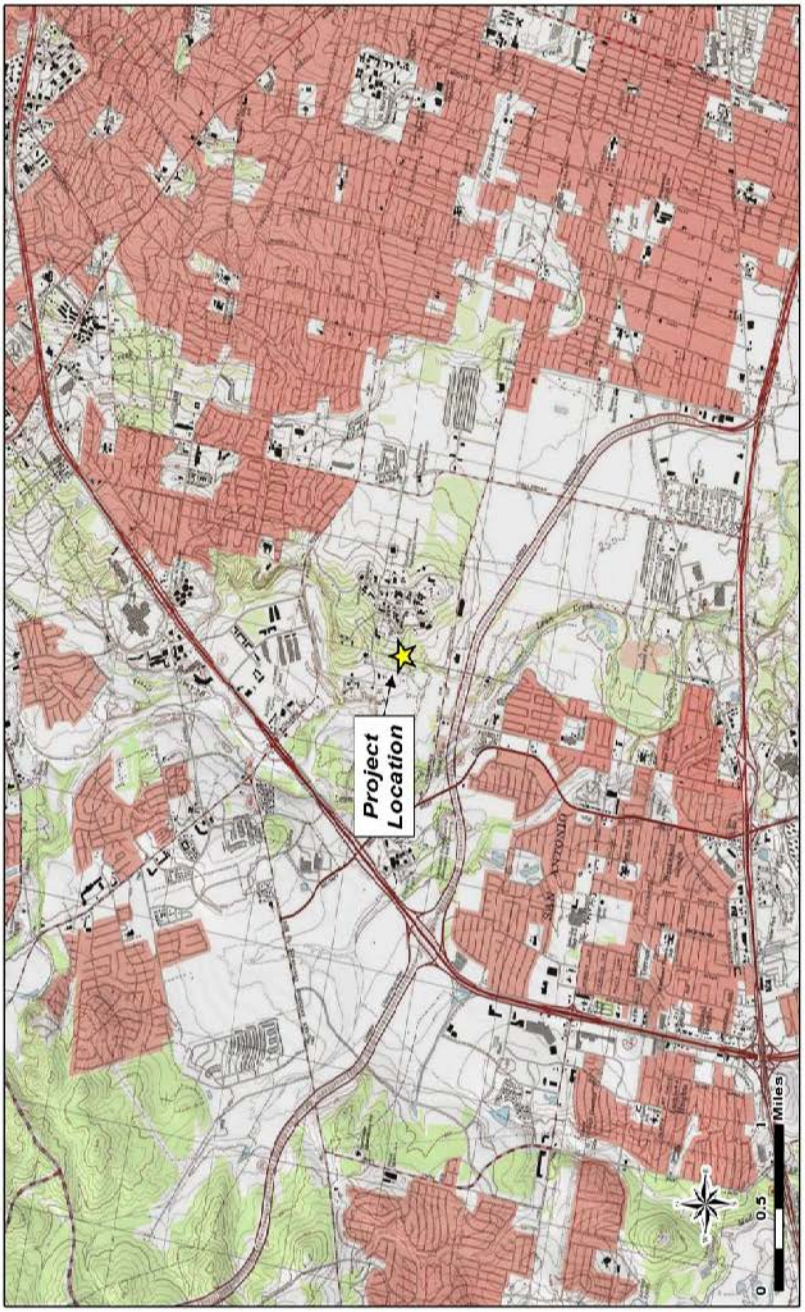


Figure 1. General Project Location

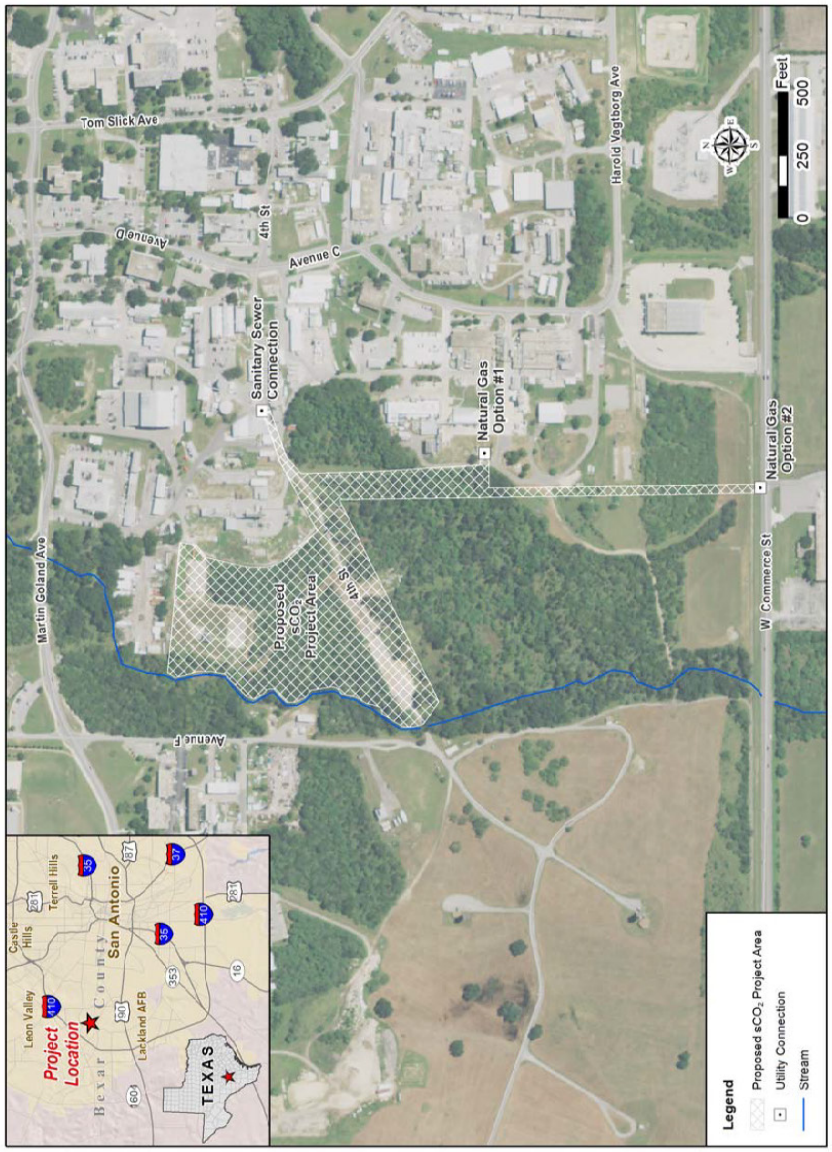


Figure 2. Proposed sCO_2 Test Facility Project Area

COMANCHE NATION

National Energy Technology Laboratory
Attn: Pierina N. Fayish
P.O. Box 10940
Philadelphia 15236

January 10, 2018

Re: Environmental Assessment for Supercritical Carbon Dioxide (sCO2)
Pilot plant Test Facility, San Antonio, Texas

Dear Pierina Fayish:

In response to your request, the above reference project has been reviewed by staff of this office to identify areas that may potentially contain prehistoric or historic archeological materials. The location of your project has been cross referenced with the Comanche Nation site files, where an indication of ***"No Properties"*** have been identified. (IAW 36 CFR 800.4(d)(1)).

Please contact this office at (580) 595-9960/9618) if you require additional information on this project.

This review is performed in order to identify and preserve the Comanche Nation and State cultural heritage, in conjunction with the State Historic Preservation Office.

Regards

Comanche Nation Historic Preservation Office
Theodore E. Villicana ,Technician
#6 SW "D" Avenue , Suite C
Lawton, OK. 73502

COMANCHE NATION P.O. BOX 908 / LAWTON, OK 73502
PHONE: 580-492-4988 TOLL FREE:1-877-492-4988

QUAPAW TRIBE OF OKLAHOMA

P.O. Box 765
Quapaw, OK 74363-0765

(918) 542-1853
FAX (918) 542-4694

January 10, 2018

Company ?
626 Cochrans Mill Road
P.O. Box 10940
Pittsburg, PA 15236

Re: EA Supercritical Carbon Dioxide (sCO_2) Pilot Plant Test Facility, San Antonio Texas.

To Whom It May Concern:

This project is outside of the current area of interest for the Quapaw Tribe; therefore, the Quapaw Tribe does not desire to comment on this project at this time. Thank you for your efforts to consult with us on this matter.

Sincerely,

Everett Bandy

Everett Bandy, THPO
Quapaw Tribe of Oklahoma
P.O. Box 765
Quapaw, OK 74363
(p) 918-238-3100

POARCH BAND OF CREEK INDIANS
5811 Jack Springs Road • Atmore, Alabama 36502
Tribal Offices: (251) 368-9136 • Administrative Fax: (251) 368-4502
www.poarchcreekindians-nsn.gov

January 12, 2018

Pierina N. Fayish
National Energy Technology Laboratory M/S 922-342C
P O Box 10940
Pittsburgh PA 15236
pierina.fayish@netl.doe.gov

RE: PBCI FN 2018-005
Pilot Plant Test Facility, San Antonio TX

Dear Ms. Fayish:

I am in receipt of your notice and accompanying information regarding the proposed above referenced Project **Pilot Plant Test Facility, San Antonio TX**. I appreciate the opportunity to provide comment on this project.

The location of the proposed project is in a geographical area that has not been identified as part of our ancestral homelands and I am not aware of any cultural or historical resources that might be impacted by this project. I defer to Tribes whose lineage has been affirmed for this geographical region for the required Section 106 review of potential historic and cultural resources. Tribes historically associated with the site will be better suited to provide relevant input.

In the event of unexpected discovery of any pre-contact artifacts, historic artifacts or human remains associated with Native Americans at any time within the project site area, the undertaking should cease, as well as all activities involving subsurface disturbance in the vicinity of the discovery should cease. I may be contacted at the THPO Office at (251) 368-9136 Ext. 2532 or by email to cwhite@pci-nsn.gov.

Sincerely,
Carolyn M. White
Carolyn M. White, MSW, LICSW
Regulatory Affairs Division Director
Acting Tribal Historic Preservation Officer

ccf/cmw

cc: Stephanie A. Bryan, Tribal Chair

Seeking Prosperity and Self Determination

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APPENDIX B
ENVIRONMENTAL SYNOPSIS OF SUPERCRITICAL CARBON DIOXIDE PILOT PLANT TEST FACILITY

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Environmental Synopsis of

Supercritical Carbon Dioxide Pilot Plant Test Facility

Funding Opportunity Announcement
DE-FOA-0001457

U.S. Department of Energy
National Energy Technology Laboratory

June 2016

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CONTENTS

LIST OF TABLES

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1. INTRODUCTION AND BACKGROUND

The U.S. Department of Energy (DOE), National Energy Technology Laboratory, issued a Funding Opportunity Announcement (FOA) DE-FOA-0001457, *Supercritical Carbon Dioxide Pilot Plant Test Facility* (DOE 2016). This FOA is funded by a supercritical carbon dioxide (sCO_2) crosscutting initiative sponsored by the DOE Offices of Energy Efficiency and Renewable Energy, Fossil Energy, and Nuclear Energy, a collaborative program with the specific mission to reduce the technical barriers and risks to commercialization of the sCO_2 power cycle. The program is structured around a common goal to establish a 10-MWe scale Supercritical Transformational Electric Power (STEP) facility for evaluating the power cycle and component performance over a range of operating conditions.

The potential efficiency and cost-of-electricity (COE) advantages over conventional steam Rankine cycles present opportunities for a large market for the developed sCO_2 power cycle technologies as well as extensive energy cost savings. For fossil fuel based applications these efficiency improvements can enable a power plant to generate the same amount of electricity from less fuel, thus decreasing CO_2 emissions. Furthermore, the relatively high density of sCO_2 leads to compact turbomachinery, potentially leading to reduced capital costs for power plants. Through the STEP program, the U.S. has a unique opportunity to position themselves on the forefront of next generation power generation technology.

The purpose of this FOA is to seek applications for a project to complete the plan, design, build and assembly, and operation of a nominally 10-MWe sCO_2 Pilot Plant Test Facility. The objectives of this project and facility will be to demonstrate the operability of the sCO_2 power cycle, verify the performance of components (turbomachinery, recuperators, and compressors, etc.), demonstrate the potential for producing a lower cost of electricity in relevant applications, and demonstrate a potential for a thermodynamic cycle efficiency greater than 50 percent. The technical approach to building and demonstrating the operability of this facility, and meeting the objectives of the project, will be based on the recommendations proposed by the selected applicant. Ultimately, this facility must demonstrate a 700°C turbine inlet temperature or higher design point, and produce a recompression closed Brayton cycle (RCBC) configuration that can be used to demonstrate and evaluate system and component design and performance capabilities (including turbomachinery and recuperators in steady state, transient, load following, and limited endurance operation). The facility must also be capable of being reconfigured to accommodate potential future testing of system/cycle upgrades, new cycle configurations (i.e., cascade cycles, directly fired cycles, etc.), and new or upgraded components (turbomachinery, recuperators, and heat exchangers). Therefore, the design basis for this facility should include the flexibility (footprint accessibility considerations, standardized component flanging, standardized fittings, standardized data acquisition systems and components, etc.) to accommodate future facility utilization to support continued demonstration of sCO_2 power cycle technologies.

As a federal agency, the DOE must comply with the *National Environmental Policy Act of 1969* (NEPA) (42 USC 4321 et seq.) by considering potential environmental issues associated with its

actions prior to undertaking the actions. The NEPA environmental review of projects evaluated under the Supercritical Carbon Dioxide Pilot Plant Test Facility FOA will be prepared pursuant to Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500 – 1508), and the Department's NEPA implementing procedures (10 CFR Part 1021), which provide directions specific to procurement actions that DOE may undertake or fund before completing the NEPA process. Per these regulations, DOE has prepared an Environmental Critique and this Environmental Synopsis to support the procurement selection process.

The Environmental Critique evaluated two proposed projects submitted for the Supercritical Carbon Dioxide Pilot Plant Test Facility FOA. The critique was developed to meet the DOE NEPA implementing procedures and, specifically, to meet the requirements in those procedures for environmental critiques of procurements, financial assistance, and joint ventures [10 CFR 1021.216(f) and (g)].

Only those projects for which an Environmental Assessment (EA) or Environmental Impact Statement (EIS) could be required were evaluated. The critique did not address projects submitted for the FOA that could be categorically excluded in accordance with Subpart D of 10 CFR Part 1021. However, it is noted that no projects that could be categorically excluded at this time were received for evaluation.

The Environmental Critique provided an evaluation and comparison of potential environmental impacts for each proposed project deemed to be within the competitive range. DOE used the critique to evaluate appreciable differences in the potential environmental impacts from those projects. As delineated in 10 CFR 1021.216(g), the Environmental Critique focused on environmental issues pertinent to a decision among the project proposals and included a brief discussion of the purpose of the procurement and each proposed project, a discussion of the salient characteristics of each project, and a brief comparative evaluation of the environmental impacts of the projects. The critique represents one aspect of the formal process used to select among applicants for funding under the Supercritical Carbon Dioxide Pilot Plant Test Facility FOA. As such, it is a procurement-sensitive document and subject to all associated restrictions.

This document is the Environmental Synopsis, which is a publicly available document corresponding to the Environmental Critique. The Environmental Synopsis documents the evaluation of potential environmental impacts associated with the proposed projects in the competitive range and does not contain procurement-sensitive information. The specific requirements for an Environmental Synopsis delineated in 10 CFR 1021.216(h) are as follows:

> *(h) DOE shall prepare a publicly available environmental synopsis, based on the environmental critique, to document the consideration given to environmental factors and to record that the relevant environmental consequences of reasonable alternatives have been evaluated in the selection process. The synopsis will not contain business, confidential, trade secret or other information that DOE otherwise would not disclose pursuant to 18 U.S.C. 1905, the confidentiality*

requirements of the competitive procurement process, 5 U.S.C. 552(b) and 41 U.S.C. 423. To assure compliance with this requirement, the synopsis will not contain data or other information that may in any way reveal the identity of offerors. After a selection has been made, the environmental synopsis shall be filed with EPA, shall be made publicly available, and shall be incorporated in any NEPA document prepared under paragraph (i) of this section.

To address the above requirements, this Environmental Synopsis includes: (1) a brief description of background information related to the Supercritical Carbon Dioxide Pilot Plant Test Facility FOA, (2) a general description of the project proposals received in response to the FOA and deemed to be within the competitive range, (3) a summary of the assessment approach used in the Environmental Critique to evaluate the potential environmental impacts associated with the projects, and (4) a summary of the environmental impacts presented in the critique, focusing on potential differences among the projects. Because of confidentiality concerns, the project proposals and environmental impacts are discussed in general terms. If an EA is prepared for these projects this synopsis will be included as an Appendix in the EA and available for public comment.

2. DESCRIPTION OF APPLICATIONS

This Environmental Critique evaluated two proposed projects, both of which could potentially require an EA or/and EIS. The objectives for both of these projects are focused on completion of the plan, design, build and assembly, and operation of a nominally 10-MWe sCO_2 Pilot Plant Test Facility.

The following are brief descriptions of the characteristics of each of the two projects evaluated. The aspects of the projects that could result in potential environmental impacts, and that were considered in the Environmental Critique, are briefly described. All procurement sensitive information has been removed from the descriptions. Most projects include other activities that would likely result in minor or no impacts on the environment (e.g., impacts to community services); these other activities are not discussed in the Environmental Synopsis.

1. Project #1

Period: 5 years
Location: Ohio

The applicant proposes to plan, design, build and assemble, and operate a 10-MWe (net) STEP test facility for evaluating sCO_2 Brayton power cycles and components. The STEP test facility would operate at turbine inlet temperatures up to 1292 degrees Fahrenheit (700 degrees Celsius) using an RCBC configuration that would demonstrate and evaluate system and component design and performance. This proposed project would largely utilize an existing turbomachinery testing facility with significant infrastructure already in place. New exterior additions to this facility as part of this project include an air-cooled condenser, a new exhaust stack, a CO_2

storage system, resistive load banks, and a primary heater and burner. A modified Synthetic Minor Title V (SMTV) air permit would be required as part of this proposal due to addition of the exhaust stack and increased fuel use. In addition, the applicant would need to submit an application for a Permit-To-Install with the Ohio Environmental Protection Agency. An existing National Pollution Discharge Elimination System (NPDES) permit may need to be modified if future water demands or processes change. The applicant indicated that additional site, building, and construction-related permits would be obtained, as required.

2. Project #2

Period: 5.5 years
Location: Texas

The applicant proposes to design, construct, commission, and operate a reconfigurable 10-MWe sCO_2 Pilot Plant Test Facility located at the Texas campus of a project partner. This pilot plant test facility would demonstrate and document the operability of the sCO_2 power cycle in a phased manner starting as a simple recuperate cycle configuration operating at 500 degrees Celsius and progressing to an RCBC configuration operating at 715 degrees Celsius to support cycle efficiency and endurance testing. This proposal would require construction of a new 12,000 square foot facility on a five-acre parcel surrounded by open buffer space at the center of the Texas campus. Significant support infrastructure for the design, construction, and operation of the 10-MWe plant already exists. Along with potential impacts related to new construction activities, new and modified permits would be required as part of proposed activities. These permits include a Resource Conservation and Recovery Act (RCRA) Subpart B permit, Texas Commission on Environmental Quality (TCEQ) Standard Permit for Electric Generating Units (EGUs) (new source), Industrial Wastewater PreTreatment permit, stormwater prevention measures, and construction permits.

3. ASSESSMENT APPROACH

Each of the two FOA applicants was required to submit an environmental questionnaire. The questionnaires included detailed information on the proposed projects including the following:

- Project Summary and objectives
- Work locations
- Materials used and produced (e.g., water, electricity, wastewater, air emissions)
- Proposed alternatives
- Land use changes
- Proximity to local, state, or national parks, forests, monuments, scenic waterways, wilderness, recreation facilities, or Tribal lands
- Potential impacts of construction activities
- Potential impacts to surface waters, floodplains, or wetlands
- Use of nanotechnology or recombinant DNA or genetic engineering

- Potential impacts to any vegetation and wildlife resources
- Changes that could result in socioeconomic or infrastructure conditions
- Potential impacts to historic or cultural resources
- Attainment status for the air quality conditions for the immediate project area
- Potential air emissions from the proposed project
- Potential amounts of wastewater, solid, hazardous, and radioactive wastes produced
- Unique health and safety factors associated with the project
- Any required permitting or other regulatory compliance activities
- Facility decommissioning and/or disposition of equipment and materials
- Potential for public controversy

For each project considered in the Environmental Critique, the potential direct and indirect effects, short-term and long-term effects, and unavoidable adverse effects were identified for 20 resource areas. These resource areas are included as the first 20 entries in Table 1 in Section 4. The Environmental Critique also included a summary of project components/activities, as well as an evaluation of areas related to resource areas including the potential for public controversy, permits that may be required, and potential mitigation measures.

The information used to evaluate potential environmental impacts was ascertained from the environmental questionnaires, project summaries, project narratives, and other files that the applicants provided.

4. SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

This section provides a summary of the potential impacts for each project. Table 1 identifies the resource areas that could be adversely or beneficially impacted for each of the two proposed projects. For each project, the potential direct and indirect, short-term and long-term, and unavoidable impacts were identified and classified into one of the following four color-coded categories:

- No impacts to a resource area are expected – blank
- Potential for minor adverse or beneficial impacts or unknown impacts of possible minor concern – black text or dot, no shading
- Potential for moderate adverse impacts or unknown impacts of possible moderate concern – light shading
- Potential for major adverse impacts or unknown impacts of possible major concern – darker shading

As summarized in Table 1, the projects have the potential largely for either no impacts or minor impacts on the environment. Because of the nature of the projects (e.g., design, build, and

operate a 10-MWe sCO_2 pilot plant test facility at developed locations including a Brownfield industrial manufacturing site and a research campus), they would have no or minor impacts on the visual, biological, or cultural resource areas. The projects would also have minor short-term air quality, noise, soil, and traffic/transportation impacts during construction and no-to-uncertain impacts on waste generation/identification during construction and/or facility operation. The projects would have minor beneficial impacts on socioeconomic conditions and utility operations.

Neither of the projects analyzed in this Environmental Critique has the potential for major or moderate adverse impacts, unknowns, or uncertainties that would result in major or moderate potential impacts to the environment.

Table 1. Summary of Potential Impacts of Supercritical Carbon Dioxide Pilot Plant Test Facility Projects

Resource Areas	Project #1	Project #2
Aesthetics	●	●
Air Quality	●	●
Biological Resources		●
Climate		
Community Services		
Cultural Resources		
Environmental Justice		
Floodplains		
Geology		
Groundwater		
Human Health and Safety		
Land use		●
Noise	●	●
Wastes and Materials	●	●
Soils	●	●
Socioeconomics	●	●
Surface Water		
Transportation/Traffic	●	●
Utilities	●	●
Wetlands		
Public Controversy		
Permits	●	●
Mitigation Measures	●	●

(Blank) No impacts expected.
● Potential to be minor adverse or beneficial impacts or there are unknowns of possible minor concern.
● Potential to be moderate adverse impacts or there are unknowns of possible moderate concerns.
● Potential to be major adverse impacts or there are unknowns of possible major concerns.

5. REFERENCES

DOE, 2016 U.S. Department of Energy, National Energy Technology Laboratory, *Supercritical Carbon Dioxide Pilot Plant Test Facility, Funding Opportunity Announcement Number: DE-FOA-0001457*, March 15, 2016.