DOE/EA-1625

FINAL ENVIRONMENTAL ASSESSMENT

Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Early Test

March 2009

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/m^3	Micrograms per Meter Cubed
3-D	Three Dimensional
AERCB	Alberta Energy Resources Conservation Board
ANSI	American National Standard Institute
APC	Mississippi Air Permit Program Regulations
AQCR 005	Mobile-Pensacola-Panama City-Southern Mississippi
AQCR	Air Quality Control Region
ATSDR	Agency for Toxic Substances and Disease Registry
asl	Above Sea Level
BEG	Texas Bureau of Economic Geology
BLS	Bureau of Labor Statistics
BMPs	Best Management Practices
CAA	Clean Air Act
CARB	California Air Resources Board
CCAR	California Climate Action Registry
CCS	Carbon Capture and Storage
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CF	Center Frequency
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted decibel
de minimus	of Minimal Importance
Denbury	Denbury Resources International Company (Denbury Resources)
DNL	Day-night Average Sound Level
DOE	U.S. Department of Energy
e.g.	*Exempli gratia*, for example
EA	Environmental Assessment
EDR	Environmental Data Resources
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EIV	Environmental Informational Volume
EOR	Enhanced Oil Recovery
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act

et al.	*et alia,* and others
et seq.	*et sequens,* and the following one or ones
etc.	*et cetera,* and so on
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
Ft	Feet or Foot
ft^3/sec	Cubic Feet Per Second
gal.	Gallons
GHG	greenhouse gas
Gt	Gigaton
HFCs	hydrofluorocarbons
hp	horsepower
HW	Mississippi Hazardous Waste Management Program Regulations
Hz	Hertz
kg	Kilogram
km	Kilometer
km^2	Square Kilometer
kW	kilowatt
kWh	kilowatt hour
i.e.	*id est,* that is
IPCC	Intergovernmental Panel on Climate Change
L	Liter
lbs	Pounds
Ldn	equivalent day night level
Leq	Equivalent Sound Level
LW	Mississippi Licensing of Well Contractors Program Regulations
Lw	sound power levels
m	Meter
m^3	cubic meter
MARIS	Mississippi Automated Resource Information Service
mD	millidarcy
MDAH	Mississippi Department of Archives and History
MDEQ	Mississippi Department of Environmental Quality
MDOT	Mississippi Department of Transportation
mg/L	Milligrams Per Liter
mi^2	Square Miles
mm	Millimeter
MMV	Measurement, Mitigation, and Verification
MSNHP	Mississippi Natural Heritage Program
MSOGB	Mississippi State Oil and Gas Board
MW	Megawatt
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory

NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NO_2	Nitrogen Dioxide
NO_x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	Noise Sensitive Area
NSPS	New Source Performance Standards
NSR	New Source Review
O_3	Ozone
OSHA	Occupational Safety and Health Administration
Pb	Lead
PFCs	Perfluorocarbons
PM_{10}	Particulate Matter Less Than 10 Microns in Diameter
$PM_{2.5}$	Particulate Matter Less Than 2.5 Microns in Diameter
ppm	Parts per Million
PSD	Prevention of Significant Deterioration
PUBHh	Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded wetland
PWL	Power Level
R&D	Research and Development
R2USA	Riverine, Lower Perennial, Unconsolidated Shore, Temporarily Flooded
RCRA	Resource Conservation and Recovery Act
Rd.	Road
SDWA	Safe Drinking Water Act
sec	second
SECARB	Southeast Regional Carbon Sequestration Partnership
SF_6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office (Officer)
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SSEB	Southern States Energy Board
SW	Mississippi Non-hazardous Solid Waste Program Regulations
T&E	Threatened and Endangered
TDS	Total Dissolved Solids
THPO	Tribal Historic Preservation Officer (Office)
TL	Transmission Loss
tpy	Tons Per Year
UIC	Underground Injection Control
UNFCCC	United Nations Framework Convention on Climate Change
USC	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compounds
VSP	Vertical Seismic Profiling
WPC	State of Mississippi Water Pollution Control Law
yd^3	cubic yards

USE OF SCIENTIFIC NOTATION

Very small and very large numbers are sometimes written using scientific notation rather than as decimals or fractions. This notation uses exponents to indicate the power of 10 as a multiplier (i.e., 10^n, or the number 10 multiplied by itself n times; 10^{-n}, or the reciprocal of the number 10 multiplied by itself n times).

For example: $10^3 = 10 \times 10 \times 10 = 1{,}000$

$$10^{-3} = \frac{1}{10 \times 10 \times 10} = 0.001$$

In scientific notation, large numbers are written as a decimal between 1 and 10 multiplied by the appropriate power of 10:

4,900 is written $4.9 \times 10^3 = 4.9 \times 10 \times 10 \times 10 = 4.9 \times 1{,}000 = 4{,}900$
0.049 is written 4.9×10^{-2}
1,490,000 or 1.49 million is written 1.49×10^6

A positive exponent indicates a number larger than or equal to one; a negative exponent indicates a number less than one.

1.0 INTRODUCTION

1.1 Summary

Carbon dioxide (CO_2) is a natural and important component of the atmosphere: animals and plants produce CO_2 during respiration, and plants need it for photosynthesis; however, high concentrations of CO_2 in the atmosphere can exert a "greenhouse" effect that traps heat within the Earth's atmosphere. Global emissions of CO_2 from human activity have increased from an insignificant level two centuries ago to over twenty-one billion metric tons per year by 2003 (DOE, 2007a). The most notable human activity associated with the generation of CO_2 emissions is the combustion of carbon-based fuels (including oil, natural gas, and coal). Many scientists, including the Intergovernmental Panel on Climate Change (IPCC), recognize a danger that even a modest increase in the Earth's temperature (called "global warming") could alter the global climate and cause significant adverse consequences for human health and welfare (DOE, 2007a).

In one of many governmental efforts to address the concerns outlined above, the Department of Energy (DOE) established the Carbon Sequestration Program in 1997 with the focus of conducting research and development (R&D) activities to evaluate and develop carbon sequestration technologies. Carbon sequestration involves capturing and storing CO_2 emissions prior to release into the atmosphere, as well as enhancing natural carbon uptake and storage processes. Geologic sequestration involves the permanent storage of CO_2 in deep unmineable coal seams, depleted oil and gas reservoirs, or saline (saltwater-filled) formations. Impermeable caprocks and/or geologic structural or stratigraphic traps retain the CO_2 in the formation similar to natural gas storage trapping mechanisms. As a part of this program, DOE formed a nationwide network of regional partnerships to help determine the best approaches for capturing and permanently storing gases that can contribute to global climate change. The Regional Carbon Sequestration Partnerships are a government/industry effort tasked with determining the most suitable technologies, regulations, and infrastructure needs for carbon capture, storage, and sequestration in different areas of the country. The Regional Partnerships' initiative is being implemented in three phases:

- Phase I, Characterization (2003-2005): Characterized opportunities for carbon sequestration, including potential geologic storage formations and trapping mechanisms;
- Phase II, Validation (2005-2009): Small scale field tests are currently under way to verify the injection rates, storage media, and trapping mechanisms; and
- Phase III, Deployment (2008-2017): Conduct large volume carbon storage validation tests.

Geographical differences in fossil fuel use and available sequestration sinks across the United States dictate regional approaches to sequestration of CO_2 and other greenhouse gases. The seven partnerships that currently form this network include over 350 state agencies, universities, and private companies, spanning 41 states, two Indian nations, and four Canadian provinces. In addition, agencies from six member countries of the Carbon Sequestration Leadership Forum are participating in the Validation Phase field tests. The Southeast Regional Carbon Sequestration Partnership (SECARB) is one of these regional partnerships and this Environmental Assessment (EA) focuses on one of its proposed projects.

Early data collection and characterization done through Phases I and II have shown that the Lower Tuscaloosa Massive Sand Unit is a large, regionally extensive saline formation with the potential to hold centuries of CO_2 emissions in the Southeast (SECARB, 2008; Hill, 2007). The Tuscaloosa Group is estimated to have a CO_2 storage capacity of 10,760 million metric tons to 43,040 million metric tons (SECARB, 2008). The Lower Tuscaloosa Formation is a key component of a larger, regional group of similar formation called the Gulf Coast Wedge (SECARB, 2008; Hill, 2007; NETL, 2008a). The Gulf Coast Wedge is estimated to have enough capacity to store the estimated regional annual CO_2 emissions of 1.1 billion short tons (1 billion metric tons) for 300 to 1,200 years (NETL, 2008a). SECARB's Phase III project would, if funded, further test this geologic formation at two sites: 1) the Cranfield Oilfield, located near Natchez, Mississippi (the "Early Test"); and 2) at a Southern Company CO_2 capture test location (yet to be determined). The Early Test is the only focus of this EA.

The DOE proposes to co-fund a project to inject and closely monitor the flow of approximately 1.7 million short tons (1.5 million metric tons) of supercritical carbon dioxide into the brine-bearing Tuscaloosa Formation in an area within the lease boundaries of the Cranfield Unit oilfield, about 12 miles (19 kilometers (km)) east of Natchez, Mississippi (Figure 2.1.1). The project team would be led by the Southern States Energy Board (SSEB), and include the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin as a subcontractor. The host site for the proposed project is owned by Denbury Resources International Company (Denbury). This field experiment is known as the SECARB Phase III Early Test project. The proposed injection period for this Phase III Early Test is 18 months followed by at least one year of post-injection monitoring.

Under the Proposed Action, three existing injection wells would be utilized and a fourth well would be drilled to extend below the oil-brine interface. These four primary injection wells (the three existing and a proposed new well) would use existing well pads used during the previous production at the Cranfield Unit and directionally drilled to the desired down-hole locations in the saline portion of the formation below the oil-brine interface. Two observation wells would also be drilled from one of the reconditioned well pads and will be dedicated full time to continuous monitoring of the formation response to the CO_2 flood. Two additional water wells would be drilled to approximately 200 feet (61 meters (m)) using a truck-mounted drilling rig to evaluate the performance of shallow groundwater monitoring strategies.

CO_2 now being transported from a natural source at Jackson Dome (near Jackson, Mississippi) to Cranfield through the existing commercial Denbury Sonat pipeline (Figure 2.1.2) as part of an ongoing enhanced oil recovery (EOR) operation would be used for this proposed project. Injection will occur primarily in existing wells. Three existing wells would be used and one new well would be drilled to extend into the brine layer in the down-dip water leg of the formation. The focal point of the proposed activity is monitoring of the injected CO_2 to understand its subsurface flow mechanisms. The existing completions would remain open in the injection and monitoring wells for approximately 1 year to allow for continued monitoring of the subsurface CO_2 flow after final injection.

The decision for DOE is to either fund or not fund the Proposed Action which includes data acquisition and the additional drilling and injection activities associated with that data acquisition. Denbury intends to conduct EOR activities at this location regardless of DOE's decision to participate or not participate. Table 1.1 below is based on that premise and illustrates that there is little difference in potential environmental impacts between the Proposed Action and the No-Action alternative.

Table 1.1. Comparison of Impacts

Resource	No-Action Alternative	Proposed Action
Air Quality	Some temporary *de minimus* decrease in localized air quality due to increased emissions of diesel engines used during EOR activities; however, the project is not expected to produce emissions that would impede the area's conformity with the State Implementation Plan under the Clean Air Act.	Same as No-Action.
Geology and Soils	Some long-term increase in subsurface pressures due to CO_2 injection may occur as part of EOR activity; however, the Proposed Action is not expected to cause measurable leakage of CO_2 from the storage formation to the surface or into another area in the subsurface, and there is no more than an imperceptible risk of inducing seismic events due to increased reservoir pressure.	There is the potential for higher pressure in the reservoir due to the additional amount of CO_2 injection called for beyond EOR activity.
Water Resources	Any changes to water quality and quantity would be expected to occur at the lowest detectable levels. Full recovery would occur in a reasonable time.	Some modest increase in water usage is expected due to the drilling of injection and monitoring wells specific to NETL's data needs.
Wetlands and Floodplains	No significant impacts to local wetlands and/or floodplains are expected and any impacts to wetlands and/or floodplains would be confined to the immediate project area and would not cause any regional impacts.	Same as No-Action.

Table 1.1. Comparison of Impacts		
Resource	**No-Action Alternative**	**Proposed Action**
Terrestrial Vegetation	Some minor removal of trees around the perimeter of old well sites will occur; however, any changes to native vegetation would be limited to a small area and would not be expected to affect the viability of the resources. Full recovery would occur in a reasonable time, considering the size of the project and the affected resource's natural state.	Same as No-Action.
Wildlife	Some local disturbance and displacement of wildlife may occur as a result of EOR activity; however, any changes to wildlife would be limited to a small portion of the population and would not be expected to affect the viability of the resource. Full recovery would occur in a reasonable time, considering the size of the project and the affected species' natural state.	Same as No-Action.
Land Use	Any change in land use would be limited to a small area and would not noticeably alter any particular land use at the project site or in adjacent areas. The affected areas would fully recover in a reasonable time once the project is completed.	Same as No-Action.
Population and Employment	Changes to the normal or routine functions of the affected community are expected to be short-term and are not expected to alter existing social or economic conditions in a way that will be disruptive or costly to the community.	Same as No-Action.
Infrastructure	The project will not noticeably affect or disrupt the normal or routine functions of public institutions, roads, electricity and other public utilities and services in the project area.	Same as No-Action.

Table 1.1. Comparison of Impacts		
Resource	**No-Action Alternative**	**Proposed Action**
Parks & Recreation	Any disturbance would be minor, temporary in duration, and in character with existing uses of the study area.	Same as No-Action.
Visual Resources	The EOR activity, along with planned mitigation, will not permanently change the visual landscape, because a number of wells have existed in the area since the 1940s.	Same as No-Action.
Noise	Noise levels in the project area will not exceed ambient noise level standards as determined by the Federal, State, and/or local government.	Some additional localized noise may occur due to utilization of an additional compressor; however, this noise will not exceed ambient noise level standards as determined by the Federal, State, and/or local government.
Environmental Justice	Neither minority nor low-income groups within the affected community will experience proportionately greater adverse effects than other members of the community.	Same as No-Action.
Human Health and Safety	The project, with current and planned mitigation measures, would pose no more than a minimal risk to the health and safety of on-site workers and the local population.	Same as No-Action.
Cultural Resources	The action would not affect the context or integrity features (including visual features) of a site listed or eligible for listing on the National Register of Historic Places or of other cultural significance.	Same as No-Action.
Waste Management	The action, along with planned mitigation measures, would not cause air, water, or soil to be contaminated with hazardous material that poses a threat to human or ecological health and safety.	Same as No-Action.

1.2 Purpose and Need

The DOE's National Energy Technology Laboratory (NETL) has a mission to implement a research, development, and demonstration program to resolve the environmental, supply, and

reliability constraints of producing and using fossil energy sources. One aspect of that mission, the resolution of environmental constraints to producing and using fossil fuels, now requires NETL to review, and where possible, mitigate projected impacts to global climate change caused by the use of fossil fuels. One possible mitigation technique under review is the capture and long-term removal of CO_2 from the atmosphere through a process called carbon sequestration. NETL is implementing the DOE Carbon Sequestration Program, which was established in 1997 to evaluate and develop carbon sequestration technologies. The focus of this Carbon Sequestration Program involves capturing and storing CO_2 emissions prior to release into the atmosphere, as well as enhancing natural carbon uptake and storage processes. The principal goal of the Carbon Sequestration Program is to gain a scientific understanding of carbon sequestration options and to provide cost-effective, environmentally-sound technology options that ultimately may lead to a reduction in greenhouse gas intensity and stabilization of atmospheric concentrations of CO_2 (DOE, 2007a). One of those options, geologic sequestration, is the placement of CO_2 or other greenhouse gases into subsurface porous and permeable rocks in such a way that they remain permanently stored.

In 2003, DOE selected seven Regional Partnerships to evaluate and pursue opportunities for carbon sequestration infrastructure development (Figure 1.2 below). The proposed Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Early Test project is part of the Carbon Sequestration Program. The **purpose** of Phase III is to test the application of large volume sequestration of CO_2 in different geological formations in North America (DOE, 2007a).

Specifically, the SECARB Phase III Early Test will evaluate high rate/high volume injection of CO_2 into a sandstone formation with properties similar to those found in other locations across the nation that may be suitable for sequestration. This test is a key component needed to increase scientific understanding of geological carbon sequestration and to test modeling and monitoring techniques to make sure that these technologies are available. Reliable modeling and monitoring are required to assure that geologic sequestration is an effective method for reducing atmospheric concentrations of CO_2 (DOE, 2008a).

Although the processes of geologic sequestration are relatively well known, there is a **need** for additional research to: fill gaps in our scientific understanding of carbon sequestration; ensure the protection of human health and the environment; reduce costs; and facilitate the full-scale deployment of this technology. Extensive laboratory investigations, modeling studies, and limited small-scale field studies have been completed to assess how CO_2 geologic sequestration would work in the subsurface. Comparing predictions from bench scale tests and numerical models with field results is necessary to validate the models and demonstrate that scientific understanding is correct (DOE, 2008a).

While the oil and gas industry has years of extensive experience with CO_2 injection for enhanced oil recovery (EOR), this information is inadequate for this validation because the fate of the injected CO_2 has not been routinely quantified. CO_2 injected for EOR can be absorbed in the oil, held by capillary forces in pore space, trapped by buoyancy forces in stratigraphic or structural compartments, dissolved in pore water, produced and reused, or leaked from the injection zone through the soils and/or penetrations. The absence of data to account for CO_2 fate in the complex EOR system leaves a gap in scientific understanding.

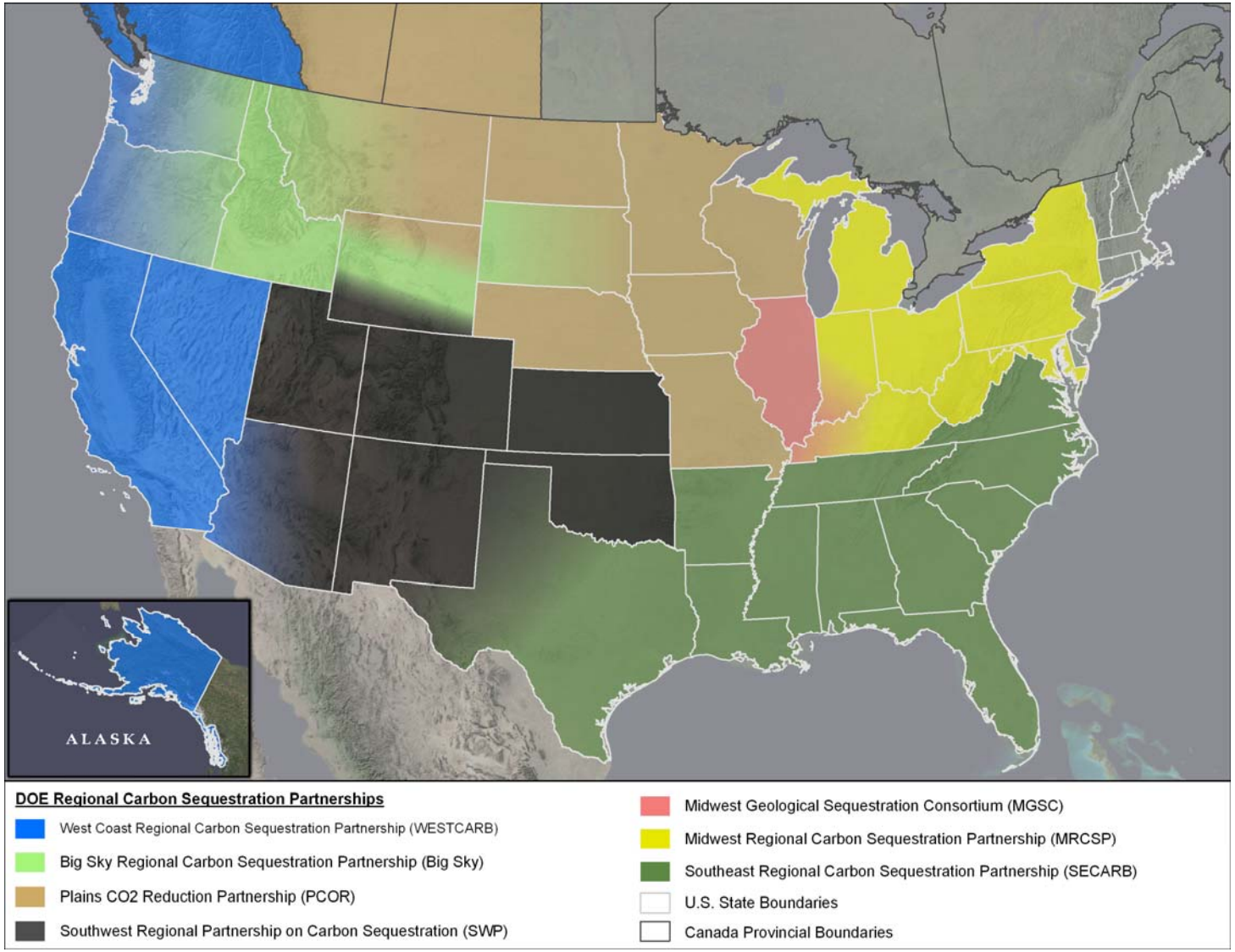


Figure 1.2. Map of Regional Carbon Sequestration Partnerships

Another significant experience gap between EOR and the validation needed for full-scale geological CO_2 sequestration is related to the type of host rock best suited for sequestration. Geologic formations that could most easily receive and retain the large volumes of CO_2, approximately 1 to 4 billion short tons/year (1 to 4 gigaton (Gt)/year), are thick, porous, and permeable sandstones (DOE, 2008a). Unfortunately, CO_2 these sandstones have not been monitored during EOR operations, due to the remoteness of the locations or other barriers to testing. For example, CO_2 is injected into thick, porous, and permeable sandstone beneath the North Sea, but it is not feasible to closely observe reservoir performance and CO_2 fate because monitoring wells are not an economic possibility in an offshore setting. Hovorka and others (2000) have inventoried 21 geologic formations in the onshore U.S. that might serve as host injection reservoirs for CO_2 (DOE, 2008a). A large-scale test using these onshore sandstones in locations where extensive monitoring can also be conducted is needed.

To address these experience and data gaps, DOE is proposing to co-fund a field experiment in a regionally significant formation similar to those that could eventually be used to sequester large volumes of CO_2. This project would be onshore so that it could be closely monitored to determine whether the CO_2 remains within the injection zone and to maximize scientific understanding. Testing is being conducted in a formation that is being subjected to CO_2 injection, so CO_2 fate and movement within the formation is somewhat already known. The demonstration would: (1) ensure that health and safety and environmental risks are minimized, (2) obtain results quickly so that experience can be used in moving to large pilots in other parts of the world, and (3) minimize costs during this phase before stakeholders are ready for full scale deployment. The test location would provide an opportunity for matching numerical model results with field observations under conditions of high volume injection at a scale similar to what would be done if CO_2 from a power plant was captured and sequestered.

1.3 Legal Framework

The legal framework for this EA involves both *substantive* legal requirements (what must be done or not done) and *procedural* legal requirements (how the agency must carry out its responsibilities). DOE has prepared this EA in accordance with the Council on Environmental Quality (CEQ) "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act," codified in Title 40 of the *Code of Federal Regulations* in Parts 1500 through 1508 (40 CFR 1500-1508) and DOE's regulations for implementing National Environmental Policy Act (NEPA) (10 CFR 1021). These regulations implement the procedural requirements of the NEPA, found in Title 40 of the *United States Code* in Section 4321 and following sections (42 USC § 4321 *et seq*.).

NEPA *requires* federal agencies to consider the potential environmental consequences of a Proposed Action in their decision-making processes. NEPA *encourages* federal agencies to protect, restore, or enhance the environment through well-informed federal decisions. The CEQ NEPA regulations specify that an EA be prepared to:

- Provide sufficient analysis and evidence for determining whether or not to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).
- Aid in an agency's compliance with NEPA when no EIS is deemed necessary.

- Facilitate EIS preparation when one is necessary.

Further, the CEQ NEPA regulations encourage agencies to integrate NEPA requirements with other environmental review and consultation requirements. Relevant environmental requirements are contained in other federal statutes, such as the Clean Air Act and the Clean Water Act, and their state counterparts. The following federal and state statutes and regulations are relevant to this EA. Federal and state permits that may be required are also listed.

Clean Air Act

The Clean Air Act (CAA), 42 USC § 7401 *et seq.*, establishes the National Ambient Air Quality Standards (NAAQS) developed by the United States Environmental Protection Agency (EPA) for the pervasive pollutants sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), lead (Pb), and particulate matter (both PM_{10} and $PM_{2.5}$). The NAAQS are expressed as concentrations of the criteria pollutants in the ambient air, the outdoor air to which the general public is exposed. The CAA also contains emission control permit programs to protect the nation's air quality and establishes New Source Performance Standards that establish design standards, equipment standards, work practices, and operational standards for new or modified sources of air emissions. Where the NAAQS emphasize air quality in general, the New Source Performance Standards focus on particular industrial categories or sub-categories (e.g., fossil fuel fired generators, grain elevators, steam generating units). Regulations implementing the CAA are found in 40 CFR Parts 50-95. Mississippi has been delegated CAA authority under Title 49 Chapter 17 of the *Mississippi Code*, and its relevant regulations are found in APC-S-1 through APC-S-10 (see: http://www.deq.state.ms.us/newweb/MDEQRegulations.nsf?OpenDatabase).

Clean Water Act

The Clean Water Act (CWA), 33 USC § 1251 *et seq.*, establishes a comprehensive framework of standards, technical tools, and financial assistance to address "point source" pollution from municipal and industrial wastewater discharges and "nonpoint source" pollution from urban and rural areas. Applicants for federal licenses or permits to conduct any activity that may result in a discharge to navigable waters must provide the federal agency with a state CWA Section 401 certification that the discharge will comply with applicable provisions of the CWA. CWA Section 404 establishes a permit program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. CWA Section 402 establishes the National Pollutant Discharge Elimination System (NPDES), which requires point sources of pollutants to obtain permits to discharge effluents and storm water to surface waters. Regulations for implementing relevant CWA programs are found in 33 CFR Parts 320-331 and 40 CFR Parts 400-503. Mississippi has been delegated CWA authority under Title 49 Chapter 17 of the *Mississippi Code*, and its relevant regulations are found in WPC-1 through WPC-6 (see: http://www.deq.state.ms.us/newweb/MDEQRegulations.nsf?OpenDatabase).

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), 42 USC 300 *et seq.*, gives EPA the responsibility and

authority to regulate public drinking water supplies by establishing drinking water standards, delegating authority for enforcement of drinking water standards to the states, and protecting aquifers from hazards such as injection of wastes and other materials into wells. Important for this EA are the SDWA provisions relating to injection wells. Congress passed the Safe Drinking Water Act in 1974. In part, the SDWA requires EPA to develop minimum federal requirements for Underground Injection Control (UIC) programs and other safeguards to protect public health by preventing injection wells from contaminating underground sources of drinking water. Mississippi has been delegated SDWA authority under the Mississippi Safe Drinking Water Act, Title 41 Chapter 26 of the *Mississippi Code*, and its relevant regulations are found in LW-1 and LW-2 (see: http://www.deq.state.ms.us/newweb/MDEQRegulations.nsf?OpenDatabase). UIC comes under the Mississippi State Oil and Gas Board at rule 63 of the MSOGB Rules of Procedure (see: http://www.ogb.state.ms.us/rulebook.htm).

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 *et seq.*, regulates the treatment, storage, and disposal of solid and hazardous wastes. RCRA sets "cradle to grave" standards for both solid waste and hazardous waste management. Certain wastes, such as domestic sewage and septic tank waste, agricultural wastes, industrial discharges, some nuclear wastes, and mining overburden are specifically excluded because they are regulated under other statutes. RCRA regulations are found in 40 CFR Parts 239-282. Mississippi has been delegated RCRA authority under Title 49 Chapter 31 of the *Mississippi Code*, and its relevant regulations are found in SW-1 through SW-9 and HW-1 through HW-3 (see: http://www.deq.state.ms.us/newweb/MDEQRegulations.nsf?OpenDatabase).

Comprehensive Environmental Response, Compensation, and Liability Act/Emergency Planning and Community Right-to-Know Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC § 9601 *et seq.*, also known as "Superfund," established a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA also establishes requirements for closed and abandoned hazardous waste sites, provides for the liability of persons responsible for the release of hazardous substances, and established a trust fund to pay for orphan facility cleanup and closure. Regulations for implementing CERCLA are found in 40 CFR Parts 300-312.

The Emergency Planning and Community Right-to-Know Act (EPCRA), 42 USC § 1001 *et seq.*, requires federal agencies to provide information on hazardous and toxic chemicals to state emergency response commissions, local emergency planning committees, and EPA. EPCRA's goal is to provide this information to ensure that local emergency plans are sufficient to respond to unplanned releases of hazardous substances. Regulations implementing EPCRA are found in 40 CFR Parts 350-374. Mississippi's EPCRA authority is found in Title 49 Chapters 31 and 35 of the *Mississippi Code*.

National Historic Preservation Act

The National Historic Preservation Act (NHPA), 16 USC § 470 *et seq.*, requires DOE to consult with the State Historic Preservation Officer (SHPO) prior to any construction to ensure that no historical properties would be adversely affected by a proposed project. DOE must also afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed project. Regulations for implementing NHPA are found in 36 CFR 800-812. Mississippi's historic preservation authority is found in Title 39 Chapter 7 of the *Mississippi Code*.

Archaeological Resources Protection Act

The Archaeological Resources Protection Act, 16 USC § 470aa *et seq.*, requires a permit for excavation or removal of archaeological resources from publicly held or Native American lands. The Act requires that excavations further archaeological knowledge in the public interest, and that the resources removed remain the property of the United States. Regulations for implementing the Act are found in 43 CFR 7 and 36 CFR 296. Mississippi's archaeological protection authority is found in Title 39 Chapter 7 of the *Mississippi Code*.

American Indian Religious Freedom Act

The American Indian Religious Freedom Act, 42 USC § 1996, establishes policy to protect and preserve the inherent and Constitutional right of Native Americans to believe, express, and exercise their traditional religions. The law ensures the protection of sacred locations, access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions, and establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by construction and operation of proposed facilities. Regulations for implementing the Act are also found in 43 CFR 7. Mississippi's Native American protection authority is found in Title 39 Chapter 7 of the *Mississippi Code*.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act, 25 USC § 3001, directs the Secretary of the Interior to guide the repatriation of federal archaeological collections and collections that are culturally affiliated with Native American Tribes and held by museums that receive federal funding. DOE would follow the provisions of this Act if any excavations associated with the proposed construction led to unexpected discoveries of Native American graves or grave artifacts. Regulations for implementing the Act are found in 43 CFR 10. Mississippi's Native American protection authority is found in Title 39 Chapter 7 of the *Mississippi Code*.

Endangered Species Act

The Endangered Species Act (ESA), 16 USC 1531 *et seq.*, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants, as well as the

preservation of the ecosystems on which they depend. ESA Section 7 requires any federal agency authorizing, funding, or carrying out any action to ensure that the action is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of critical habitat of such species. Regulations implementing the ESA interagency consultation process are found in 50 CFR Part 402. Mississippi's endangered species protection authority is found in Title 49 Chapter 5 Sections 101-119 of the *Mississippi Code*.

Fish and Wildlife Conservation Act/Fish and Wildlife Coordination Act

The Fish and Wildlife Conservation Act, 16 USC § 2901 *et seq.*, encourages federal agencies to conserve and promote conservation of non-game fish and wildlife species and their habitats. In addition, the Fish and Wildlife Coordination Act, 16 USC § 661 *et seq.*, requires federal agencies undertaking projects affecting water resources to consult with the U.S. Fish and Wildlife Service and the state agency responsible for fish and wildlife resources. Compliance with these statutes is internalized in the DOE NEPA process. Mississippi's fish and wildlife authority is found in Title 49 Chapters 3 through 5 of the *Mississippi Code*.

Noise Control Act

The Noise Control Act of 1972, 42 USC § 4901 *et seq.*, directs federal agencies to carry out programs in their jurisdictions to the fullest extent within their authority and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare. This would involve complying with applicable municipal noise ordinances to the maximum extent practicable.

Farmland Protection Policy Act

The Farmland Protection Policy Act, 7 USC § 4201 *et seq.*, directs federal agencies to identify and quantify adverse impacts of federal programs on farmlands in order to minimize the unnecessary and irreversible conversion of agricultural land to non-agricultural uses. Regulations implementing the Act are found in 7 CFR 658. Mississippi's farmland protection authority is contained in Title 69 Chapter 28 of the *Mississippi Code*.

Occupational Safety and Health Act

The Occupational Safety and Health Act, 29 USC § 651 *et seq.*, requires employers to furnish employees employment and a place of employment that are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees, and to comply with occupational safety and health standards promulgated by the Occupational Safety and Health Administration (OSHA). OSHA standards are implemented under regulations found in 29 CFR Parts 1900-2400. Mississippi regulates OSHA requirements through its Department of Employment Security.

Pollution Prevention Act

The Pollution Prevention Act, 42 USC § 13101 *et seq.*, establishes a national policy for waste management and pollution control that focuses first on source reduction, and then on environmentally safe waste recycling, treatment, and disposal. Three executive orders provide guidance to agencies to implement the Pollution Prevention Act: Executive Order 12873, "Federal Acquisition, Recycling, and Waste Prevention," Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition" and Executive Order 13148, "Greening the Government through Leadership in Environmental Management."

Federal Aviation Administration Act

49 USC § 106(f) and (g) give the Administrator of the Federal Aviation Administration (FAA) a number of powers, including the authority to regulate objects affecting navigable airspace. Regulations requiring FAA notification if any structure of more than 200 feet (approximately 60 m) high would be constructed are found in 14 CFR Part 77. The FAA then determines if the structures would or would not be an obstruction to air navigation. Mississippi regulates navigable airspace under Title 61 of the *Mississippi Code*.

Executive Orders

A number of presidential executive orders, in addition to those noted above, provide additional guidance in developing this EA. The most relevant of them include:

- Executive Order 11514, "Protection and Enhancement of Environmental Quality"
- Executive Order 11988, "Floodplain Management"
- Executive Order 12856, "Right to Know Laws and Pollution Prevention Requirements" Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"
- Executive Order 13112, "Invasive Species"
- Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"
- Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management"

Federal executive orders can be accessed at: http://www.archives.gov/federal-register/codification/.

Federal and State Permitting

The following are potentially applicable federal and state permitting requirements to construct and operate the proposed facilities.

- Acid Rain Permit, 40 CFR Part 72
- Airspace Obstruction Control Permit, 14 CFR Part 77
- Clean Air Act Prevention of Significant Deterioration permit, Acid Deposition Control permit, and Operating Permit, 40 CFR Parts 50-96

- Clean Water Act, Section 401 Certification, Section 402 NPDES Permit, Section 404 Wetlands Permit, and Pretreatment Authorization for Discharge of Wastewater to Municipal Collection System, 40 CFR Parts 104-140, 403
- Safe Drinking Water Act Underground Injection Control Permit, 40 CFR Part 144
- Rivers and Harbor Act Permit, 33 CFR Part 322
- Notice to the Federal Aviation Administration, 14 CFR Part 77
- Resource Conservation and Recovery Act (RCRA), 40 CFR Parts 239 through 299
- Sales Tap Approval, 18 CFR 157.211. Approval would be required to tap into or modify existing interstate gas pipelines.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The Proposed Action is for the DOE to provide 69 percent of the funds necessary to complete the project, to SECARB for a project led by the SSEB), in cooperation with Denbury, to inject and closely monitor the flow of approximately 1.7 million short tons (1.5 million metric tons) of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure, downdip of the oil-bearing zone (Noceti, 2008a). The proposed injection period for the Phase III Early Test is 18 months followed by at least one year of post-injection monitoring. This proposed field experiment is known as the SECARB Phase III Early Test project.

2.1.1 Project Location

The proposed activities would take place in an area of approximately 2 square miles (mi^2) (5 square kilometers (km^2)) within the lease boundaries of Denbury's Cranfield Unit, an oil and gas field that was largely abandoned in 1965. The site is about 4 miles (6 km) northeast of Cranfield, Mississippi and about 12 miles (19 km) east of Natchez, Mississippi (Figure 2.1.1). Denbury is currently undertaking a commercial CO_2 flood of this field (using the subsurface injection of CO_2 to enhance the recovery of oil). The Cranfield Unit is in a large, closed domical structure at depths greater than 10,000 feet (3,000 m) with a gas-tight geologic seal. This work will be done under Denbury's existing Class II Underground Injection Control (UIC) Permit.

The target injection zone is described as sandstone, which is overlain by a series of relatively impermeable shale zones of the Middle Tuscaloosa Formation. The Middle Tuscaloosa Formation is a closed domical structure, expected to be at least 300 feet (approximately 90 meters) thick in the injection area. Further impermeable confining shale formations are the Midway-Navarro-Taylor, about 6,500 to 8,500 feet (1,981 – 2,591 m) below grade, and the Cockfield/Cook Mountain shale formation at 1,600-2,800 feet (488 – 853 m) depth.

In addition, the Selma-Austin chalks and marls provide a buffering system below the Midway-Navarro-Taylor. Any carbon dioxide that may escape the first confining layer would be reactive with the calcium carbonate, which would reduce any further escape. Above the Midway-Navarro-Taylor shale formations, the previously produced and partially depleted Wilcox group of sands will provide a pressure sink due to earlier extraction of oil and gas. This pressure sink would serve to attract and hold any gases that may escape other entrapment.

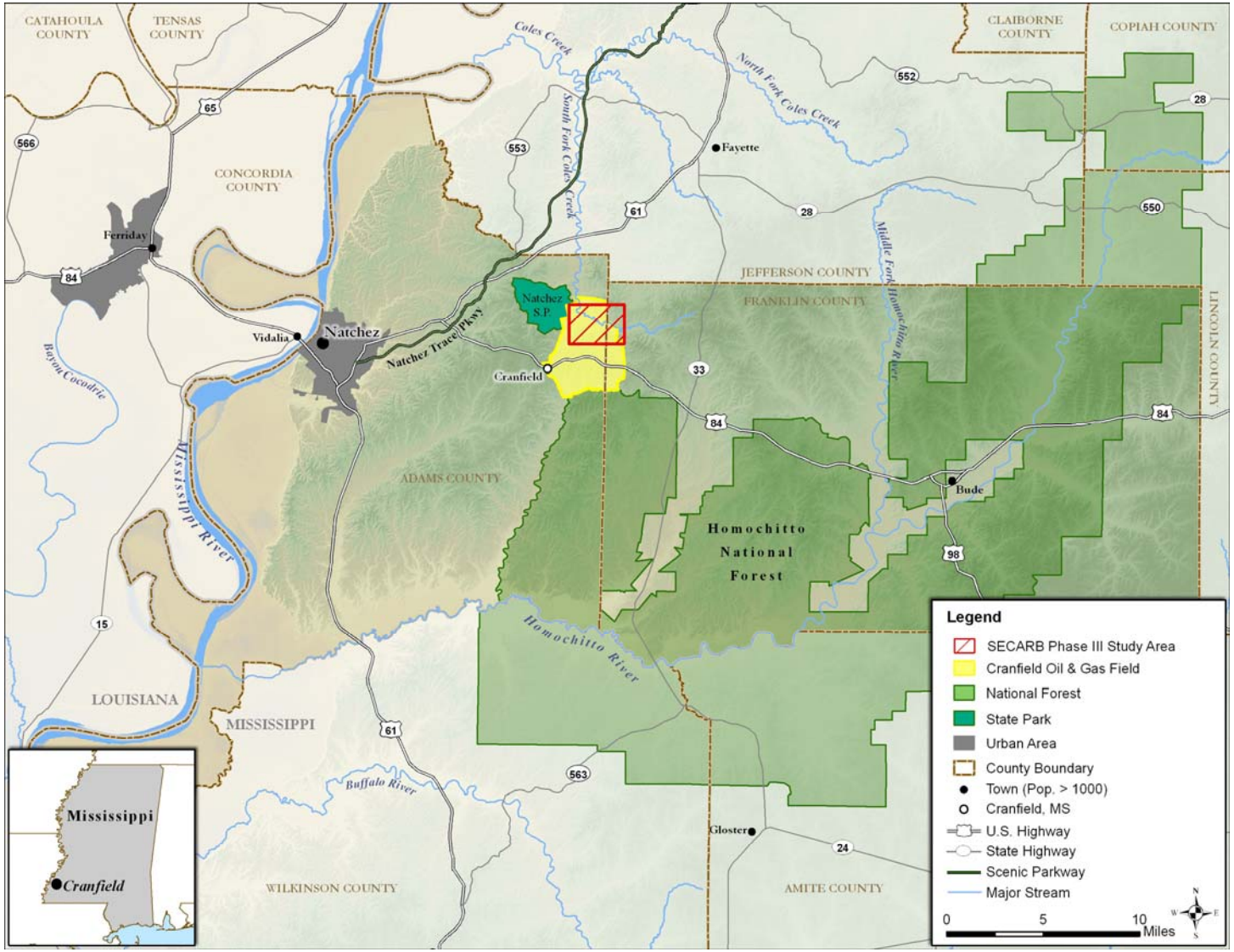


Figure 2.1.1. Phase III Early Test Study Area and Adjacent Land Use

2.1.2 First Stage: Drilling and Characterization

The Proposed Action calls for the use of four injection wells. Three of these wells have already been drilled by Denbury as a part of ongoing EOR operations. These three wells extend below the oil-brine interface into the deeper brine-bearing Tuscaloosa Formation below 10,000 feet. An additional injection well would also be drilled to the same depth. These four primary injection wells would use existing well pads used during the previous production at the Cranfield Unit and directionally drilled to the desired down-hole locations. The three wells already completed as a part of ongoing EOR are identified as selected study wells in Figure 2.1.2. The fourth well will be drilled from one of two previous well pad sites, depicted as optional study wells in the southeast section of the study area (Figure 2.1.2). The selection of the well pad for this fourth well would be determined by Denbury based on cost, accessibility, and other factors unrelated to the study.

Since the well pads were abandoned in the mid-1960s, Denbury will recondition them to support drilling operations. This reconditioning will include land clearing of approximately one acre or less (0.4 hectare), leveling and fill activities, rebuilding access roads, laying connector pipelines, and extending other infrastructure services as needed. The drilling, site preparation, and infrastructure construction must be permitted by the Mississippi Oil and Gas Board (MSOGB) and conducted in compliance with all applicable federal and state regulations and acceptable industry practices for environmental protection. All planned well pad, pipeline, and road construction activity will be conducted as part of the EOR activity and will occur whether DOE funds the Proposed Action or not (i.e., No-Action alternative).

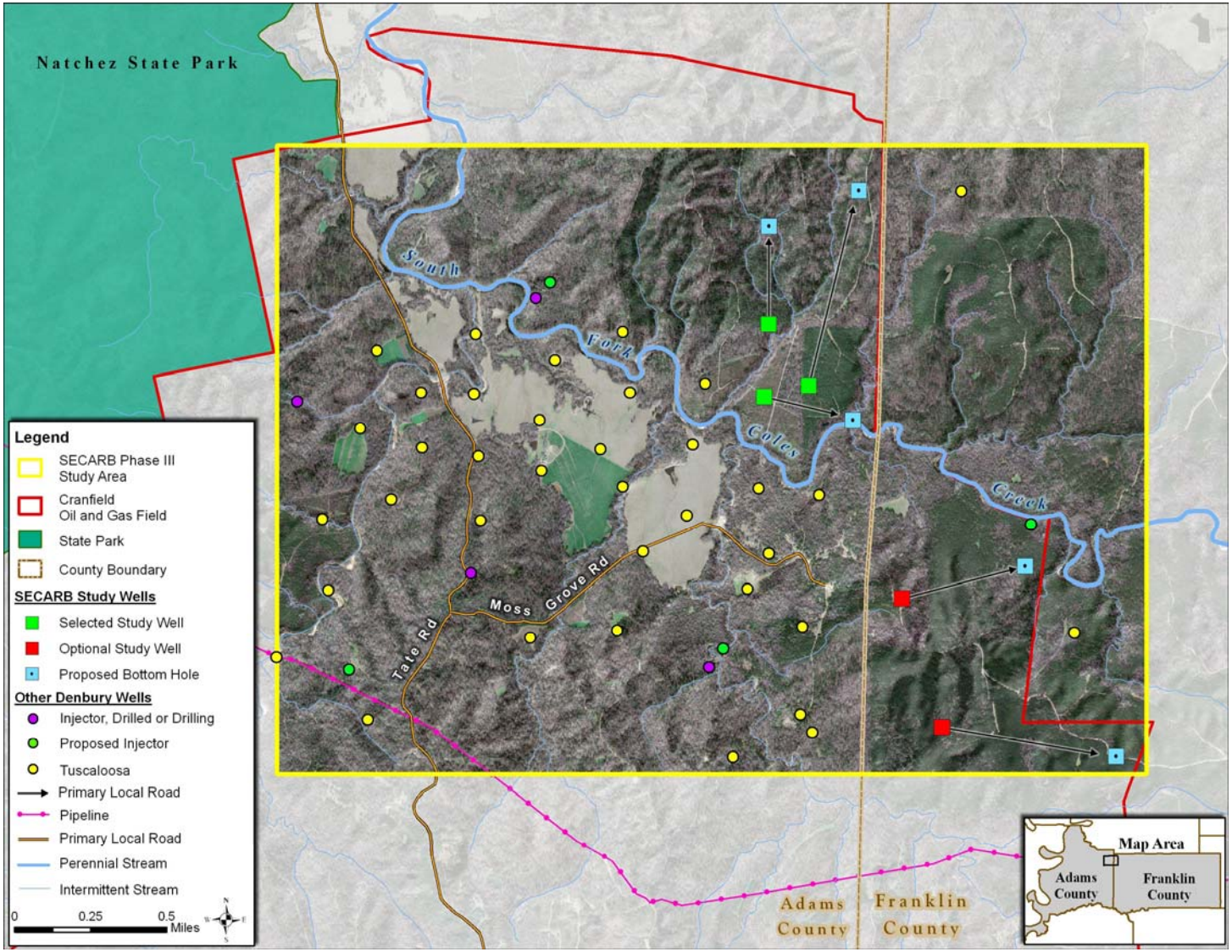


Figure 2.1.2. Location of Proposed and Existing Wells

Denbury is conducting all activities related to the drilling of the injection wells as part of current commercial operations. Under the Proposed Action, the wells would be drilled further than necessary ("extended") for normal EOR operations. This "extension" of three of the four primary SECARB injection wells into the water leg of the formation has been completed and the fourth well will require only minor additional resources (approximately 3 percent longer casing, more drilling mud, and higher fuel consumption during drilling). Table 2.1.2 lists the quantities of materials to be used.

Table 2.1.2. Materials Used and Produced During the Project

Materials Used		Materials Produced	
Material	**Quantity**	**Material**	**Quantity**
Water	500,000 – 840,000 gallons (gal). (1.8 – 3.2 million Liters (L))	Wastewater	1.39 – 2.31 million gal. (5.3 – 8.7 million L)
Diesel fuel	20,000 – 42,000 gal. (76,000 – 159,900 L)	Solid waste	6,000 – 10,000 pounds (lbs). (2,700 – 4,500 kilograms (kg))
Steel pipe	738 short tons (670,000 kg)	Drill cuttings	Approximately 70,000 cubic yards (yd^3) (53,519 cubic meters (m^3)
Explosives	33 pounds for wellbore stimulation (15 kg)		
Gravel	5,000 – 9,000 yd^3 (3,800 – 6,900 m^3)		
Drilling mud	90,000 – 150,000 lbs (40,800 – 86,000 kg)		

An additional compressor for the injection of the increased volume of CO_2 would be installed in conjunction with current compressors along existing Denbury pipelines if the Proposed Action is funded. The injected volume of CO_2 under the Proposed Action (1.7 million short tons or 1.5 million metric tons) is twice the amount needed for EOR, which means that Denbury under the No-Action alternative would only inject half of that amount (DOE, 2008a). The collocation of the additional compressor at an existing compressor station should minimize any incremental increase in noise levels. The integrity of new well completions would be tested to assure that wells do not become leakage pathways. All existing wells in the area will be identified and a search of publically available records completed. Plug and abandonment records provide evidence that old wells in the study area have been properly plugged and abandoned and should not become leakage pathways.

Two observation wells would also be drilled from one of the reconditioned well pads and would be dedicated full time to continuous monitoring of the formation response to the CO_2 flood. The final selection of well pads for the locations of the two monitoring wells has not been

determined, but they would be sited close to one or more of the four injection wells. The monitoring wells would be used to characterize the subsurface formations and to improve evaluation and modeling of the proposed injection plume. The subsurface characterizations conducted during the drilling operations are to assess formation and fluid conditions, evaluate permeability and other modeling parameters of the injection formation, revise numerical models, and refine plans for injection operations. Shallow groundwater quality and soil conditions would also be evaluated to establish baseline near-surface conditions in the study area.

Two additional water wells would be drilled to approximately 200 feet (approximately 61 m) using a truck-mounted drilling rig to evaluate the performance of surface-monitoring strategies. Near-Surface-monitoring activities planned during the first stage include soil-gas surveys, groundwater-level measurements, groundwater geochemical measurement, and/or acoustic geophysical measurements, and tracer injections. A gravel access road and drilling pad would not be required for these two wells. Cuttings from each of the water wells would result in less than 200 yd^3 (153 m^3) based on the volume of 6-inch well to a depth of 200 feet. Materials would be land farmed at permitted facilities within the Cranfield Unit similar to other wells constructed by Denbury in the area.

The construction of all six of the primary deep wells for this study, including the four injection wells and the two observations wells, would require a total of an estimated 500,000 – 840,000 gallons (2 to 3 million L) of additional make-up water that would be obtained from existing Denbury water wells. All four injection wells, the three already completed and the planned fourth, were always a planned part of Denbury's commercial EOR operations even if the SECARB study is not conducted (i.e., No-Action alternative). Only about one-third of this total water usage, or approximately only 167,000 – 280,000 gallons (approximately 632,000 L to 1.1 million L) of makeup water, will be used for the drilling of the two deep observation wells which are being constructed solely for this study.

Labor requirements beyond those to be employed by Denbury for its on-going commercial operations would be limited to the crews needed to drill the observation and groundwater monitoring wells. SECARB staff and contractors would conduct monitoring and maintenance of sampling equipment. The drilling of the observation wells would take approximately 6 weeks and would be conducted by contractors already employed by Denbury for other deep well construction. Typical crews consist of 12 drilling crew workers on a 24-hour per day schedule for 2 weeks and 6 completion crew workers on a 12-hour per day schedule for 4 weeks.

The drilling of the shallow groundwater monitoring wells would take approximately 1-2 days and would be conducted by a local, state-licensed operator contract by SECARB. A crew of 2-5 people is required for these temporary rigs.

On-going operation and maintenance of monitoring equipment would be performed by SECARB personnel and contractors on a periodic, non-continuous basis approximately 4 times during the study period. Monitoring crews consist of 8 researchers working for 2 weeks during each of the 4 study intervals.

The construction of the deep wells for this study would require a total of an estimated 20,000 – 42,000 gallons (75,708 – 158,987 L) of diesel fuel and an estimated 90,000 – 150,000 pounds (40,823 – 68,039 kg) of drilling mud. Of this usage, only an estimated 7,000 – 14,000 gallons (26,498 – 52,996 L) of diesel fuel and 30,000 – 50,000 pounds (13,608 – 22,680 kg) of drilling mud would be used for drilling the two deep observation wells; the remaining materials will be used for Denbury's commercial EOR operations even if the SECARB study is not conducted (i.e., No-Action alternative).

Drilling mud used for the construction of the observation wells would be treated and disposed of by Denbury in accordance with MSOGB regulations. Water-based bentonite drilling muds are sent by pumper trucks for reuse if possible or disposed of on-site in permitted cutting pits. Specialty muds that cannot be recycled would also be disposed of at on-site permitted oilfield waste disposal sites. Existing MSOGB regulations adequately protect the environment with strict standards of construction, operation, and maintenance; and provide for penalties and appropriate remedial actions for failure to comply.

Power would be brought to the observation well site on poles or by buried conduit from nearby domestic power lines. Fences will be placed as needed to keep livestock away from wellheads.

Approximately 55,000 barrels of water would be produced during well development. Produced freshwater would be land farmed and saline water would be disposed of in existing MSOGB permitted oilfield disposal wells following best available practices.

Up to 2.31 million gallons (8,706,447 L) of wastewater will be produced and collected in portable tanks and shipped by truck to an authorized disposal site as part of the ongoing EOR. Up to 10,000 lbs. (4,536 kg) of solid waste will be disposed of at local commercial landfills. Using tank trucks with 6,000-8,000 gal capacity, it would require between 300- 400 truck trips to transport wastewater. Denbury disposal wells are at the Cranfield Unit; therefore, wastewater that would be generated as a result of the proposed project would likely not require transport on public roadways. Non-drilling, non-hazardous solid waste is projected to be picked up by a commercial service on a monthly basis throughout the construction period and transported to a local permitted landfill. Figure 2.1.2 shows the location of the eight wells to be drilled for the Proposed Action.

2.1.3 Second Stage: CO_2 Injection and Monitoring

As part of the ongoing EOR, the CO_2 will be transported from a natural source at Jackson Dome (near Jackson, Mississippi) to Cranfield through the commercial Denbury Sonat pipeline (Figure 2.1.2), which is a former natural gas pipeline that Denbury retrofitted for CO_2 transport in 2007. Distribution lines and compression will be developed by Denbury to bring CO_2 from the pipeline head to the injection wells (i.e., No-Action alternative). The total distance from Sonat pipeline to the 4 proposed injection wells varies from 2 to 5 miles depending upon the selected route (which has not been determined). The connector lines will be $2\ ^5/_8$ or 3 inch in diameter with a construction corridor of a maximum of 30 feet wide.

CO_2 injection will be regulated at the surface by controlling pressure and volume of injection

using standard industry practices. Denbury has previously conducted four other CO_2 floods into the Lower Tuscaloosa in Mississippi, which provide the best practices under which this test would be conducted. The CO_2 injection technology and methodologies used for EOR have been used by the oil and gas industry for many years, and Denbury has over 10 years of successful experience. Existing industry practices along with MSOGB regulations, have proven adequate to ensure the safe and reliable operation of injection wells for several decades. Preliminary modeling shows that the footprint (maximum horizontal extent in the subsurface), as well as maximum pressure buildup of the CO_2 plume, will be controlled by pressure drawdown at production wells in the oil-producing rim. Down-dip spread of the plume is expected to be limited, with most of the plume moving up-dip toward the oil-producing area.

The injection rate and volume of CO_2 that is proposed for this study would primarily be through three existing EOR wells along with a fourth well that would be drilled. Three of these injection wells now extend into the brine layer in the down-dip water leg of the formation. The injection rate would be increased to attempt to inject the full 1.0 million metric tons/year (1.0 billion kg) into these four wells. However, if an adequate injection volume cannot be achieved within regulated safety limits to avoid fracturing of the formation, other injection wells at the Cranfield Unit could also be used to inject the CO_2 necessary to achieve the target 1.0 million metric tons/year (1.0 billion kg) volumes required for the study.

The focal point of the proposed activity would be monitoring of the injected CO_2 to understand its subsurface flow mechanisms. The monitoring program would evaluate the movement of CO_2 and evaluate the performance of seals to assure CO_2 is retained within the target injection zone. Tracers (10 kg) would be injected with the CO_2 in minor amounts, and both the injection and monitoring wells would be sampled to identify the tracer and CO_2 concentrations. Geochemical tracer techniques would include isotopic profiles of injected CO_2, introduced noble gases, and introduced perfluorocarbons.

Subsurface monitoring in the four injection wells, two observation wells, and selected other wells in the field will use wire-line and tubing-conveyed instruments to assess pre-injection fluid and rock properties. Monitoring would include down-hole pressure and temperature measurements, time-lapse logging, tilt and acoustic measurements, cross-well tomography, and fluid-sampling tools. Water level and quality would be sampled quarterly to semi-annually from existing and newly drilled municipal and make-up water wells located locally. Borehole geophysical (wire-line) logging would be conducted in the injection formation and above the injection zone, to verify that CO_2 is being properly contained. Repeat Vertical Seismic Profiling (VSP) and/or repeat three dimensional (3-D) seismic surveys would assess the maximum lateral spread of CO_2.

Planned surface monitoring activities at the two newly drilled near-surface water monitoring wells would include soil-gas surveys, groundwater-level measurements, groundwater geochemical measurement, experimental and/or acoustic geophysical measurements, and tracer injections. Soil gas, pore water, and shallow groundwater will be sampled and analyzed to establish background CO_2 concentrations. Because background values vary seasonally with changes in biologic activity, sampling will be repeated. These points will also be monitored

throughout the injection and post-injection phases. Shallow auger holes will be used to sample soil gas.

The existing well completions would remain open in the injection and monitoring wells for approximately 1 year to allow post-injection monitoring. Monitoring would include pressure and temperature measurements and well logging, cross-well or surface seismic surveys, and geochemical sampling and analyses. Fluid monitoring frequency would decrease as changes in pressures and concentrations become minimal, indicating equilibration of the subsurface physical environment. This stabilization is anticipated to occur less than one (1) year after the beginning of injection. Shallow groundwater dissolved gas and soil-gas concentrations would be monitored throughout this time at sample points established during pre-injection field activities. Waste formation brine resulting from surface seismic surveys and geochemical sampling would be transported to an existing MSOGB-permitted Class 2 disposal well.

2.1.4 Decommissioning

It is not anticipated that a full decommissioning of the site would be required after cessation of the proposed project. The site is part of an existing petroleum production area and will be decommissioned as part of that operation. In addition, Denbury would have the choice, after the proposed project, of incorporating the observation wells into its EOR project (some wells may need to be re-completed for this option).

Pipelines are regulated in Mississippi by the Public Safety Commission which enforces the rules and regulations of the Minimum Federal Safety Standards in 49 CFR 192 (Walden, 2008). With or without the implementation of the Proposed Action, wells will be abandoned according to Mississippi Oil & Gas Board per Rule 63, Underground Injection Control, Section 10, Plugging and Abandoning regulations. The pipelines would continue to be used by Denbury after the study for EOR operations. Denbury will eventually abandon the pipelines at the completion of the EOR operation, but the exact abandonment methods will be determined by Denbury in accordance with the applicable state and federal regulations at the time of abandonment (Walden, 2008).

Other equipment may be recycled or re-conditioned for future use or sale.

2.2 No-Action Alternative

The No-Action alternative means that DOE funds would not be used to support the proposed data collection at the target site. Without DOE funds, the data collection proposed would not occur because such data collection is unnecessary for the purposes of EOR at this site. With no intent to collect the proposed data set, those wells specific to such data collection would be unnecessary. Not conducting such tests would delay by several years the development of information needed to assess technological options for geologic carbon sequestration. From an overall perspective, therefore, the No-Action alternative within the SECARB region would adversely affect the ability to provide options to help meet national objectives for greenhouse gas emission reductions by using sequestration as a mitigation option. Also, increased understanding of subsurface behavior of CO_2 would not be gained, and the possibility of an example of

successful and safe sequestration within the SECARB region could not be offered for consideration by the public, policy makers, and regulators during any future consideration of regional CO_2 sequestration proposals. In the absence of an adequate base of knowledge, the complexities of future projects could result in long delays for public and regulatory approval, thereby jeopardizing goals for action on climate change issues.

The Proposed Action would be conducted in an oilfield in association with a planned EOR program by Denbury Resources. The proposed Cranfield Unit site was drilled and oil and gas extracted beginning in the 1940s and running through the 1960s. The proposed site is in an area where drilling and other subsurface activities familiar to the surrounding communities have occurred for many decades in a mature oilfield setting that provides abundant subsurface data. It is the intention of Denbury Resources to implement oil and gas removal at this site using CO_2 injection, with or without the data collection proposed by DOE. In other words, those potential environmental impacts associated with this EOR project would occur even if DOE were not involved. In fact, one of the primary reasons for selecting this site for the Proposed Action was to take advantage of the infrastructure developed for CO_2-EOR efforts by the field operator. This presents SECARB with the opportunity to inject approximately 1.7 million short tons (1.5 million metric tons) of CO_2 over 1.5 years in the down-dip leg of an oil reservoir in order to test a number of commercial and experimental monitoring protocols for carbon sequestration. Thus, the No-Action alternative represents a lost opportunity to utilize the cost-savings, background data, and limited additional environmental impacts associated with using the established oilfield. Choosing the No-Action alternative would delay development of technological options for geological CO_2 sequestration and possibly result in increased CO_2 emissions before any stabilization efforts could be started.

2.3 Alternatives Considered but Eliminated from Detailed Analysis

In order to evaluate the alternatives provided below, it is necessary to appreciate the fact that the decision under review in this EA is for the DOE to either fund or not fund the Proposed Action. The alternatives offered below were considered by the SECARB partnership with a preferred option chosen and submitted to DOE for funding.

Two additional alternatives were available for satisfying DOE's need for developing information on potential technological solutions for geological carbon sequestration in this region. Alternatives to the Proposed Action include: (1) conducting the experiment at another field site in the same sedimentary basin and (2) conducting the experiment in another geographic area (different sedimentary basin). These alternatives to the Proposed Action are listed in Table 2.3 below, along with the primary reason for dismissing them from detailed analysis.

Table 2.3. Alternatives Considered and Dismissed

Alternative	Reason for Dismissal
Alternative location in same basin	Any other alternative looses the advantages of working within an active oilfield EOR setting that also has a long history of data acquisition.
Injection in a different basin	As above, this alternative would lack comparable subsurface data and oil industry infrastructure.

Many other basins in the Gulf Coast region contain formations suited to geological CO_2 sequestration (Hovorka et al., 2000). However, few of these basins are characterized by a high concentration of both man-made and natural CO_2 sources and an abundance of available subsurface data in the form of well logs and 3-D seismic data. Fewer still have a robust on-site oil and gas industry presence, which would reduce Proposed Action costs.

The proposed early test would be conducted in the down-dip "water leg" of the Cranfield Unit operated by Denbury Resources, which is the Proposed Action. Large volumes of CO_2 can be delivered by Denbury's Sonat Pipeline, which is supplied by abundant natural CO_2 from the nearby Jackson Dome. Denbury recently leased the mineral rights and unitized the necessary lands. Conducting the Proposed Action at this site would allow collection of high-quality data from a large volume CO_2 injection site. No other location offers these data collection and cost savings opportunities in this region, which is why other locations in this and other basins within the region were dismissed from further consideration by SSEB.

2.4 Issues Considered and Dismissed

The Purpose and Need section above highlighted the importance of the overall program of evaluating carbon capture and storage (CCS) as one tool among many to address global climate change while providing this nation with a secure energy future. Because of the lack of potential impact to certain issues due to the specific characteristics of the Proposed Action, the following issues were considered but dismissed from detailed analysis:

- Right-of-Way Acquisition – There was no need for additional right-of-way.
- Forest Fragmentation – This is a site that was initially fragmented in the 1940s and no additional significant forest clearing will be necessary.
- Increase Local Govt. Expenditures – The expected population dynamics of the temporary workforce are not expected to impose additional local govt. expenditures through need for new roads, schools, etc.
- Impact Property Values – This is a minor expansion of an existing industrial facility and not a new construction on a green-field site.
- Alter Local Hydrology Patterns – None of the proposed construction would impact drainage in the local watershed.
- Wild and Scenic Rivers – No listed Wild and Scenic rivers are within the general area of the proposed project site.

3.0 THE ENVIRONMENTAL ANALYSIS APPROACH

This chapter describes how the environmental review team analyzed the potential impacts of this Proposed Action (i.e., injection and analysis of potential for geologic storage of CO_2 in conjunction with enhanced oil recovery). Chapter 4 provides a description of the affected environment and the potential environmental effects of the Proposed Action along with an analysis of environmental effects if the Proposed Action was not implemented.

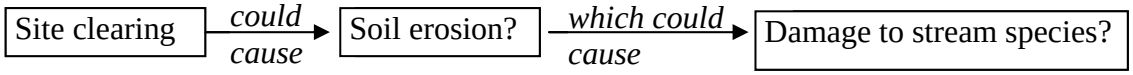
3.1 Approach to the Analysis

An Environmental Assessment is intended to be a clear, focused analysis of impacts. It is not intended to be merely a compilation of encyclopedic information about the project or about the environment. Accordingly, the environmental review team used a systematic approach to identifying, and then answering, the relevant impact questions.

The initial step was to develop a detailed description of the components of the EOR process to be used at this oil field site along with those components that would be added by NETL to study the potential of geologic sequestration of CO_2 along with EOR at this site. This description was presented in Chapter 2.

For each project component, (e.g., underground injection of CO_2) the team sought to identify all the types of direct effects which that activity could cause on any environmental resource. For example, clearing a site of vegetation could cause soil erosion. In doing this preliminary identification of the types of impacts that potentially could occur, the team drew upon their experience with previous projects.

For each potential direct effect, the team then sought to identify the potential indirect effects on other environmental resources. For example, soil erosion could cause sedimentation in nearby streams, which could in turn harm the fish and other species in the stream.



In some cases, the team identified multiple effects on the same resource which are shown in the diagram (Figure 3-1). Figure 3-1 is the overall Cause-Effect-Question diagram for the entire project. This served as the framework of the analysis of impacts. That is, the team focused their efforts on answering these questions as to whether these effects would in fact occur, and if so, how extensive, how severe, and how long-lasting they would be.

Note that Figure 3.1 (the next 4 pages) contains references to the specific section of the document where each impact is addressed. Also, note that most of the actions presented in the diagram relate to the EOR activity that will occur at the project site whether the DOE chooses to fund or not fund the Proposed Project (i.e., No-Action alternative); no questions relating specifically to study actions are identified.

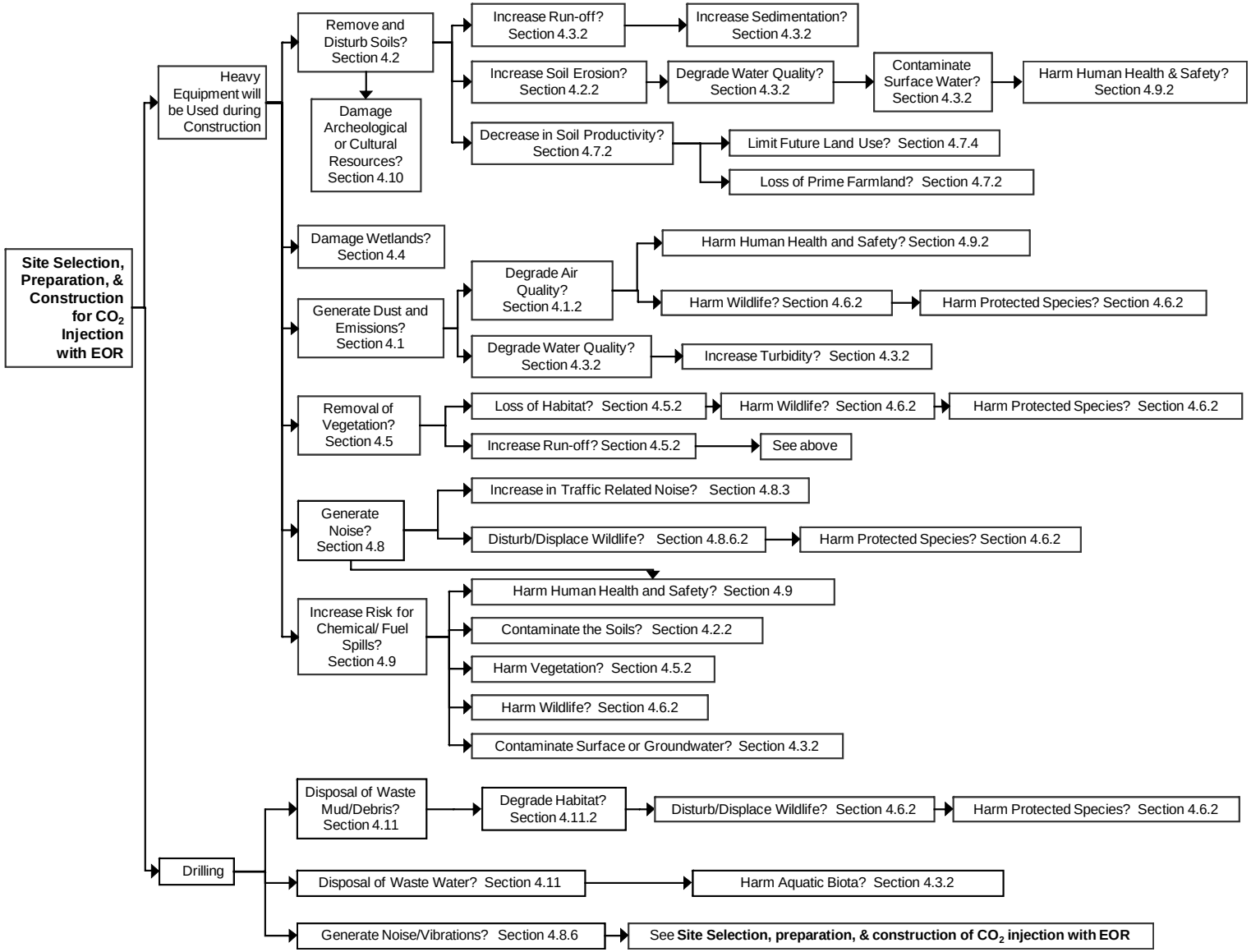


Figure 3.1-1. Cause-Effect-Questions Part 1

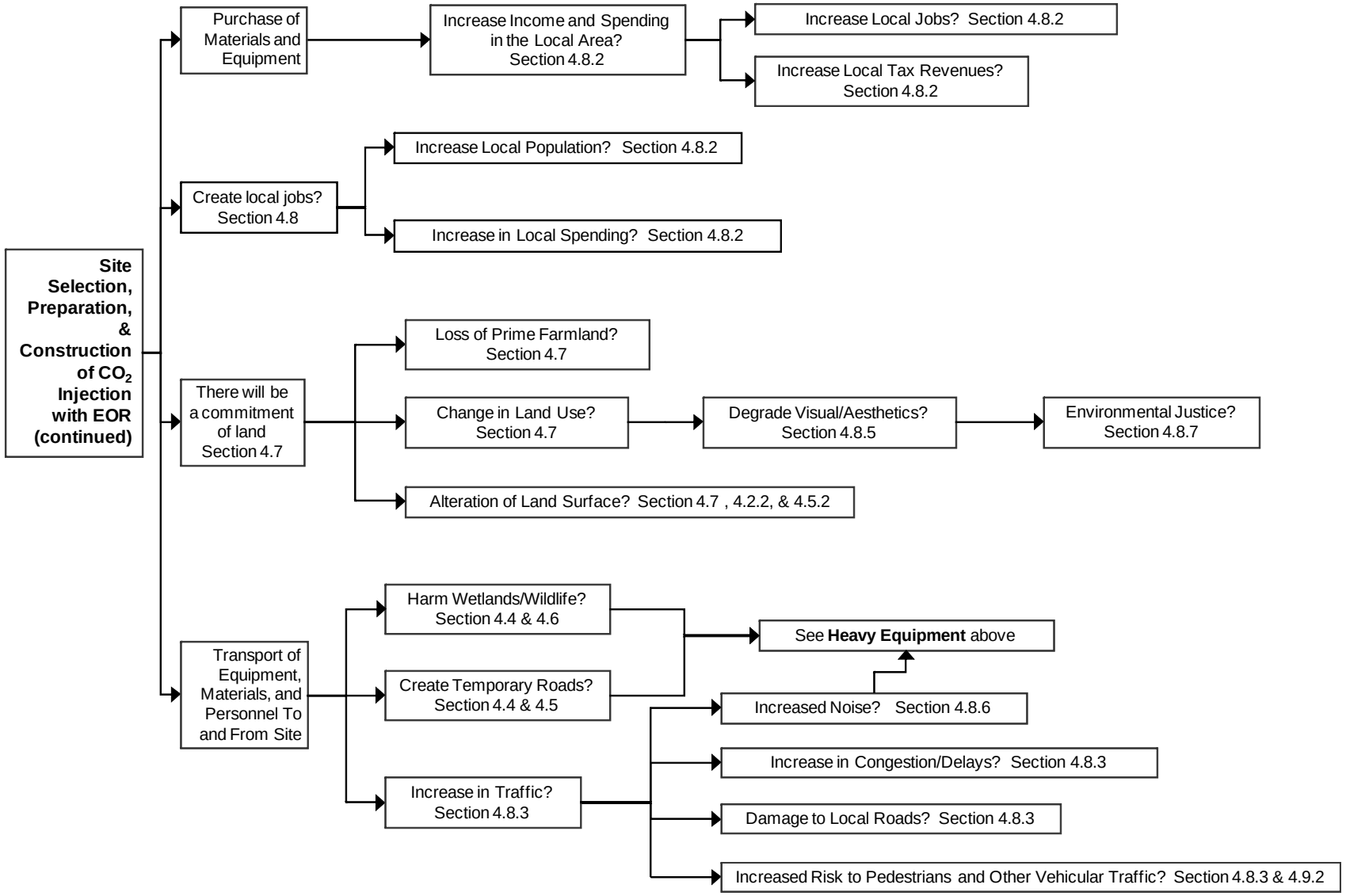


Figure 3.1-2. Cause-Effect-Questions Part 2

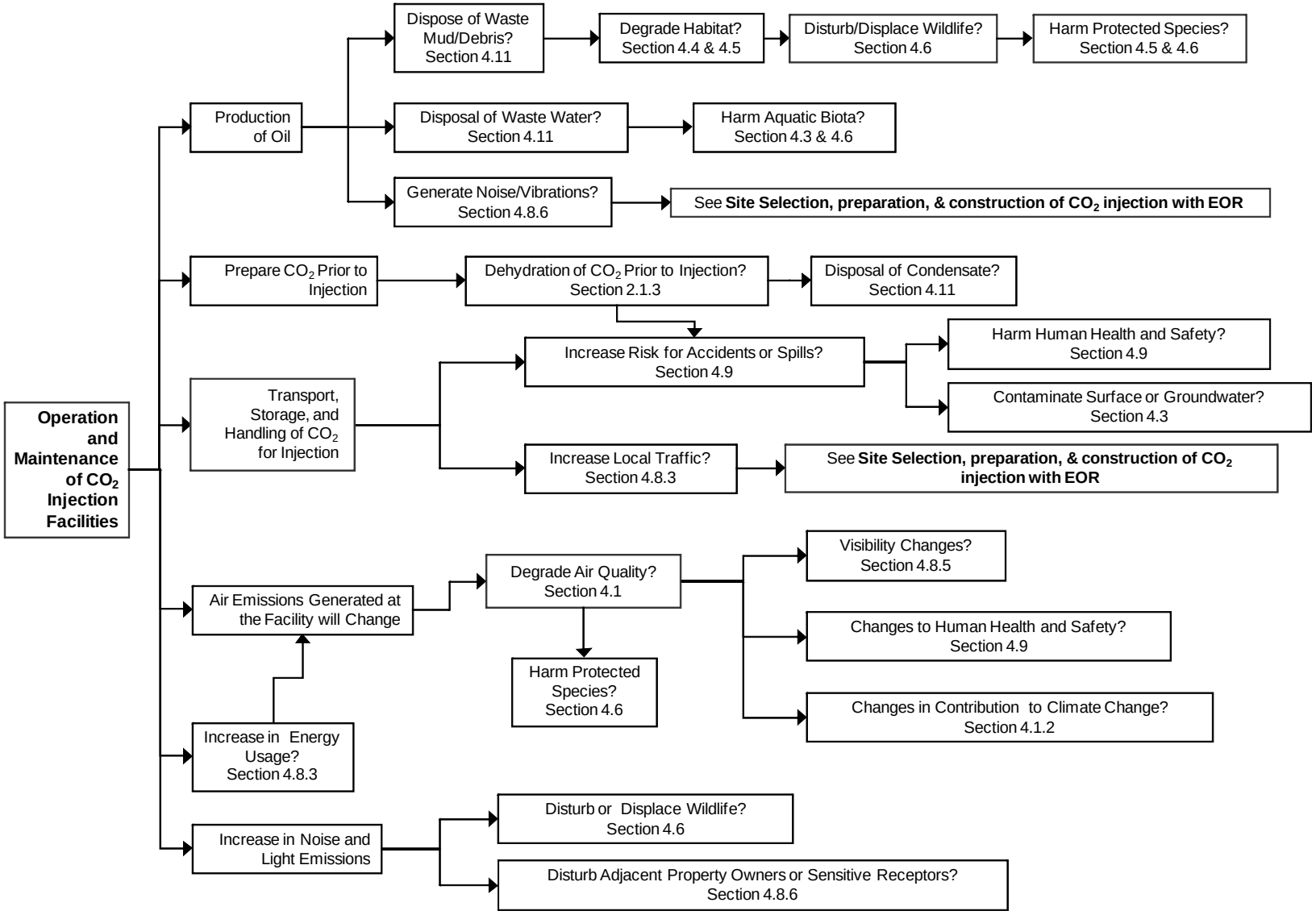


Figure 3.1-3. Cause-Effect-Questions Part 3

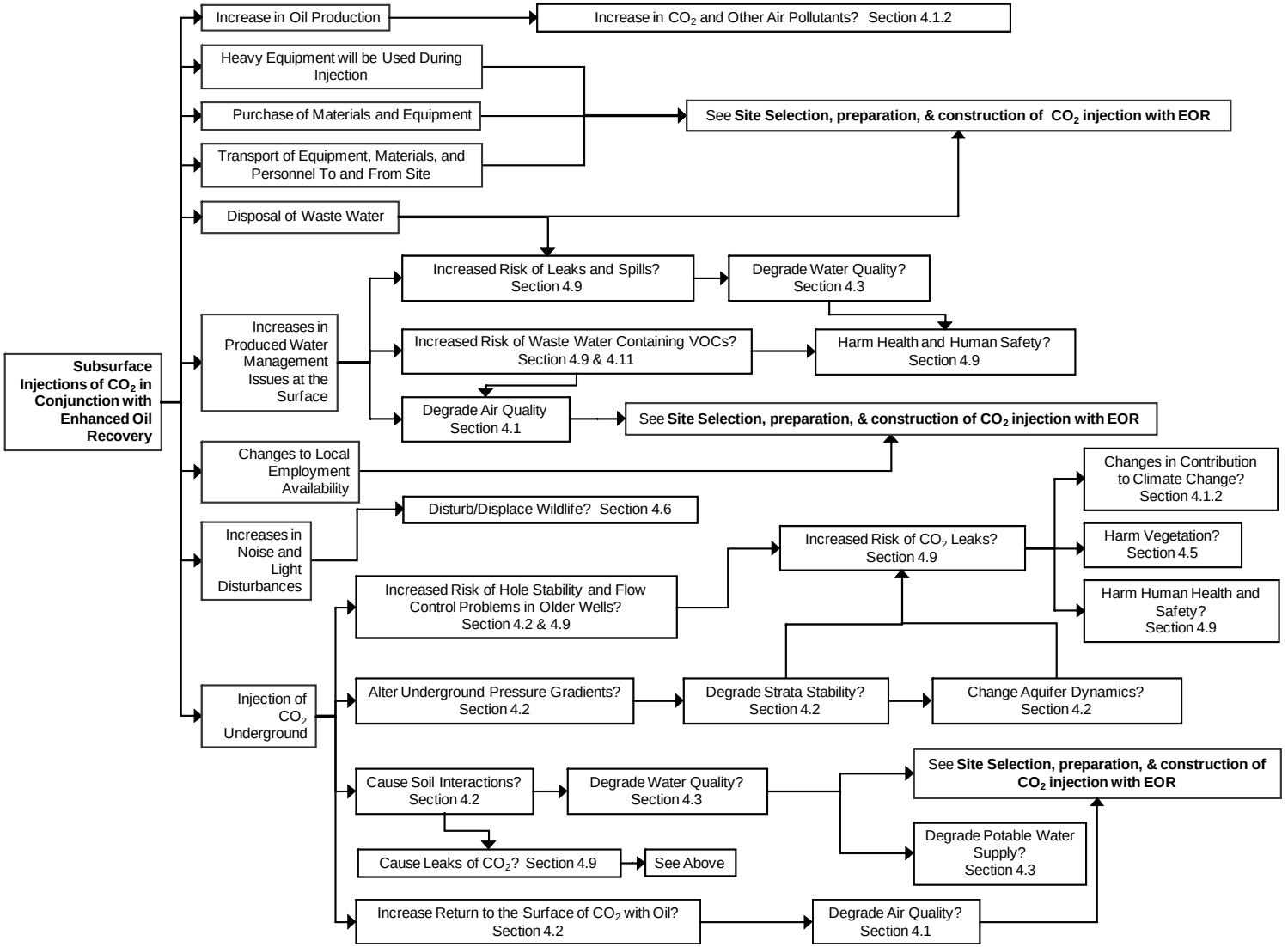


Figure 3.1-4. Cause-Effect-Questions Part 4

3.2 Analysis of Significance

The review team used a systematic process to evaluate the significance of the predicted impacts. This process involved comparing the predictions to the significance criteria established by the team and set out below in Table 3.2. These significance criteria were based on legal and regulatory constraints and on team members' professional technical judgment.

Table 3.2. Impact Significance Thresholds

Resource Area	Impact Significance Thresholds An impact would be significant if it EXCEEDS the following conditions
Air Quality	The project would not produce emissions that would impede the area's conformity with the State Implementation Plan under the Clean Air Act.
Geologic Formations	The Proposed Action would cause no measurable leakage of CO_2 from the storage formation to the surface or into another area in the subsurface, and there is no more than an imperceptible risk of inducing seismic events due to increased reservoir pressure.
Soils	Any changes in soil stability, permeability, or productivity would be limited in extent. Full recovery would occur in a reasonable time*, considering the size of the project. Mitigation, if needed, would be simple to implement and proven to be effective in previous applications.
Surface Water	Any changes to surface water quality or hydrology would be confined to the immediate project area. Full recovery would occur in a reasonable time, considering the size of the project and the affected area's natural state.
Groundwater	Any changes to groundwater quality and quantity would be at the lowest detectable levels. Full recovery would occur in a reasonable time. Mitigation, proven to be effective in previous applications, would be implemented, if needed.
Wetlands and Floodplains	Any impacts to wetlands and/or floodplains would be confined to the immediate project area and would not cause any regional impacts. Planned mitigation measures would fully compensate for lost wetland values in a reasonable time.
Terrestrial Vegetation	Any changes to native vegetation would be limited to a small area and would not affect the viability of the resources. Full recovery would occur in a reasonable time, considering the size of the project and the affected resource's natural state. Mitigation, proven to be effective in previous applications, would be implemented, if needed.
Wildlife	Any changes to wildlife would be limited to a small portion of the population and would not affect the viability of the resource. Full recovery would occur in a reasonable time, considering the size of the project and the affected species' natural state.
Threatened or Endangered Species	Any effect to a federally listed species or its critical habitat would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. This negligible effect would equate to a "no effect" determination in U.S. Fish and Wildlife Service terms.

Land Use	Any change in land use would be limited to a small area and would not noticeably alter any particular land use at the project site or in adjacent areas. The affected areas would fully recover in a reasonable time once the project is completed.
Population and Employment	Changes to the normal or routine functions of the affected community are short-term or do not alter existing social or economic conditions in a way that is disruptive or costly to the community.
Infrastructure	The project would not noticeably affect or disrupt the normal or routine functions of public institutions, roads, electricity, and other public utilities and services in the project area.
Parks and Recreation	Any disturbance would be minor, temporary in duration, and in character with existing uses of the study area.
Visual Resources	The action, along with planned mitigation, would not permanently change the visual landscape in a way that is objectionable to a number of local residents or frequent visitors. (or) The action, along with planned mitigation, would not change the visual resource classification of the affected area.
Noise	Noise levels in the project area would not exceed ambient noise level standards as determined by the Federal, State, and/or local government.
Environmental Justice	Neither minority nor low-income groups within the affected community will experience proportionately greater adverse effects than other members of the community.
Human Health and Safety	The project, with current and planned mitigation measures, would pose no more than a minimal risk to the health and safety of on-site workers and the local population.
Cultural Resources	The action would not affect the context or integrity features (including visual features) of a site listed or eligible for listing on the National Register of Historic Places or of other cultural significance. Following consultations with the SHPO/Tribal Historic Preservation Officer (THPO) and consultations with any other potentially affected groups including Indian Tribes, local governments, and the National Park Service (NPS), the determination of effect under Section 106 of the NHPA would be *no adverse effect*.
Waste Management	The action is unlikely to cause air, water, or soil to be contaminated with hazardous material that poses a threat to human or ecological health and safety.

* Recovery in a reasonable time: Constant, sustainable improvement is apparent and measurable when the site is routinely observed, and full recovery is achieved over a period of no more than several years.

4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

4.1 Air Quality

4.1.1 Description

This is a description of regional climate, ambient air quality with respect to attainment of National Ambient Air Quality Standards (NAAQS), and identification of applicable air quality regulations.

4.1.1.1 Climate and Weather

The SECARB Phase III study area is located in the humid subtropical climate division characterized by high humidity (especially in summer) and typically mild winters. The area has no dry season; even the driest summer month receives at least 1.2 inches (30 millimeters [mm]) of rain. Precipitation is rather evenly distributed throughout the year, but is markedly greater during summer or early spring, especially during frequent thunderstorms. Tropical hurricanes strike the coastal areas occasionally, and can bring very heavy rains. Snow fall is rare and melts almost immediately. January, historically the coldest month, temperatures range from an average low of 38.8 degrees Fahrenheit (° F) (3.8 degrees Celsius (° C)) to an average high of 58.3° F (14.6° C). In July, historically the warmest month, temperatures range from an average low of 72.1° F (22.3° C) to an average high of 91.0° F (32.8° C).

4.1.1.2 National Ambient Air Quality Standards and Attainment Status

USEPA Region 4 and the State of Mississippi Department of Environmental Quality (MDEQ), regulate air quality in Mississippi. The Clean Air Act (CAA) (42 USC 7401-7671q), as amended, gives USEPA the responsibility to establish the primary and secondary NAAQS (40 CFR Part 50) that set acceptable concentration levels for seven criteria pollutants: fine particulate matter (PM_{10}), very fine particulate matter ($PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrous oxides (NO_x), ozone (O_3), and lead. Short-term standards (1-, 8-, and 24-hour periods) have been established for pollutants contributing to acute health effects, while long-term standards (annual averages) have been established for pollutants contributing to chronic health effects. Based on the severity of the pollution problem, non-attainment areas are categorized as marginal, moderate, serious, severe, or extreme. Each state has the authority to adopt standards stricter than those established under the federal program; however, the State of Mississippi accepts the federal standards.

Federal regulations designate Air-Quality Control Regions (AQCRs) in violation of the NAAQS as “non-attainment” areas. Federal regulations designate AQCRs with levels below the NAAQS as “attainment” areas. “Maintenance” AQCRs are areas that have previously been designated “non-attainment,” and have been redesignated to “attainment” for a probationary period through implementation of maintenance plans. The SECARB Phase III study area is completely within the Mobile-Pensacola-Panama City-Southern Mississippi AQCR (AQCR 005) (40 CFR 81.144). Federal regulations designate AQCR 005 as an attainment area for all criteria pollutants (40 CFR

81.338). Notably, the study area is also located more than 150 miles away from the nearest Class I visibility area (Breton Wilderness Area, Louisiana). Because the SECARB Phase III study area is in an attainment region, the air conformity regulations do not apply. Although the area is in attainment, and the air conformity regulations do not apply, the project's emissions of criteria pollutants and the applicability thresholds under the general conformity rules were carried forward for more detailed analysis to determine the level of impact under NEPA.

4.1.1.3 Local Ambient Air Quality

Worst case ambient air quality conditions can be estimated from measurements conducted at air-quality monitoring stations (Table 4.1.1.3). It should be noted that the cited stations provide data from urban and industrial counties, such as Harrison County (Gulfport) and Jackson County (Pascagoula) and are not representative of the more rural study area. They are used here to demonstrate overall air quality in the region. Hence the levels outlined on Table 4.1.1.3 can be considered a conservative worst case.

With the exception of the eight-hour O_3 standards, air-quality measurements are below the NAAQS (USEPA, 2008). The reported maximum of 0.091 parts per million (ppm) for the eight-hour level exceed the standards of 0.08 ppm within the region. However, the 3-year average of the fourth highest daily maximum 8-hour average ozone concentrations over each year has not exceeded 0.08 ppm; hence, the attainment status.

Table 4.1.1.3. NAAQS and Monitored Air Quality Concentrations

Pollutant and Averaging Time	Primary NAAQS[1]	Secondary NAAQS[1]	Monitored Data[2]	Location of Station
CO				
8-Hour Maximum[3] (ppm)	9	(None)	*(no data available)*	-
1-Hour Maximum[3] (ppm)	35	(None)	*(no data available*	
NO_2				
Annual Arithmetic Mean (ppm)	0.053	0.053	0.006	Jackson County
Ozone				
8-Hour Maximum[4] (ppm)	0.08	0.12	0.091	Harrison County
$PM_{2.5}$				
Annual Arithmetic Mean[5] ($\mu g/m^3$)	15	15	14.8	Lauderdale County
24-Hour Maximum[6] ($\mu g/m^3$)	35	35	35	
PM_{10}				
Annual Arithmetic Mean[7] ($\mu g/m^3$)	50	50	22	Jackson County
24-Hour Maximum[3] ($\mu g/m^3$)	150	150	42	
SO_2				
Annual Arithmetic Mean (ppm)	0.03	(None)	0.002	
24-Hour Maximum[3] (ppm)	0.14	(None)	0.011	Jackson County
3-Hour Maximum[3] (ppm)	-	0.5	0.034	

1 - Source: 40 CFR 50.1-50.12.
2 - Source: (USEPA, 2008)
3 - Not to be exceeded more than once per year
4 - The 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations over each year must not exceed 0.08 ppm.
5 - The 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from must not exceed 15.0 $\mu g/m^3$.

6 - The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor must not exceed 65 $\mu g/m^3$.
7 - The 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 $\mu g/m^3$.
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
NO_2 = Nitrogen dioxide

4.1.1.4 Greenhouse Gasses and Global Warming

Greenhouse gases (GHG) are components of the atmosphere that contribute to the greenhouse effect and climate change. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities such as the burning of fossil fuels. Federal agencies, states, and local communities address climate change by preparing GHG inventories and adopting policies that will result in a decrease of GHG emissions. According to the Kyoto Protocol and California Climate Action Registry (CCAR), there are six GHGs: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (UNFCCC, 2007;CARB, 2007a). Although the direct GHG (CO_2, CH_4, and N_2O) occur naturally in the atmosphere, human activities have increased their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2004, concentrations of CO_2 have increased globally by 35 percent. Within the United States, fossil fuel combustion accounted for 94 percent of all CO_2 emissions released in 2005. On a global scale, fossil fuel combustion added approximately 30 $x10^9$ short tons (27 $x10^9$ metric tons) of CO_2 to the atmosphere in 2004, of which the United States accounted for about 22 percent (USEPA, 2007a). DOE's Energy Information Administration (EIA) report indicates that U.S. CO_2 emissions have grown by an average of 1.2 percent annually since 1990 and energy-related CO_2 emissions constitute as much as 83 percent of the total annual CO_2 emissions (DOE, 2007b).

Since 1900, the Earth's average surface air temperature has increased by about 1.2 to 1.4ºF since. The warmest global average temperatures on record have all occurred within the past 10 years, with the warmest year being 2005 (USEPA, 2007b). With this in mind, DOE while preserving their core operations is poised to support climate-changing initiatives to reduce GHG emissions.

4.1.2 Effects of Proposed Action

Short-term minor impacts to air quality would be expected with the implementation of the Proposed Action. Direct and indirect air emission would not be expected to exceed applicability thresholds, be "regionally significant," or contribute to a violation of any federal, state, or local air regulation. Therefore, expected emissions from the Proposed Action would not impede the area's conformity with state air emission standards. Air emissions would be limited to temporary diesel emissions from drilling and construction equipment during well development as part of the SECARB Phase III Early Test. These activities are in addition to Denbury's on-going commercial operations in the area. No emissions would result from injection or monitoring operations during the SECARB Phase III Early Test.

4.1.2.1 Estimated Emissions and General Conformity

The general conformity rules require federal agencies to determine whether their action(s) would increase emissions of criteria pollutants above preset threshold levels (40 CFR 93.153(b)). These *de minimis* (of minimal importance) rates vary depending on the severity of the non-attainment and geographic location. Because AQCR 005 is in attainment, the general conformity regulations do not apply. However, all direct and indirect emissions of criteria pollutants were estimated and compared to applicability threshold levels of 100 short tons (91,000 kg) per year (tpy) to determine whether implementation of the Proposed Action would cause significant impacts. The proposed project actions would be only a small part of overall site actions related to EOR; therefore, the total direct and indirect emissions associated with the following activities include both ongoing EOR operations and projected proposed project actions were accounted for:

- Site preparation & construction;
- Construction and operation of transport pipeline;
- Operation and maintenance of injection facilities, and
- Subsurface injections of CO_2.

Construction emissions would primarily be due to the use of diesel drilling rigs, mud pumps, diesel generators and motors, heavy construction equipment, deliveries to the site, the application of architectural coatings, and fugitive dust. Drill rig operations during well construction are anticipated to occur 24 hours per day and 7 days per week for no more than three months. There are no planned operational activities along the proposed pipeline or at the well sites that would generate emissions of criteria pollutants.

The total direct and indirect emissions associated with the Proposed Action would not exceed applicability threshold levels (Table 4.1.2.1). Because AQCR 005 is an attainment area, there is no existing emission budget. However, due to the limited size and scope of the Proposed Action, it is not anticipated that the estimated emissions would make up 10 percent or more of regional emissions for any criteria pollutant and not be regionally significant. A detailed breakdown of drilling and construction emissions is located in Appendix A.

Table 4.1.2.1. Proposed Action Emissions Compared to Applicability Thresholds

	Annual emissions (Short Tons Per Year)						***De minimis* threshold (Short Tons Per Year)**	**Would emissions exceed applicability thresholds? [Yes/No]**
Activity (Year)	**CO**	**NO_x**	**VOC**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**		
Drilling and Construction (2008)	4.8	8.7	1.2	0.0	0.4	0.4	100	No
Operational Emissions	*<none>*							

Notes: VOC is volatile organic compounds, and SO_x is sulfur oxides.

4.1.2.2 Regulatory Review

New stationary sources of emissions may be subject to both federal and state permitting requirements. These requirements include, but are not limited to, New Source Review (NSR), Prevention of Significant Deterioration (PSD), and New Source Performance Standards (NSPS) for selected categories of industrial sources. These regulations are outlined in Mississippi Department of Environmental Quality (MDEQ), Air Emission Regulations for the Prevention, Abatement, and Control of Air Contaminants, APC-S-1 through 8. In addition, the prevention and elimination of waste by the pollution of air is prohibited through the guidelines set out in the Mississippi State Oil and Gas Board (MSOGB), Rule Book 4, Rule 45. The guidelines reiterate that all gas that is being vented shall be processed in a manner so that emissions do not exceed applicable standards. This is consistent with the state and federal regulations governing air pollution. In addition, the guidelines state all non-combustible gas, such as carbon dioxide (CO_2), etc., which is not being used for a useful purpose, shall be returned to the subsurface stratum from which it was originally produced if emissions to the atmosphere would exceed applicable standards (MSOGB, 2007). The proposed SECARB Phase III site is located in an attainment area and would not introduce any new stationary sources of air emissions. Therefore, it is unlikely that any of the above stated regulations would apply.

All drilling and construction would be accomplished in full compliance with the Mississippi Regulations for the Control and Abatement of Air Pollution. The necessary facilities shall be constructed in a manner such as to prevent the solids from becoming windborne and to prevent the materials from entering state waters without the proper environmental permits. The construction shall be performed in such a manner so as to reduce fugitive dust emissions from construction activities to a minimum.

4.1.2.3 Greenhouse Gasses and Global Warming

Direct and Indirect CO_2 Emissions. For the proposed project, CO_2 would be transported from a natural source at Jackson Dome (near Jackson, Mississippi) to Cranfield Unit and sequestered. It is anticipated that 1,650,000 short tons (1,500,000 metric tons) of CO_2 would be sequestered during the project injection period. However, the overall amount of CO_2 generated as a result of Proposed Action related activities would increase by approximately 70,000 short tons (63,500 metric tons) due to the burning of diesel fuel during drilling, the additional electrical demand [estimated at 7.5 megawatt (MW)], and worker commutes. This constitutes a net decrease of approximately 1,580,000 short tons (1,430, 000 metric tons) of CO_2 emissions over the life of the project (Table 4.1.2.3). Notably, this is less than 0.0001% of the global CO_2 emissions.

Table 4.1.2.3. Net CO_2 Emissions for the Proposed Action

Activity/Source	Emissions (Short Tons)
Drilling and Construction	154
Electricity Usage	70,342
Worker Commutes	362
Sequestration	(1,653,450)
Total Emissions	(1,582,592)

Fugitive CO_2 Emissions and Compressor Blowdown. Because transport and compression of CO_2 is an integral part of activities for the Proposed Action, fugitive air emissions of CO_2 could occur during routine operations. Sources of emissions during sequestration operations could include injection and monitoring wells; and aboveground valves, piping, and well heads that comprise the transmission pipeline. In addition, compressors are often equipped with automatic blowdown valves that depressurize compressors, bottles, separators, and interconnecting lines in the event of a shutdown.

CO_2 that could be expected to be vented from the area during this proposed project are similar in quantity to emissions that would otherwise have occurred from the compression unit, pipeline, and wells that will be in place due to EOR. Therefore, these sources of fugitive emission would not increase overall CO_2 emissions.

4.1.3 Effects of No-Action

Selecting the No-Action alternative could have minor indirect impacts to air quality. No-Action, meaning that this project is not carried out in any setting, would delay planned larger-scale sequestration projects by perhaps several years. The increased understanding of subsurface behavior of CO_2 would not be gained, nor could an example of successful and safe sequestration, on any scale, be offered to the public in support of a larger, more expensive project. The complexities of a larger pilot might translate to long delays in public and regulatory approval, thereby jeopardizing goals of rapid action on climate change issues. A 3-year delay in initiating large-scale sequestration efforts would lead to an increase CO_2 emissions by approximately 5% and atmospheric concentrations of CO_2 would increase by as much as 6 ppm before any stabilization effort would be started.

4.1.4 Cumulative Effects

The State of Mississippi takes into account the effects of all past, present, and reasonably foreseeable emissions during the development of the State Implementation Plan (SIP). The State of Mississippi accounts for all significant stationary, area, and mobile emission sources in the development of this plan. Estimated emissions generated by the Proposed Action would be *de minimis* and would not be regionally significant. Therefore, it is anticipated that the Proposed Action would not impede the area's conformity with the state's air emissions standards and is not expected to exceed the impact significance threshold.

4.2 Geology and Soils

4.2.1 Description

The SECARB test site is topographically heterogeneous, consisting of undulating hills with flatter, lower-lying areas. Elevations across the test site span measured in feet above sea level (asl) are between 280 feet (asl) (85.3m) and 400 feet (ft) (asl) (121.9 m) (DOE, 2008a). The South Fork of Coles Creek subdivides the test site providing surface drainage to the hilly uplands on both north and south aspects of the site.

The upper geology of the Cranfield area (Thompson, 1969), listed from youngest to oldest is:

- Pleistocene and Holocene alluvial sediments and loess
- Pascagoula – Hattiesburg – Catahoula (Miocene – Oligocene)
- Cockfield (Eocene)
- Sparta (Eocene)
- Wilcox (Eocene – Paleocene)
- Midway – Navarro – Taylor (Paleocene)
- Selma – Austin chalk (Upper Cretaceous)
- Tuscaloosa (Upper Cretaceous)
- Washita – Fredericksburg (Lower Cretaceous)

The geology consists of inter-bedded sandstone and shale formations in the upper sections with marl and chalk beds becoming more prevalent into the Cretaceous deposits (Bicker, 1969). Limestone and salt deposits appear in the Lower Cretaceous and Jurassic deposits. Several unconformities are present throughout the geological column. This likely reflects cyclical transgression and recession events. The target injection zone is located in the Mississippi Salt Basin and is comprised of the deep saline Tuscaloosa Formation. The generalized subsurface geology of the Tuscaloosa Formation indicates a predominate presence of shale interspersed with highly-porous, lenticular sandstone strata. The regional stratigraphy indicates that the CO_2 injection site will be into the Lower Tuscaloosa Formation, sealed by the overlying Middle and Upper Tuscaloosa units. Beneath the injection site, the Washita-Fredericksburg Groups provide a seal from downward movement of injected CO_2.

Sand and shale units of the Tuscaloosa Group are over 1,000 ft (305m) thick (Chacko et al., 1997) and represent a complete depositional cycle. The Tuscaloosa Group comprises three units. The lower Tuscaloosa represents a transgressive stage of the depositional cycle and consists of an arenaceous and argillaceous lower unit. The marine shale forms the middle Tuscaloosa unit and represents the inundated phase of the depositional cycle. The marine shale is mostly gray to black, fissile and sandy at some locations thickening down-dip. In Pike County, Mississippi the marine shale is 500 ft (152 m) thick increasing to 800 ft (243 m) in the south-central area of Washington Parish, Louisiana (Chacko et al., 1997). The project area is approximately 50 miles (80 km) northwest of these marine shale deposits. The upper Tuscaloosa sands and clays represent the regressive phase of the depositional cycle (Mancini and Puckett, 2005). It is difficult to distinguish the upper Tuscaloosa from the overlying Eutaw Formation because of their lithological similarity. The permeability of the lower Tuscaloosa Formation varies from 35 millidarcy (mD) to over 2000 mD with a porosity varying from 25% to 30%. The permeability of the Tuscaloosa shale, the first upper seal, is from less than 0.01 mD to 0.06 mD with porosities from 2.3% to 8.0%.

The 350 ft (106 m) to 560 ft (171 m) (Curry, 1934) lower seal of the Washita Group has low permeability with porosities of 10% to 20% (Goddard, 2001). Other seals such as the Austin chalk range in thickness from 200 ft to 600 ft (McNulty, 1976) with permeability from 0.05 mD to 2 mD with porosities of 2% to 5% (Goddard, 2001).

Structurally the test site is located within the Adams County High on the western slopes of the Leedo salt dome (Thompson, 1988). There are no apparent fault zones within the area.

However, faults in the Tuscaloosa Formation are evident approximately 60 miles (96.6 km) to the east. The dip of the Tuscaloosa Formation in the immediate area of the proposed injection site is to the west (Thompson, 1988). Any migration as a result of CO_2 buoyancy would therefore be updip to the east and the apex of the Leedo salt dome located approximately 20 miles (32 km) to the east.

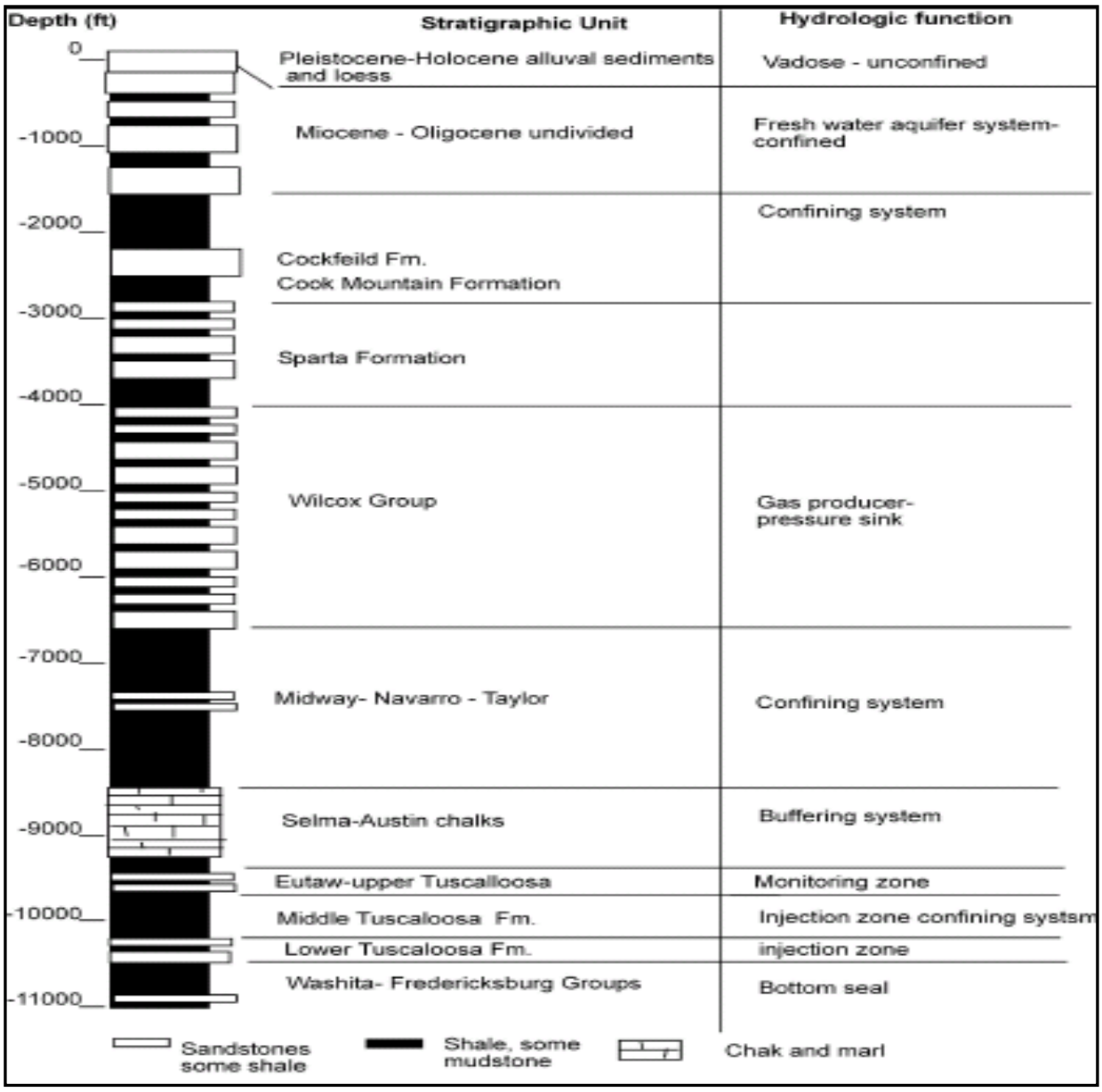


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Figure 4.2.1-1. Generalized Stratigraphic Sections/Hydrological Functions as Related to the SECARB Project
Source: (DOE, 2008a).

Information on soil types in the SECARB test region are mapped by the Natural Resources Conservation Service (NRCS) as presented in Figure 4.2.1-2 (DOE, 2008a). The test region is characterized by heterogeneous soil series consisting of both upland and floodplain soil groups (NRCS, 2008a). Adjacent to the South Fork of Coles Creek, the soil type is predominantly Collins silt loam which is described as being very deep and moderately drained and permeable and subject to flooding. Additionally, Crevasse-Bruno complex, Tippo, and Memphis silt loams are also present. The Bruno complex and Memphis series are particularly well-drained, produce negligible runoff and are moderately to highly permeable. The higher elevation ridges and hilltops along the South Fork of Coles Creek and predominantly throughout the test site is Memphis silt loam, although some intermixed smaller amounts of Lucy-Memphis and Smithdale-Lexington-Memphis associations are present. The Memphis series soils are described as very deep, moderately permeable and well drained. Runoff potential for these soil types are described as being medium to high. Given the heterogeneous nature of soil types throughout the test site, the soil properties and thus runoff response is highly variable and dependent on land use/cover (NRCS, 2008a).

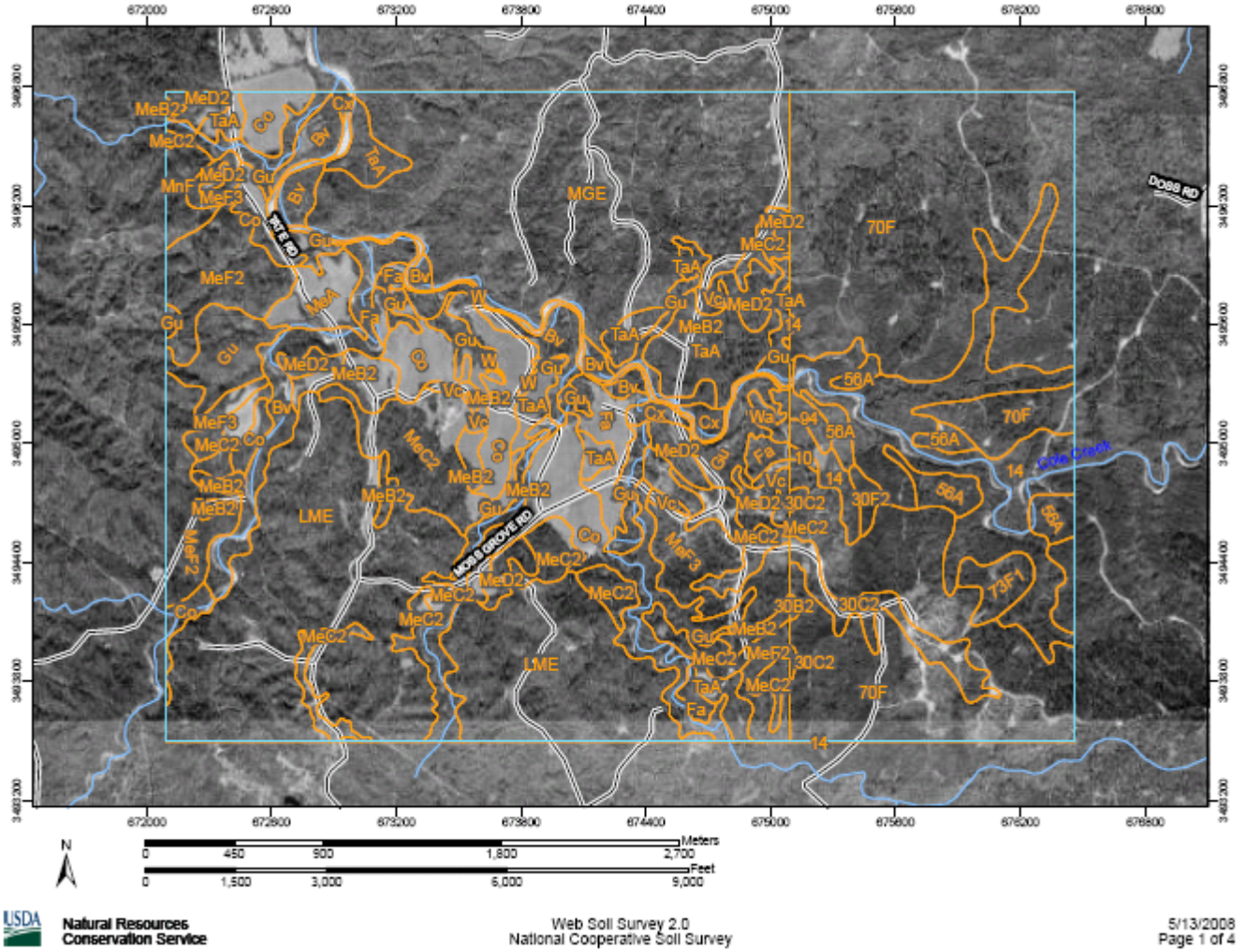

Figure 4.2.1-2. NRCS Generated Map of Soil Series at SECARB Test Site
Source: (DOE, 2008a).

Table 4.2.1. Legend for NRCS Generated Map of Soil Series at SECARB Test Site	
Map Unit Symbol	**Map Unit Name**
Bv	Bruno and Vicksburg soils
Co	Collins silt loam
Cx	Crevasse-Bruno complex
Fa	Falaya silt loam
Gu	Gullied land
LME	Lucy-Memphis association, hilly
MeA	Memphis silt loam, 0 to 2 percent slopes
MeB2	Memphis silt loam, 2 to 5 percent slopes
MeC2	Memphis silt loam, 5 to 8 percent slopes
MeD2	Memphis silt loam, 8 to 17 percent slopes
MeF2	Memphis silt loam, 17 to 60 percent slopes
MGE	Memphis-Gullied land association, hilly
MnF	Memphis-Natchez complex, 17 to 60 percent slopes
TaA	Tippo silt loam, 0 to 3 percent slopes
Vc	Vicksburg silt loam, local alluvium
W	Water
Wa	Waverly silt loam
10	Ariel silt loam, occasionally flooded
14	Gillsburg silt loam, occasionally flooded
30B2	Memphis silt loam, 2 to 5 percent slopes
30C2	Memphis silt loam, 5 to 8 percent slopes
30F2	Memphis silt loam, 8 to 40 percent slopes
56A	Bude silt loam, 0 to 2 percent slopes
70F	Smithdale-Lexington-Memphis association, 5 to 40 percent slopes
73F1	Lorman silt loam, 15 to 35 percent slopes
94	Trebloc silt loam, frequently flooded

Source: (NRCS, 2008a)

4.2.2 Effects of Proposed Action

Geology: The Proposed Action would increase the pressure gradients within the Tuscaloosa Formation resulting in the movement of multi-phase fluids. Hydrocarbon recovery will develop an emulsion of hydrocarbons, saline water and gasses including CO_2. The likelihood of accidental surface releases increase slightly with the collection and disposal of saline water and gasses at the surface. Increasing formation pressures may, to a minor extent, increase the likelihood of well casing failures and gas migration resulting in potential leakage from aging wells. However, if operational protocols are followed, the activities planned for this CO_2 storage and EOR operations are not expected to cause measurable leakage of CO_2 from the storage formation to the surface.

Soils: Actual and potential impacts to soils would occur at all stages of this project. During the first stage, all major activities that would impact soils would occur as part of Denbury's

commercial EOR operations even if the SECARB study is not conducted (i.e., No-Action alternative). These activities would include the traffic of heavy equipment and light vehicles to reopen roads and drilling pads and lay pipelines. Re-established forest would be cleared and right of ways established for new high pressure CO_2 injection lines. Drilling muds and drill cuttings (containing additives and oily saline cuttings) would be produced and land treated. There is a potential for fuels, lubricants, coolants, drilling muds and produced fluids to be spilled to ground. First stage activities would be undertaken in cleared (vegetation removed) areas, in undulating terrain consisting of heterogeneous (mix of properties) silt loam soils, and in an environment which receives heavy rains from tropical storms. Liquids released to the ground if not "cleaned up" would either be washed into the surrounding surface water or leached into the soil. While land treatment areas may be difficult to manage in this environment, Denbury has had over 10 years of experience in similar drilling and EOR operations in this area and has successfully managed land treatment in accordance with environmental regulations.

To mitigate potential soils and subsurface geology impacts from the construction stage if the Proposed Action is implemented, Denbury plans to:

- Re-establish oil production infrastructure on pre-disturbed lands thereby minimizing the development footprint to reconditioned well pads and flow lines within a total area of approximately 2 mi^2 (3.21 km^2).
- Establish SECARB wells and infrastructure in forested areas away from land developed for agriculture crops.
- Integrate the SECARB project into their own EOR development thereby minimizing infrastructure and operational requirements.
- Directionally drill additional injection wells from existing (re-established) former well pads.
- Extend four injection wells into the brine water leg down dip formation thereby reducing the incremental impact of the SECARB project from drilling.
- Handle and dispose of drilling mud and associated waste according to MSOGB rules and regulations.
- Install an additional compressor for the SECARB project in-line with existing pipelines minimizing soil disturbance.
- Drill two observation wells from re-conditioned well pads already being used for EOR injection wells.
- Use smaller/lighter drilling and sampling equipment to establish groundwater monitoring wells.
- Collect and then dispose of any brinish water produced to a permitted Class II injection well.

During the second phase, the impacts would be restricted to light vehicles accessing injection and monitoring locations to maintain operations and record observations. Impacts to soils could result from spillage of lubricants and fluids from the compressors or very minor loss of fluids collected from the sampling program. Leakage from the injection formation up into the soil profile is a possibility and could result from pipeline ruptures, casing leaks or formation fracturing. CO_2 gas accumulations in soil can cause root function inhibition and oxygen deprivation to soil microbes and surface vegetation.

To minimize impacts to soils and subsurface geology if the operational phase of the SECARB Study is implemented, Denbury and SECARB plan to:

- Verify abandoned well integrity through the review of plug and abandonment records.
- Integrate SECARB operations into Denbury operations and maintenance into the EOR project to gain operational efficiencies.
- Monitor well casing vent flows.
- Test well completion integrity.
- Undertake soil-gas surveys using shallow auger holes resulting in minimal surface soil disturbance.
- Properly plug and abandon observation wells at the end of the SECARB study to help prevent CO_2 and saltwater migration up to the surface.
- Monitor the site at least one (1) year after the SECARB injections have been terminated.
- Collect and then dispose of any brinish water produced as a result of sampling to a permitted Class II injection well.

4.2.3 Effects of No-Action

Denbury plans to develop the EOR regardless of the implementation of the SECARB Phase III Early Test.

Geology: The only difference between a full implementation of the SECARB project and no implementation, from a geological perspective, would be the establishment of two deep observation wells by drilling into the brine water leg down dip of the target formation, the establishment of two shallow groundwater monitoring wells, and the injection of the additional volume of CO_2.

Soils: Surface disturbance would be similar except for the disturbance and infrastructure needed to establish deep observation wells, shallow groundwater wells, the compressor site, and the tests associated with operational monitoring of soils throughout the life of the SECARB project.

4.2.4 Cumulative Effects

Geology: The Proposed Action would cause an increase in pressure gradients within the Tuscaloosa Formation resulting in the movement of multi-phase fluids. Hydrocarbon recovery brought on by implementation of the Proposed Action could develop additional emulations of hydrocarbons, saline water and gasses including CO_2. The collection and disposal of saline water and gasses increases the likelihood of accidental releases. Increasing formation pressures could increase the likelihood of well casing failures and gas migration resulting in potential leakage from aging wells.

At the termination of CO_2 sequestration, the injection and monitoring wells would need to be properly abandoned to prevent potential releases both at the surface and along the well bore. The retained pressure in the target formation may result in a restriction with respect to future development of any remaining oil and gas resources or CO_2 disposal activities.

Soils: The SECARB study developed in conjunction with the EOR project would result in the following potential additional impacts to soil:

- The additional use and eventual land treatment of 33% more drilling mud (30,000 to 50,000 lbs. or 13,608 to 22,680 kg) plus cuttings with associated impacts to the receiving soils and potentially the surrounding area (the lower sections of the wells are in oil and salt water bearing strata).
- Increased traffic (soil compaction and disturbance) due to establishment of groundwater monitoring wells and implementation of soil and geological monitoring programs.
- The potential for spillage to the soil surface of additional 167,000 to 280,000 gallons (631,978 to 984,207 L) of water (potentially including additives and oil/salts from the subsurface formations) needed for the observation well drilling program.

Provided there are no spills or there is timely and effective spill response the cumulative impact to the soils of the Cranfield Oil and Gas Field development will be negligible. All activities by Denbury and SECARB including the construction, operation, maintenance, and closure of wells, compressors, and related facilities would be required to meet all MSOGB requirements. Existing MSOGB regulations adequately protect the environment with strict standards to prevent and contain spills, erosion, waste, and release of other materials; and provide for penalties and appropriate remedial actions for failure to comply.

Given the predicted impacts of the CO_2 injection to the geological formations at the SECARB site, we do not expect that they would exceed the impact significance threshold. Provided there are no spills or there is timely and effective initiation of spill response, the cumulative impact to the soils of the Cranfield Oil and Gas Field development would be negligible.

4.3 Water Resources

4.3.1 Description

The regional topography is dominated by the drainage basin of the South Fork of Coles Creek. The creek transects the area entering along the eastern boundary and flows northwest. Tributary ephemeral streams enter the creek from the upland areas to the north and southwest. Natchez Lake is located approximately 1 mile (1.6 km) to the west of the area and the Mississippi River is located approximately 10 miles (16.1 km) to the west.

Flow from the South Fork Basin is monitored by the United States Geological Survey (USGS). Hydrometric records from 1999 to 2004 indicate peak discharge volumes of 22,500 cubic feet per second (ft^3/sec) (637.1 m^3/sec) (USGS, 2005). Water quality data collected on the South Fork of Coles Creek (1961-1982) indicate that the surface water is a moderately soft, sodium bicarbonate type (USGS, 2008a). The Mississippi Department of Environmental Quality (MDEQ) lists the South Fork of Coles Creek (MS454E) as an impaired water body in its 2008 Section 303(d) List of Impaired Water Bodies (MDEQ, 2008).

Two major fresh water aquifer systems have been noted in the area. A phreatic (or unconfined) aquifer is located within the recent quaternary surficial deposits, while confined aquifers are located in the older, yet shallow Miocene and Oligocene geologic age deposits. The USGS

determined that the elevation of the aquifer (base) where total dissolved solids (TDS) less than 1,000 milligrams per liter (mg/L) (less than 1,000 ppm) is at approximately 600ft (183m) (Gandl, 1982). Where TDS less than 3000 mg/L (less than 3,000 ppm), the base of useable-water quality, is between 1,200 and 1,400 ft (366-427m) depth. The depth of the potentially useable-quality water (less than 10,000 ppm/TDS) is between 1,400 and 1,600 ft depth (427-488m) (DOE, 2008a).

The fresh water aquifers are underlain by the confining Cockfield Formation. The Cockfield Formation represents a major regional aquifer system which has been declining (both in quality and quantity) in recent years (USGS, 2005). The results of water quality testing have shown an increasing trend (5-year) in the levels of chloride in the Cockfield Formation in Washington County, north of the SECARB test site and the Cockfield Formation is not a part of USDW in the study area. It was also reported that groundwater flow in this formation is complex and largely affected by anthropogenic behavior, indicated by the falling potentiometric levels and shifting well draw downs (Mason, 2001).

4.3.2 Effects of Proposed Action

Production of emulsions of hydrocarbons, saline water and gasses increase the potential for casing and pipeline failures, potentially increasing the number of spills. The effect of casing failures could be the migration of fluids into confined domestic use aquifers. Surface spills could result in infiltration to phreatic aquifers and flow to surface water bodies.

To minimize soil and therefore groundwater and surface water impacts during the operational phase of the SECARB Study, Denbury would implement, develop, maintain, monitor and abandon the SECARB project following the strategy outlined in Section 2.0 above.

4.3.3 Effects of No-Action

Denbury plans to develop the area for EOR regardless of whether the SECARB Phase III Early Test is implemented or not; therefore, the effect of the No-Action alternative would be a lower probability of impacts to surface and groundwater resources as a result of less oil production and CO_2 sequestration infrastructure development and operational activity.

4.3.4 Cumulative Effects

The potential cumulative effects of the Proposed Action are similar to those outlined in Section 4.2.4 above for soils:

- The land treatment area would be a potential source of both surface and groundwater contamination. The heterogeneous soils in this area make the land treatment area development specifications very site specific (soils range from being very permeable to subject to severe erosion). The SECARB development would add 33 % to the volume of drilling mud potentially available for treatment.
- The potential spillage of an additional 167,000 to 280,000 gallons (631 978 to 984 207 L) of drilling waste water could impact both surface and groundwater quality.

- The drilling of two additional observation wells could potentially provide a conduit for CO_2 and salt water migration into the aquifer above.
- Containment of compressors leaking lubricants and coolants will be required. Containment will be necessary for both the compressor itself and oil and coolant reservoirs to prevent spillage to the ground and surface and groundwater impacts.

Other than observation well water samples, the SECARB project would produce negligible quantities of produced water. If there is soil erosion as a result of field re-development the incremental impact of the SECARB project would have a negligible influence on overall soil erosion and potential surface water impacts. Operationally, SECARB would not need any make up water.

Provided there are no spills, or there is a timely and effective spill response, the cumulative impact to the surface and groundwater of the Cranfield Oil and Gas Field development would be negligible and therefore is not expected to exceed the impact significance threshold.

4.4 Wetlands and Floodplains

4.4.1 Description

Regionally, marshes, lakes, and swamps are numerous (Bailey, 1995), although none are found in the study area. One perennial stream, South Fork of Coles Creek, crosses the study area, as well as several intermittent streams and four small freshwater ponds (Figure 4.4.1-1). Although some riverine wetlands occur in the study area, no jurisdictional wetlands have been recorded in the National Wetlands Inventory within the project boundaries (USFWS, 1982).

National Wetlands Inventory map units of the site are classified as PUBHh and R2USA (USFWS, 1982). The PUBHh units are the freshwater ponds classified as palustrine unconsolidated bottom permanently flooded diked/impounded units (USFWS, 2008). Palustrine system designations include all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens. The R2USA units are the riverine wetlands associated with the South Fork of Coles Creek classified as riverine lower perennial unconsolidated shore temporarily flooded (USFWS, 2008). Riverine system designations include all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water or which forms a connecting link between the two bodies of standing water. The lower perennial subsystem is characterized by a low gradient and slow water velocity.

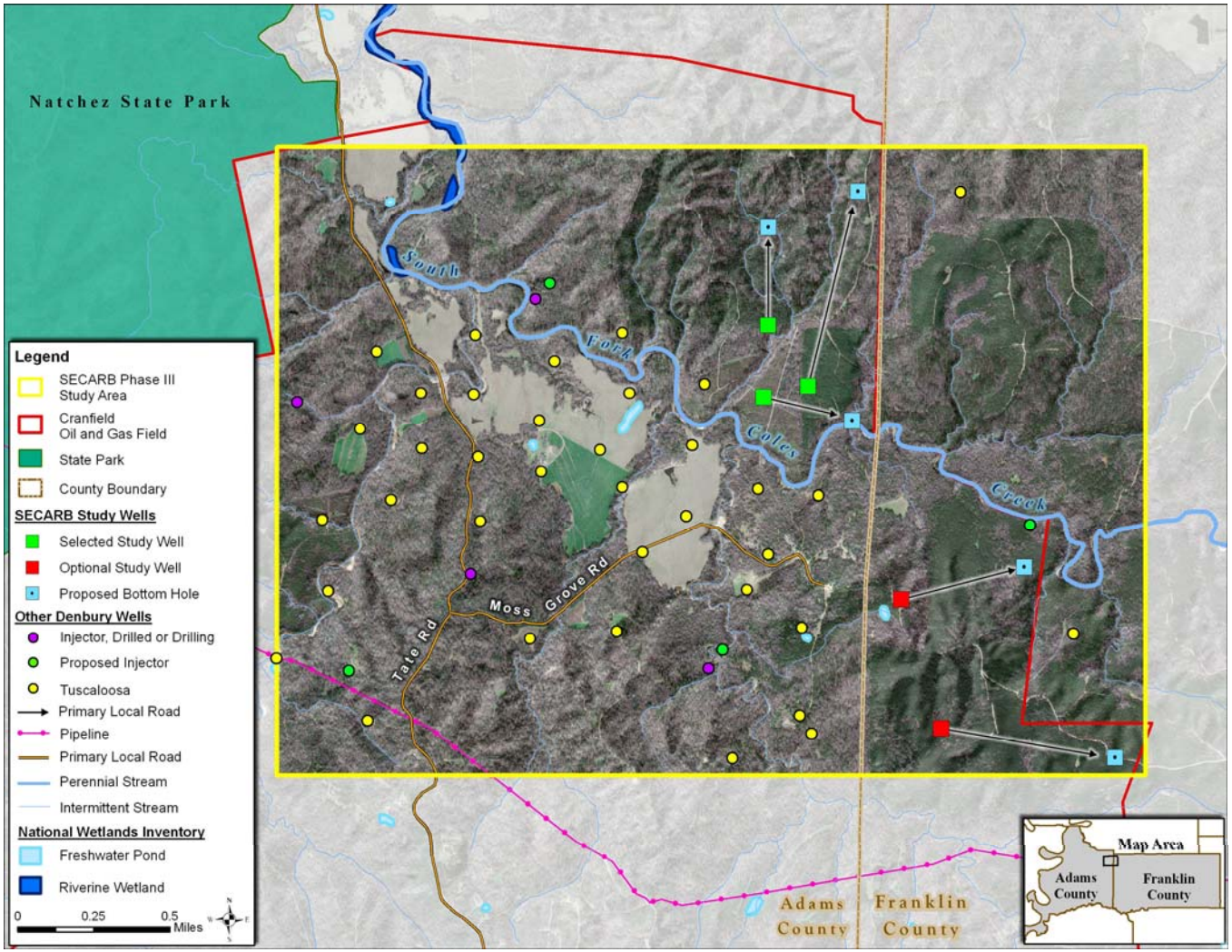

Figure 4.4.1-1. Water Bodies and Wetlands in the Project Area

Additionally, there is a small 100 year floodplain in the project area associated with the South Fork of Coles Creek (Figure 4.4.1-2) (FEMA, 1977; FEMA, 1989). Normal and peak stream flows of Coles Creek in this area are known from operation of a stream-gauging station near Fayette, MS (U.S. Geological Survey station 07290870) approximately 10 miles north of the project site. The drainage area for Coles Creek above the Fayette stream-gauging station totals 257 square miles. The gauge datum is 67.3 feet above mean sea level. Maximum discharge measured at the Fayette gauge between 1961 and 1995 was 75,000 cubic feet per second (cfs) on April 12, 1974, which corresponded to a gauge height of 31.96 feet. Thus, the peak flood elevation near Fayette from 1961 to 1995 was 99.26 feet above sea level. This peak flood elevation is sufficient to inundate the lowland floodplains of Coles Creek; however, water elevations of the creek during high floods, such as in 1974, are more than 90 feet below the land-surface elevation of 190 feet above sea level at the project site (USGS, 2008b).

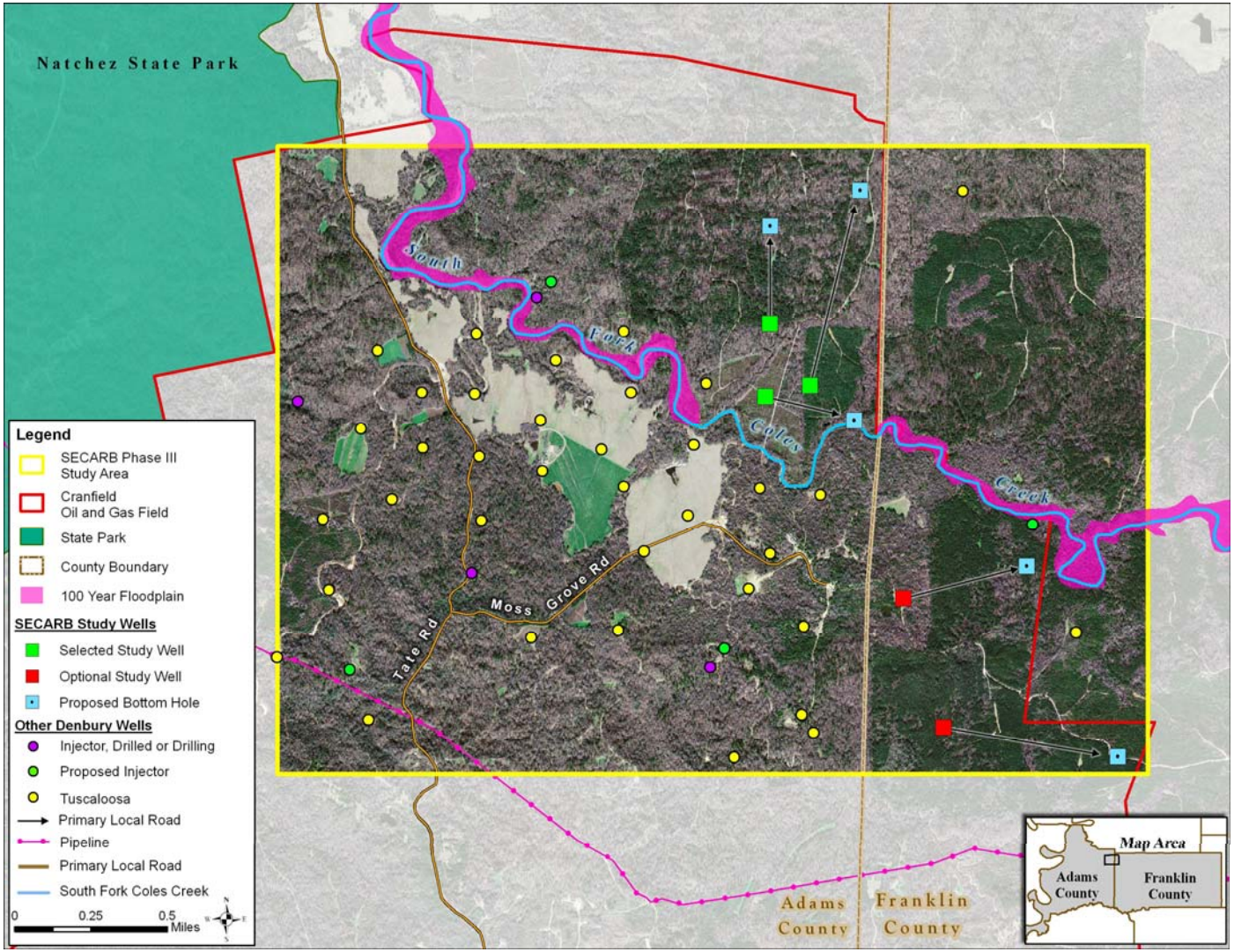

Figure 4.4.1-2. Floodplains in the Project Area

4.4.2 Effects of Proposed Action

If the northern optional study well is selected (see Figure 2.1.2) as the fourth injection well, it is possible that the small freshwater pond located nearby (see Figure 4.4.1-1) and any associated wetlands would be affected since the well pad site is located very close to the pond. Since the existing well pad was abandoned in the mid-1960s, it would be reconditioned to support drilling operations to include land clearing of approximately one acre or less, leveling and fill activities, rebuilding access roads, laying connector pipelines, and extending other infrastructure services as needed. These activities increase the likelihood of soil erosion and sediment delivery to the small pond through the disturbance of surface soils. The effects to the pond and wetland water quality and hydrology would be adverse and short-term. Best management practices to control erosion and sediment release would be utilized during all construction activities.

It is also possible that construction activities could destroy some wetland surface area. However, while clearing land and installing other infrastructure, efforts would be made to avoid direct wetland damage.

Diesel fuel products would be needed for construction of the deep well located near the freshwater pond; therefore, there is some risk of an accidental fuel spill, which could adversely affect water quality if the spill were to enter the wetland. Again, best management practices would be used during handling of fuel to minimize the risk of spills.

The construction of Denbury pipelines and roadways may cross streams or run adjacent or through wetlands. Disturbance of road surfaces and embankments caused by excavation and grading during installation of pipeline and roadways would likely cause soil erosion and sediment delivery to the streams and wetlands. Construction activities that would take place within stream channels or wetlands would result in potential contamination (i.e., fuel or oil spills) of riparian and/or wetland vegetation and sedimentation, which could disturb organisms and raise water temperatures. Effects to stream and wetland water quality and hydrology could be adverse and short-term lasting only during construction activities. These activities, which will occur regardless of SECARB participation, would be conducted in accordance with best management practices of the industry and comply with all federal and state environmental regulations to minimize impacts.

Since none of the injection wells would be located in or near the floodplain of the South Fork of Coles Creek, construction activities would not cause any impacts to this floodplain. Conversely, flooding of the South Fork of Coles Creek would not reach or damage the well sites. As described for wetlands above, pipeline and roads which may cross floodplains could disturb floodplain soils and cause soil erosion. However, floodplain structure and function would not be altered or compromised.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on wetlands and floodplains near or at some distance from the project site. Wetland vegetation and water quality could be impacted by increased concentrations of CO_2, possibly resulting in changes in species composition, plant death, changes in pH and water quality (International Energy Agency, 2007).

Although leakage of CO_2 to the surface affecting wetlands and floodplains in a widespread area is possible, it is more likely that any impacts to wetlands would be confined to the immediate project area and would not cause any regional impacts. Thus, impacts on wetlands and floodplains by the Proposed Action would not be expected to exceed the significance threshold.

4.4.3 Effects of No-Action

Under the No-Action alternative, the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would not be implemented. No additional impacts to wetlands or floodplains would occur as a result of this alternative beyond impacts that would occur regardless of SECARB participation.

4.4.4 Cumulative Effects

Past oil and gas development in the Cranfield Unit has likely resulted in impacts to area wetlands and floodplains. Wetlands and floodplains are subject to damage from ongoing activities in the area including hunting, cattle grazing, and timber harvest operations; these activities are likely to continue in the future, along with Denbury's commercial enhanced oil recovery operations. The proposed project could pose some threats to wetlands and floodplains, including soil erosion and sediment delivery, destruction of some wetland surface area, and risk of accidental fuel spills. It is also possible that an unlikely leakage of CO_2 to the surface would have wider spread consequences on wetlands and floodplains. However, given the larger impacts to wetlands and floodplains from past, present, and future activities, cumulative impacts contributed by the proposed project would not exceed the significance threshold.

4.5 Terrestrial Vegetation

4.5.1 Description

The proposed new CO_2 injection wells and observation wells would be located in an area characterized by the Bailey Ecoregion classification as the Southeastern Mixed Forest Province of the Subtropical Division (National Atlas, 2008). The area consists of wooded hills with deciduous and evergreen forests and flatter areas used for agriculture, consisting of pasture and row crops. Forest tree species include loblolly and shortleaf pine, oak, hickory, and some adjacent gum and cypress. The main grasses are bluestem, panicums, and longleaf uniola. Dogwood, viburnum, haw, blueberry, American beautyberry, youpon, and numerous woody vines are common (Bailey, 1995). Moderate to high amounts of forest fragmentation occur in isolated areas near the South Fork of Coles Creek.

A beech-magnolia forest in a recovering loess ravine habitat that has been listed as a natural community of concern by Mississippi Natural Heritage Program (MSNHP) has been reported in an isolated area near Highway 84 immediately south of the study area. The only other natural community of concern listed by the MSNHP near the study site is in Natchez State Park. These sites are approximately one mile from the outer boundaries of the study area and more than two miles from the proposed injection well sites.

No critical habitats or federally listed plant species exist in the vicinity of the project site or in Adams and Franklin counties. Table 4.5.1 lists the Mississippi state listed species that occur in Adams and Franklin counties, but not necessarily at the project location. The U.S. Fish and Wildlife Service reviewed the project location and has determined that no federally listed or proposed threatened or endangered plant species are likely to occur at the project site, and that the project site would not be located within officially designated critical habitat. Copies of the review request and the determination letter are included in Appendix B.

Table 4.5.1. State Listed Plant Species in Adams and Franklin Counties, MS

Scientific Name	Common Name	Global Rank	State Rank
Adams County			
Antennaria solitaria	Single-headed pussytoes	G5	S3?
Carex decomposita	Cypress-knee sedge	G3	S3?
Celastrus scandens	Climbing bittersweet	G5	S2S3
Dryopteris australis	Southern wood fern	G3	S1
Erythrodes querceticola	Low erythrodes	G3G5	S1?
Herbertia lahue ssp. *caerulea*	Herbertia	G4G5	S2
Mikania cordifolia	Florida Keys hempvine	G5	S3S4
Pachysandra procumbens	Allegheny spurge	G4G5	S3
Phacelia dubia	Small-flower scorpionweed	G5	S?
Platanthera cristata	Crested fringed orchid	G5	S3
Schisandra glabra	Scarlet woodbine	G3	S3?
Stewartia malacodendron	Silky camellia	G4	S3S4
Trillium foetidissimum	Fetid trillium	G3	S3
Franklin County			
Antennaria solitaria	Single-headed pussytoes	G5	S3?
Hookeriopsis heteroica	Trachyxiphium moss	G2?	S1?
Lobelia appendiculata	Appendaged lobelia	G4G5	S2S3
Mikania cordifolia	Florida Keys hempvine	G5	S3S4
Schisandra glabra	Scarlet woodbine	G3	S3?
Stewartia malacodendron	Silky camellia	G4	S3S4
Trillium foetidissimum	Fetid trillium	G3	S3

Source: (MSNHP, 2008). (Note: Ranking definitions are as follows:

G3 - Either very rare or local throughout its range or found locally in a restricted range or vulnerable to extinction from other factors.
G4 - Apparently secure globally (may be rare in parts of range).
G5 - Demonstrably secure globally.
S1 - Critically imperiled in Mississippi (5 or fewer occurrences or less than 1000 individuals) because of extreme rarity or because of extreme vulnerability to extinction due to some natural or man-made factor.
S2 - Imperiled in Mississippi because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
S3 - Either very rare and local in Mississippi (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.
S4 - Apparently secure in Mississippi (may be rare in parts of range))

4.5.2 Effects of Proposed Action

Construction activities associated with the Proposed Action would necessitate removal of plants where land is cleared for well reconditioning, and for installation of roads, pipelines, and power lines; however, much of the project area has already been disturbed during past oil and gas activities. Trees and ground cover would be removed for site preparation. Repeated disturbance of vegetation (i.e., due to vehicle passes or foot traffic) during construction, injection, and monitoring in areas where plants are not cleared would cause damage to plants and destruction of the vegetation mat.

It is estimated that a total of one to two acres of vegetation would be disturbed by installation of wells, roads, pipeline, and power lines. The majority of disturbance would occur in previously disturbed areas, minimizing adverse impacts on vegetation. Well reconditioning would include land clearing of approximately one acre or less, which would occur regardless of SECARB participation. A gravel access road and drilling pad would not be required for the two water wells, so no additional land would be cleared. Construction of roads, pipeline, and power lines would require some additional land clearing, but likely not more than one acre. There would also be localized vegetation disturbance from foot traffic during installation, injection, and monitoring; however, this area would likely be minimal and limited to the areas immediately surrounding the equipment.

Exotic plants or seeds could be brought to the site with fill material or on equipment. New introductions could allow for exotic plants to become established and spread, especially in areas where the ground is disturbed by construction activities. Exotic plants currently growing in the area can also become established and spread on newly disturbed substrates. However, mitigation to ensure that imported material does not contain exotic plant material would be implemented.

As no critical habitats or federally listed plant species exist in the vicinity of the project site, there would be no impacts on threatened or endangered species.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on vegetation near or at some distance from the project site. Although atmospheric CO_2 promotes plant growth, increased concentrations in the soil could lead to root asphyxiation and plant death (International Energy Agency, 2007). Impacts of seepage on on-shore ecosystems could also include altered biological diversity and changes to the composition and numbers of species in the local environment. The range of effects on terrestrial ecosystems could extend to entire ecosystems and could be chronic, acute, or lethal depending on species affected and concentrations of CO_2.

Any changes to native vegetation would be limited to a small area and would not affect the viability of the resources. Full recovery would occur in a reasonable time, considering the size of the project and the affected resource's natural state. Therefore, impacts on terrestrial vegetation would not be expected to exceed the significance threshold.

4.5.3 Effects of No-Action

Under the No-Action alternative, the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would not be implemented. No impacts to terrestrial vegetation would occur as a result of this alternative beyond impacts that would occur regardless of SECARB participation.

4.5.4 Cumulative Effects

Vegetation in the Cranfield Unit has been previously cleared for construction of wells, roads, and related infrastructure as part of past oil and gas operations. The area has and continues to be used for hunting, cattle grazing and timber harvest. Each of these activities involves removal, trampling, or destruction of vegetation and disturbance of ground cover. Additionally, if enhanced oil recovery by Denbury is successful, other oil fields in the general area of the project site may be worked over again, contributing to vegetation impacts in the region. Land clearing as part of the proposed project would be limited to well pad sites of one acre or less, associated road construction or reconditioning necessary to provide access to the sites, and pipeline construction for CO_2 and product recovery. Most of this activity would occur on property already disturbed by prior drilling and other activities and would be conducted as part of Denbury's commercial enhanced oil recovery operations. It is also possible that an unlikely leakage of CO_2 to the surface would have wider spread consequences on vegetation. Overall, cumulative impacts from the proposed project when added to other past, present, and reasonably foreseeable future actions would not exceed the significance threshold.

4.6 Wildlife

4.6.1 Description

Common mammals that occur in rural areas east of the Mississippi River include white-tailed deer, beaver, raccoon, skunk, rabbit, squirrel, mole, and shrew. Common birds include bobwhite quail, mourning dove, meadowlark, robin, hawks, and owls. Black bass, bluegill, and catfish are commonly found in area streams. Common snakes include cottonmouth moccasin, copperhead, rough green snake, rat snake, coachwhip, and speckled kingsnake. Fence and glass lizards are also found, as is the slimy salamander.

The closest wildlife refuge, St. Catherine Creek National Wildlife Refuge, is a protected area for the bald eagle and least tern. This refuge is located approximately 20 miles (32 km) southwest of the project area on the east bank of the Mississippi River about 10 miles (16 km) south of the City of Natchez, Mississippi.

Table 4.6.1 lists the federal and state listed species for Adams and Franklin counties. The U.S. Fish and Wildlife Service reviewed the experiment location and has determined that two federally listed threatened or endangered wildlife species and one recently de-listed species could be found on or near the project area. Copies of the review request and the determination letter are included in Appendix B.

Table 4.6.1. Federal & State Listed Wildlife Species in Adams & Franklin Counties, MS				
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Adams County				
Cyprinella whipplei	Steelcolor shiner	G5	S3	
Graptemys ouachitensis	Ouachita map turtle	G5	S4?	
Paravitrea significans	Domed supercoil	G?	S?	
Potamilus capax	Fat pocketbook	G1	S1	Endangered
Scaphirhynchus albus	Pallid sturgeon	G1	S1	Endangered
Ursus americanus luteolus	Louisiana black bear	G5	S1	Threatened
Franklin				
Alloperla natchez	Natchez stonefly	G2	S2	
Crystallaria asprella	Crystal darter	G3	S1	
Haploperla chukcho	Chukcho stonefly	G2	S2	
Homoeoneuria cahabensis	Cahaba sand-filterning mayfly	G2	S1S3	
Picoides borealis	Red-cockaded woodpecker	G3	S1	Endangered
Procambarus penni	Pearl blackwater crayfish	G3	S3	
Uniomerus declivis	Tapered pondhorn	G5	S2	
Ursus americanus luteolus	Louisiana black bear	G5	S1	Threatened

Source: (MSNHP, 2008; USFWS, 2005). (Note: Ranking definitions are as follows:

G1 - Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.

G2 - Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.

G3 - Either very rare or local throughout its range or found locally in a restricted range or vulnerable to extinction from other factors.

G5 - Demonstrably secure globally.

S1 - Critically imperiled in Mississippi (5 or fewer occurrences or less than 1000 individuals) because of extreme rarity or because of extreme vulnerability to extinction due to some natural or man-made factor.

S2 - Imperiled in Mississippi because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.

S3 - Either very rare and local in Mississippi (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.

S4 - Apparently secure in Mississippi (may be rare in parts of range).

The federally listed threatened Louisiana black bear occurs primarily in bottomland hardwood and floodplain forests along the Mississippi River and the southern part of the state. The Louisiana black bear can survive under a range of habitat types, but some necessary habitat requirements include hard mast, soft mast, escape cover, denning sites, forested corridors, and limited human access. Den trees, bald cypress, and tupelo gum with visible cavities with a

minimum diameter at breast height of 36 inches (0.9 m) occurring along water bodies should be preserved if possible.

The red-cockaded woodpecker, federally listed endangered, excavates nesting cavities in mature pine trees. All cavity trees, active and inactive, are important and should be avoided. Additionally, older pine stands within a half-mile (0.8 km) of roosting trees is considered foraging habitat and should not be disturbed.

Although the bald eagle was officially removed from the federal list of threatened and endangered species in 2007, it continues to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Bald eagles nest in Mississippi from December through mid-May in mature trees near marshes or open water.

4.6.2 Effects of Proposed Action

Construction activities for installation of wells, roads, pipeline, power lines, and vehicle traffic, lighting during night work, and human presence would cause temporary displacement and disturbance of resident wildlife for the 18 months duration of the construction and injection period and one year of monitoring. Species are expected to return to the area after construction and injection is completed, although there may still be some minimal disturbance during the additional year of monitoring and during decommissioning activities. These impacts would be localized and limited to the immediate area of the project site.

It is estimated that a total of one to two acres of wildlife habitat would be disturbed by installation of wells, roads, pipeline, and power lines. Well reconditioning would include land clearing of approximately one acre or less, which would occur regardless of SECARB participation. A gravel access road and drilling pad would not be required for the two water wells, so no additional land would be cleared and no habitat lost in their installation.

Construction of roads, pipeline, and power lines would require some additional land clearing, but likely not more than one acre. There would also be localized habitat disturbance from foot traffic during installation, injection, and monitoring; however, this area would likely be minimal and limited to the area immediately surrounding the equipment.

Two federally listed threatened or endangered wildlife species and one recently de-listed species could occur in the vicinity of the project site. It is possible that proposed activities in the area could cause impacts to Louisiana black bear habitat by increasing human disturbance, fragmenting forests, and removing den trees. Similarly, proposed activities could disturb red-cockaded woodpecker foraging habitat or cavity trees, and bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. However, if any habitat for these three species exists in the area, it has likely been disturbed by past oil and gas operations, and land clearing under the Proposed Action would be minimal. Mitigation measures would be in place to avoid removing black bear den trees, red-cockaded woodpecker cavity trees, or bald eagle nest trees. These species would be subject to the same temporary displacement and disturbance as other wildlife species from activities associated with the Proposed Action; however, if any of these species are actually found in the vicinity of the project

area, mitigation measures would be in place to minimize such disturbance, for example, ceasing all activity near a den, cavity or nest tree. Therefore, adverse impacts on threatened or endangered species could occur, but would be minimized.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on wildlife near or at some distance from the project site. Effects of a leak would decrease in severity in a series of concentric rings, with those organisms closest to the leak suffering from acute or even lethal concentrations of CO_2 (International Energy Agency, 2007). Changes in subsurface biogeochemical processes could lead to changes in soil pH with associated negative effects on microbial populations, leading to a change in nutrients present which would progress up the food chain. Changes in the quality of groundwater could have serious consequences on water resources. Both food chain and water resource impacts would likely have detrimental effects on animal health. Additionally, prolonged exposure to high CO_2 concentrations may result in increased risk of asphyxiation for some wildlife (International Energy Agency, 2007).

Any impacts on wildlife from the Proposed Action would be limited to a small portion of the population and would not affect the viability of the resource. Full recovery would occur in a reasonable time, considering the size of the project and the affected species' natural state. Therefore, impacts on wildlife would not be expected to exceed the significance threshold.

4.6.3 Effects of No-Action

Under the No-Action alternative, the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would not be implemented. No impacts to wildlife would occur as a result of this alternative beyond impacts that would occur regardless of SECARB participation.

4.6.4 Cumulative Effects

Wildlife and habitat in the Cranfield Unit have been, and continue to be, subject to disturbance and damage from hunting, timber harvest, traffic, Denbury's commercial enhanced oil recovery operations, and past oil and gas operations. Habitat disturbance associated with infrastructure as part of the proposed project would be limited, and wildlife displacement and disturbance would be temporary lasting only for the duration of the construction, injection, and monitoring period. Similar impacts could occur to any threatened and endangered (T&E) species if they are present in the area. It is also possible that an unlikely leakage of CO_2 to the surface would have wider spread consequences on wildlife and habitat. Cumulative impacts from the proposed project when added to other past, present, and reasonably foreseeable future actions would be limited to a small portion of the wildlife population and would not affect the viability of the resource. Recovery of this resource from any temporary change would occur in a reasonable period of time and not exceed the impact significance threshold

4.7 Land Use

4.7.1 Description

The Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would be

situated in an approximately two square mile (5.2 km^2) area within the northeast corner of Adams County and northwest corner of Franklin County in southwestern Mississippi. The project area is approximately twelve miles (approximately 19 km) east of Natchez, Mississippi, and four miles northeast (approximately 6 km) of the unincorporated village of Cranfield. The setting of the project area can be characterized as rural. Land cover classes identified by the U.S. Geological Survey and the percentage of cover types within the study area are displayed below in Table 4.7.1-1.

Table 4.7.1-1. USGS Land Cover Classes for SECARB Phase III Early Test Project Area

Land Cover Type	Percentage of Study Area
Forest	76%
Scrub/Shrub	14%
Developed Open Space	4%
Pasture/Hay	3%
Crops	3%
Wetlands	less than 1%

Source: (USGS, 2001)

Approximately 80% of the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project area would be located within the boundaries of the Cranfield Oil and Gas field. Oil and Gas recovery operations began at Cranfield in 1943 and, and soon became Mississippi's second largest oil and gas field (Cockrell, 2005). By 1965, the field was largely abandoned. However, Denbury currently is conducting commercial operations in the project area, including well drilling and access road construction (DOE, 2008a).

Currently, predominant land uses in the project area and in the immediate vicinity include timber production, gravel quarrying, and oil production, in addition to some farming for crops such as cotton, corn, soybean, grain, and hay/pasture (DOE, 2008a). Major transportation arteries providing access to the project area include U.S. Highways 61 and 84. Direct access to well sites is provided by a network of local and private gravel roads. Recreational lands in direct proximity to the project area include Natchez State Park.

The Natural Resources Conservation Service has identified areas of prime farmland within the project area. Descriptions of prime farmland types and the percentages of these types within the study area are displayed below in Table 4.7.1-2.

Table 4.7.1-2. NRCS Prime Farmland Classes for SECARB Phase III Early Test Project Area

Prime Farmland Class	Percentage of Study Area
All Areas are Prime Farmland	9%
Prime Farmland if Drained	6%
Prime Farmland if Protected from Flooding	8%
Prime Farmland of Statewide Importance	8%
Not Prime Farmland	69%

Source: (NRCS, 2008b)

4.7.2 Effects of Proposed Action

Under the Proposed Action, four injection wells would be repositioned and drilled to extend below the oil-water interface into the deeper brine-bearing Tuscaloosa Formation. These four primary injection wells would be drilled from existing well pads used during the previous production at the Cranfield Unit and directionally drilled to the desired down-hole locations. Three of these wells have already been completed as part of ongoing EOR. The fourth well would be drilled from one of two previous well pad sites. Because, the well pads were abandoned in the mid-1960s, Denbury will recondition them to support drilling operations. This reconditioning will include land clearing and leveling activities of less than one acre, as well as the construction of a gravel access road to safely operate a drilling rig. Two groundwater monitoring wells would also be drilled but would not require a road or pad, as they could be drilled with a truck-mounted rig. Additionally, a CO_2 compressor would also be installed in conjunction with an existing Denbury compressor station. Fences may be installed on an as-needed basis to keep livestock away from wellheads. No permanent surface facilities would be required.

Because of the project area's historical use as an oil and gas field, the relatively small amount of land clearing that would take place as part of the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would not likely have a substantial impact on land use within the project area. The small well pads, requiring less than one acre of land clearing, are similar to other well pads in the Cranfield Unit and would not likely have a substantial impact on the forest, pasture, or prime farmland resources in the project area. Additionally, all of the land clearing activities associated with the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project will be conducted by Denbury regardless of the implementation of the Phase III Early Test project. As such, activities associated with the Phase III Early Test project would likely be consistent with current land uses in the project area, and would not substantially alter land use patterns. Furthermore, because monitoring and injection operations would take place in subsurface formations at depths of up to 10,000 feet (approximately 3,000 m), impacts to surface land use would not likely exceed the significance threshold.

4.7.3 Effects of No-Action

Under the No-Action alternative, the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would not be implemented. No impacts to land use would occur as a result of this alternative beyond impacts that would occur regardless of SECARB participation.

4.7.4 Cumulative Effects

Because of the project area's historical use as an oil and gas field within the Cranfield Unit, as well as Denbury's ongoing commercial enhanced oil recovery efforts, any cumulative effects to land use within the project area as a result of implementation of the Southeast Regional Carbon Sequestration Partnership Phase III Early Test project would not likely alter any particular land use at the project site or in adjacent areas. Because land clearing activities associated with the Phase III Early Test project is a component of Denbury's current commercial operations and are

a small spatial percentage of the overall study area, cumulative impacts to other adjacent land uses (such as timber production, farming, and recreation) would not likely be substantial as a result of implementation of the Phase III Early Test Project.

4.8 Socioeconomic Resources

This socioeconomic assessment considers how the proposed project activity would affect people, institutions, communities, and the local economy, as well as larger infrastructure, social and economic systems. This section describes the socioeconomic conditions that may be affected by implementation of SECARB and addresses the potential impact that may result from actions undertaken as a part of this project.

4.8.1 Population

4.8.1.1 Description

The study area includes portions of two counties in Southwestern Mississippi, Franklin and Adams, which together constitute the larger, geographic boundaries for the assessment of socioeconomic effects. Major concentrations of population located in or near the study area include the incorporated communities of Roxie (population 569), approximately six miles east of the study area boundary in Franklin County, and the city of Natchez (population 18,464), approximately 12 miles (approximately 19 km) west of the study area boundary in Adams County. Several smaller unincorporated settlements (population under five hundred residents) are also present, including Hamburg, Orange, Fayette, Leesdale, and Cranfield. Census block data indicate a total of 135 individuals living in 67 housing units dispersed in areas adjacent to the study area.

Franklin is an almost entirely rural county with a 2000 population of 8,448 (Census, 2007). Since 2000, the estimated population shows a decline of 2.1 percent to a 2006 estimate of 8,269. Franklin County supports a total of 4,119 housing units with an average density of 7.3 units per square mile and a population density of 15.0 persons per square mile (Census, 2000a). For the year 2000, the occupancy rate for all units in the county was 78 percent (Census, 2000b). The median age of Franklin County residents, 37 years, is slightly higher than that for the state as a whole, 33.8 years. Approximately 72.7 percent of the population is 18 years or older, with 6.5 percent under the age of five and 15.2 percent aged 65 and over (Census, 2000b).

Located to the west of the study area, Adams County contained a population of 34,340 residents in 2000. Estimates for 2006 indicate that the county population has declined by five percent to 32,626 (Census, 2007). In 2000, there were a total of 15,175 housing units in the county, with an occupancy rate of 90.1 percent and an average density of 33 units per square mile. Population density for 2000 was 74.6 persons per square mile (Census, 2000a). With a median age of 38.1 years, the county population is older than that of the state. Residents aged 18 years and older comprise 73.2 percent of the population. Children five years of age and younger represent 6.8 percent of the county's population and persons 65 years of age and older account for 15.6 percent (Census, 2000c).

4.8.1.2 Effects of Proposed Action

Implementation of the Proposed Action would be expected to require only minimal additional labor requirements beyond that already established as part of Denbury's current operations. Additional employment under this alternative would be limited to drilling crews for the observation and monitoring wells and personnel to perform ongoing maintenance of sampling equipment. Drilling companies already contracted by Denbury for EOR operations would likely be used for the construction of the deep observation wells. A local water well driller would be contracted to drill the shallow groundwater monitoring well. As a result, no substantial impact would be associated with changes in the community character, demographic composition, or housing availability beyond that already existing for Denbury's ongoing operations in the Cranfield Unit. A slight but temporary increase in local population may be experienced during the construction phase; however, any such increase would be small and of short duration. On-going operation and maintenance of monitoring equipment would be performed by SECARB personnel and contractors on a periodic, non-continuous basis approximately 4 times during the study period. Monitoring crews consist of 8 researchers working for 2 weeks during each of the 4 study intervals. Local resources and accommodations would not be substantially affected and no change to community character and setting would be anticipated.

4.8.1.3 Effects of No-Action

The study area is an established oil field setting where drilling and other subsurface activities familiar to the surrounding communities have occurred for several years. Current and planned activity at this site would be conducted as a part of Denbury's current commercial operations and would be expected to continue irrespective of any additional data collection activities. Current operations may be expected to have a minor influence on local employment and correspondingly on local residential patterns. However, any such increase would be expected to be small and of no substantial consequence to the size and composition of the local population. Since ongoing activities at the Cranfield Unit would be similar to those already existing at the site, no substantial impact to community character and setting would be anticipated.

4.8.1.4 Cumulative Impacts

The cumulative effects resulting from the addition of the Proposed Action to ongoing Denbury commercial activities would be limited to the additional temporary workforce required during the drilling phase and some minimal addition of labor during the operation and maintenance phase. These requirements are minimal and would not be expected to stress local resources and accommodations. The proposed activity is in character with existing operations at the site and would add only minimally to existing conditions in the study area. None of these impacts could be expected to exceed the significance threshold. Therefore, no substantial impact would be associated with the Proposed Action when taken into consideration with other current or future actions proposed for the site.

4.8.2 Employment and Income

4.8.2.1 Description

The economy of Franklin County is characterized by its relative size and diversity, with manufacturing, information services and retail trade among the leading economic sectors (BLS, 2006). In 2006 Franklin had a per capita personal income of $20,628 (BEA, 2006). Employment statistics for March 2008 indicate that the county supported a total labor force of 3,332 workers, with an unemployment rate of 6.4 percent. This represents a decrease of 0.6 percent from the 2007 annual average unemployment (BLS, 2008). The largest occupational categories for the Franklin County workforce in 2000 were sales and office occupations – 24.2 percent; management, professional, and related occupations - 23.3 percent; and production and transportation – 20.3 percent (Census, 2000d). Median household income in 2000 was $25,234. A summary of income distribution by household is presented in Table 4.8.2.1.

Table 4.8.2.1. Household Income for 1999

	Franklin County		Adams County	
	Number	**Percent**	**Number**	**Percent**
Less than $10,000	702	21.7	2,928	21.4
$10,000 to $14,999	312	9.7	1,480	10.8
$15,000 to $24,999	606	18.8	2,382	17.4
$25,000 to $34,999	442	13.7	2,041	14.9
$35,000 to $49,999	450	13.9	1,828	13.3
$50,000 to $74,999	496	15.4	1,585	11.6
$75,000 to $99,999	125	3.9	761	5.6
$100,000 to $149,999	58	1.8	324	2.4
$150,000 to $199,999	7	0.2	109	0.8
$200,000 or more	30	0.9	255	1.9
Total Households	**3,228**	**100.0**	**13,693**	**100.0**

Source: (Census, 2000d)

Leading sectors of the Adams County economy include construction, mining, retail trade and accommodation and food services. Per capita personal income for the county in 2006 was $27,413 (BLS, 2006). As of March 2008, the county's civilian labor force totaled 13,963 with an unemployment rate of 6.2 percent. This represents a slight increase over the early part of the year, but is down 0.1 percent from the 2007 annual average (BLS, 2008). The largest occupational categories for the Adams County workforce were management, professional, and related occupations - 27.8 percent; sales and office occupations - 26.4 percent; and service occupations - 18.5 percent. Median household income was $25,234 (Census, 2000d). Income distribution for Adams County is presented in Table 4.8.2.1.

4.8.2.2 Effects of Proposed Action

The addition of the SECARB test activities to the current Denbury oil recovery operations at the Cranfield Unit would be expected to result in minimal change to the conditions of the local economy. Labor requirements, beyond those already identified for ongoing operations, would be

small and would be limited to the crews necessary to drill the observation and groundwater monitoring wells and necessary personnel for ongoing maintenance and monitoring activity. These would not be expected to contribute substantially to overall labor and income growth in the local economy. Resource demands from the local economy would not be sufficient to stress any currently existing supply levels. The provision of additional CO_2 by Denbury will add only a small increment to its existing income from the Cranbury unit. As a result, no substantial impact to the local economy would be expected under this alternative.

4.8.2.3 Effects of No-Action

Denbury's commercial operations at the site represent the existing conditions for the local economy. Any resource and labor requirements associated with site operations have already been incorporated into the local economy and do not have a substantial adverse effect. This would be expected to result in an overall beneficial effect from expenditures for supplies, materials, construction services and labor to the extent that they are available from the local economy. Since Denbury operations at the Cranfield Unit have been ongoing for decades, it is likely that several new business entities have been developed in the local market to supply needed goods and services. These entities would experience a direct benefit. However, the extent to which resources and labor are supplied from the local economy is dependent on need, availability, and price at the time the requirement is experienced. Some additional expenditure outside the two-county area may be required for materials and services not locally available.

Current Denbury operations at the Cranfield Unit are pre-existing in that they would occur whether or not the SECARB project is implemented. Existing recovery operations would be expected to continue and potentially expand at the Cranfield Unit. The costs of operations at the Cranfield Unit include 26 well workovers (production wells) at an estimated $570,000 each (total: $14.82 million) and 20 injection wells at an estimated cost of $1.3 million each (total: $26 million), totaling $40.82 million. Current labor availability and existing unemployment rates would indicate that requirements for employment at the Cranfield site would not stress the local labor market or the provision of services and accommodations in the local area.

4.8.2.4 Cumulative Impacts

Cumulative effects are the result of the incremental impact of the Proposed Action when added to the other past present or reasonably foreseeable future actions. The site selected for the Proposed Action is an existing commercial oil field that has been in operation for several decades. The Proposed Action would add only incrementally to the existing conditions and therefore would not be expected to contribute substantially to any significant change in employment, labor market conditions, services and resource availability, or local income generation. Therefore, it would not exceed the significance threshold.

4.8.3 Infrastructure

4.8.3.1 Description

The road system in and around the study area is a mixture of highway, paved secondary roads

and unpaved service roads. The study area itself is traversed by two primary local roads: Tate Road (Rd.), running north to south through the western portion of the study area; and Moss Grove Rd., intersecting with Tate Rd. and running east to west across the Adams County portion of the Study area. A network of unpaved roads services the various operating units within the study area.

Three major highways are located in the near vicinity of the study area. These roads represent the primary surface access routes for the Cranfield site. U.S. Highways 98/84 runs east-west approximately two miles (approximately 3 km) to the south of the study area. Traffic count data from the Mississippi Department of Transportation (MDOT) estimates the average annual daily traffic to be 4600 vehicles per day for this segment. U.S. Highway 61 runs southwest to northeast approximately three miles north of the study area with an average volume of 6500 vehicles per day. To the west of the study area, State Route 33 runs north-south, intersecting with U.S. Highway 84 in Franklin County and U.S. Highway 61 further to the north in Jefferson County. Average daily estimates for this segment are calculated at 1100 vehicles per day (MDOT, 2006).

There are no utility transmission lines within the boundaries of the study area. A single pipeline crosses the southwest corner of the study area in Adams County (Figure 2.1.2).

4.8.3.2 Effects of Proposed Action

The introduction of the proposed SECARB activity to the existing conditions at the Cranfield site would add only minimally to current levels of traffic and road use. Any increases would be temporary and would not be expected to substantially alter existing patterns.

4.8.3.3 Effects of No-Action

Current operations at the Cranfield Unit have not resulted in a substantial impact to local traffic. However, some temporary increase in heavy truck traffic may be experienced along the major highways and local service roads as equipment and supplies are transported to the site during construction activities. No substantial disruption to local traffic or degradation of service is anticipated along these major roadways. Some minor disruption of local traffic may occur on unpaved service roads as heavy trucks are moved to the site. There are no public utilities at the site which might be disturbed during either the construction or ongoing operations phase of the project.

4.8.3.4 Cumulative Impacts

Cumulative impacts associated with implementation of the proposed alternative would be temporary and minimal, if noticeable at all. The area and its associated road network have been part of ongoing oil and gas field operations for several decades. There are no planned or reasonably foreseeable actions proposed for the area that may affect local road use or traffic patterns. The introduction of a temporary increase in traffic during construction operations can be easily accommodated by the existing road system with only minor disruptions. The project would not noticeably affect or disrupt the normal or routine functions of public institutions,

roads, electricity, and other public utilities and services in the project area. Continuing operations of the SECARB wells following construction would have no additional impact and would not exceed the impact significance threshold.

4.8.4 Parks and Recreation

4.8.4.1 Description

The two Mississippi counties that contain the study area offer a variety of park, national forest and dispersed outdoor recreational opportunities. Facilities in the Franklin County area include:

- The Homochitto National Forest – 189,000 acres located to the south of the study area with the nearest piece to the project area boundary being approximately 2 miles (3 km), extending west into Adams county and north into Jefferson, Lincoln, and Copiah counties;
- The Clear Springs Recreation area – (approximately 13 miles (21 km) to the southeast of the project area boundary) a part of the Homochitto National Forest, activities include camping, swimming, fishing and picnicking;
- Okhissa Lake is approximately 19 miles (31 km) to the southeast of the project area boundary; and
- The Homochitta River – (approximately 14 miles (23 km) to the south of the project area boundary) suitable for canoeing, river rafting, swimming, and fishing.

Located immediately, as in sharing a border with the project area, to the northwest of the study area in Adams County, the Natchez State Park includes scenic trails and facilities for picnicking, swimming, boating, fishing and overnight lodging. Within the vicinity of the proposed project site, a number of private holdings offer hunting excursions and overnight lodging for guests.

4.8.4.2 Effects of Proposed Action

Additional drilling operations related to the SECARB project would be expected to generate only minimal impact to recreational activities in the immediately surrounding area of the Cranfield Unit. Some disruption of hunting activity during the construction phase may be anticipated as equipment, materials, supplies and workers are moved throughout the site. However, any such disruptions would be temporary and easily accommodated by the landowners who, for the most part, also hold mineral rights to the properties involved. No disruption would be expected during the ongoing maintenance and monitoring phase.

4.8.4.3 Effects of No-Action

Parks and recreational opportunities in the surrounding region and within the study area itself have existed along with Denbury drilling operations and extraction operations for several years. No additional impact would be anticipated form current oil and gas recovery operations at the site.

4.8.4.4 Cumulative Impacts

The addition of the proposed SECARB action to ongoing activities at the Cranfield Unit and in the surrounding area would have no substantial impact to the use of National Forest lands, state parks, or other recreational opportunities in the two-county area. As noted under the Proposed Action, some temporary disruption may occur in the study area itself during drilling operations. However, any disturbance would be minor, temporary in duration and in character with existing uses of the study area and is not expected to exceed the impact significance threshold.

4.8.5 Visual Resources

4.8.5.1 Description

There are no scenic vistas or aesthetic landscapes in the vicinity of the proposed project. The Cranfield Unit where the study is located is an oil and gas field that was largely abandoned in 1965. The field site is adjacent to the site where Phase II SECARB research is now under way. Facilities constructed under the proposed project would not contrast with the present landscape as gravel roads and well sites are common in the vicinity of the study area and are consistent with existing timber, gravel, and oil production uses.

4.8.5.2 Effects of Proposed Action

Under the Proposed Action, installation of two observation wells and two shallow water wells, a network of distribution pipelines to individual well sites, and associated land clearing, access roads, and power lines would minimally alter the visual elements of the project area as it is located in an abandoned oil and gas field. The wooded nature of the area would furthermore provide a tree buffer to shield any new visual elements from off-site viewers. Additionally, the four injection wells and related pads, pipelines, and access roads would be constructed regardless of SECARB involvement.

Facilities constructed under the proposed project would not contrast with the present landscape as gravel roads and well sites are common in the vicinity of the study area. The proposed project would not interfere with visual resources, eliminate scenic views, or alter the present landscape. The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on terrestrial ecosystems, having impacts on visual resources if areas of vegetation are altered. Any minor changes that may result from implementation of the Proposed Action in species composition, frequency and density of plants, or vegetation dieback are not expected to alter visual elements in the landscape and viewsheds.

Overall, it is not likely that the Proposed Action would change the visual landscape in a way that would be objectionable to local residents or frequent visitors; thus impacts on visual resources would not be expected to exceed the significance threshold.

4.8.5.3 Effects of No-Action

Under the No-Action alternative, the Southeast Regional Carbon Sequestration Partnership Phase

III Early Test project would not be implemented. No impacts to visual resources would occur as a result of this alternative beyond impacts that would occur regardless of SECARB participation.

4.8.5.4 Cumulative Impacts

Visual quality at the Cranfield Unit has been predominantly altered by the past oil and gas operation under which drilling rigs and wells were installed and then abandoned, land was cleared, and gravel roads were constructed. Other ongoing activities which have affected the visual quality of the area are hunting camps and removal of trees as part of timber harvest operations. Additionally, Denbury's current commercial enhanced oil recovery operations could potentially further alter the visual elements of the area. Given the larger impacts to visual resources from past, present, and future activities, cumulative impacts added from the proposed project would not change the visual resource classification of the affected area and not exceed the impact significance threshold.

4.8.6 Noise

Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise intrusive. Human response to noise varies depending on the type and characteristics of the noise, distance between the noise source and the receptor, receptor sensitivity, and time of day. Noise is often generated by activities part of everyday life, such as construction or vehicular traffic.

Sound varies by both intensity and frequency. Sound pressure level, described in decibels (dB), is used to quantify sound intensity. The dB is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. Hertz (Hz) are used to quantify sound frequency. The human ear responds differently to different frequencies. A-weighing, described in a-weighted decibels (dBA), approximates this frequency response to express accurately the perception of sound by humans. Sounds encountered in daily life and their approximate level in dBA are provided in Table 4.8.6.

Table 4.8.6. Common Sounds and Their Levels

Outdoor	Sound level (dBA)	Indoor
Snowmobile	100	Subway train
Tractor	90	Garbage disposal
Noisy restaurant	85	Blender
Downtown (large city)	80	Ringing telephone
Freeway traffic	70	TV audio
Normal conversation	60	Sewing machine
Rainfall	50	Refrigerator
Quiet residential area	40	Library

Source: (Harris, 1998)

The dBA noise metric describes steady noise levels. Although very few noises are, in fact, constant; therefore, a noise metric, Day-night Sound Level (DNL) has been developed. DNL is

defined as the average sound energy in a 24-hour period with a 10-dB penalty added to the nighttime levels (10 P.M. to 7 A.M.). DNL is a useful descriptor for noise because (1) it averages ongoing yet intermittent noise, and (2) it measures total sound energy over a 24-hour period. In addition, Equivalent Sound Level (Leq) is often used to describe the overall noise environment. Leq is the average sound level in dB.

The Noise Control Act of 1972 (Public Law 92-574) directs federal agencies to comply with applicable federal, state, interstate, and local noise control regulations. In 1974 the U.S. Environmental Protection Agency (USEPA) provided information suggesting that continuous and long-term noise levels in excess of DNL 65 dBA are normally unacceptable for noise-sensitive land uses such as residences, schools, churches, and hospitals. The State of Mississippi has no state-wide noise regulation. The closest towns of Natchez and Roxie have local nuisance noise ordinances. However, both are greater than 5 miles away (8 km) from the study area.

4.8.6.1 Description

Existing sources of noise near the pipeline and drilling site include local road traffic, high-altitude aircraft overflights, and natural noises such as leaves rustling, and bird vocalizations. The areas surrounding these locations can be categorized as very quiet rural area. The noise environment consists of very light traffic conditions where very few automobiles and trucks pass. The background sound is likely distant traffic noise from Interstate 84. Existing noise levels (DNL and Leq) were estimated for the proposed sites and surrounding areas using the techniques specified in the *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound Part 3: Short-term measurements with an observer present*. Table 4.8.6.1 outlines the closet Noise Sensitive Areas (NSAs) such as residents, schools, churches, and hospitals, and the estimated existing noise levels at each location.

Table 4.8.6.1. Estimated Existing Noise Levels at Nearby Noise Sensitive Areas

Closest Noise Sensitive Area (NSA)				Estimated Existing Sound Levels (dBA)		
Distance	**Direction**	**Type**	**Land Use Category**	**DNL**	**Leq (Daytime)**	**Leq (Nighttime)**
8800 ft (2680 m)	SSW	Residence	Very quiet, sparse suburban or rural residential areas	45	43	37
4400 ft (1340 m)	E	Residence				

Source: (ANSI, 2003)

4.8.6.2 Effects of Proposed Action

Short-term and long-term minor adverse effects to the noise environment would be expected with the implementation of the Proposed Action. The effects would be primarily due to heavy equipment noise during construction and drilling of the injection, observation and groundwater monitoring wells, and the operation of an additional proposed compressor as part of the

SECARB Phase III Early Test. These activities would be in addition to Denbury's on-going commercial operations in the area.

Construction Noise. There would be some form of moderate to heavy construction at the well locations. Individual pieces of construction equipment typically generate noise levels of 80 to 90 dBA at a distance of 50 feet. Table 4.8.6.2 presents typical noise levels (dBA at 50 feet) that USEPA has estimated for the main phases of outdoor construction.

Table 4.8.6.2. Noise Levels Associated with Outdoor Construction

Construction Phase	Leq (dBA) at 50 feet from Source
Ground Clearing	84
Excavation, Grading	89
Foundations	78
Structural	85
Finishing	89

Source: (USEPA, 1974)

With multiple items of equipment operating concurrently, noise levels can be relatively high during daytime periods at locations within several hundred feet of active construction sites. The zone of relatively high construction noise levels typically extends to distances of 400 to 800 feet (122 – 244 m) from the site of major equipment operations. Locations within 1000 feet (305 m) would experience substantial levels (greater than 62 dBA) of construction noise. However, there are no NSAs within 1000 feet (305 m) of the construction sites. These effects would be temporary, and would be considered minor. The equipment mufflers would be properly maintained and in good working order to reduce these already limited effects.

Drilling Noise. The Proposed Action would involve drilling operations for the monitoring wells. Components of the drilling equipment include the drill rig, mud pumps, and diesel generators. Drilling equipment is expected to operate twenty-four hours per day, seven days per week, for up to three months. The nearest NSA is 4400 feet (ft) [1340 meters (m)] east of the closest well location. A DNL of 43 dBA and a Leq of 37 dBA were estimated for the drilling operations at this distance. This is less than or equal to the estimated background level for this area and would not likely be audible. These effects would be temporary, and would be considered minor. Detailed noise calculations are located in Appendix C.

The generator and combined diesel driven systems would have the standard exhaust muffles. Barriers can be installed around the noisy components to diminish the noise, but would not likely be necessary given the distance to the nearest NSA. Drilling noise would be expected to dominate the soundscape for all on-site personnel. Personnel, and particularly equipment operators, would don adequate personal hearing protection to limit exposure and ensure compliance with federal health and safety regulations.

Operational Noise. The only major noise-producing equipment that could be expected during the operation stages of the study is an additional in-line CO_2 compressor. This compressor would operate 24 hours per day 7 days per week during the injection phase. The exact location of the

compressor is unknown and associated manufacturers specifications have not been finalized. Dresser-Rand will supply CO_2 compressors to Denbury for injection operations at Cranfield. Compressors already in use or ordered for the operations are 2,325 horsepower models 2HHE-VG-2. Since the additional compressor to be used for the SECARB study would be collocated with existing Denbury compressors, the incremental increase in noise levels will be less noticeable. For analysis purposes, a 10,000 horsepower (hp) [7462 kilowatt (kW)] reciprocating compressor was chosen to represent a worst case noise scenario. This is both the largest and loudest off-the-shelf compressor use for CO_2 pipeline applications (Ariel Corporation, 2008; Bies, 2003). A compressor of this size and type would be loud enough to generate a DNL greater than 65 at all NSA within approximately 1200 feet (approximately 366 m) of its location. Based on the pipeline route in the study area, it is unlikely that any NSAs would be within 1200 feet (approximately 366 m) of the compressor. In addition, because of the remote location it is unlikely that there would be a violation of the local noise ordinances. In the final design stages, extra care would be taken to insure the size, type, and location of the compressor is consistent with all federal, state, and local guideline with respect to noise.

4.8.6.3 Effects of No-Action

The No-Action alternative would have no impacts to noise because no additional drilling would occur, and no additional equipment would be installed. Noise levels would remain consistent with that attributable to activities that will be completed by Denbury as part of their EOR operations regardless of the implementation of the SECARB Phase III Early Test. As a result, minimal differences exist between the build and no build scenarios with respect to noise.

4.8.6.4 Cumulative Impacts

The Proposed Action would introduce long-term incremental increases the noise environment. All noise associated with the project would be in addition to Denbury's on-going commercial operations in the area. These increases would be relatively small and have a minor cumulative effect on the overall noise environment but would not be expected to exceed ambient noise standards beyond the proposed project boundary.

4.8.7 Environmental Justice

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (The White House, February 11, 1994), requires that Federal Agencies consider as a part of their action, any disproportionately high and adverse human health or environmental effects to minority and low income populations. Agencies are required to ensure that these potential effects are identified and addressed.

The Environmental Protection Agency defines environmental justice as; "the fair treatment and meaningful involvement of all people regardless or race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." For purposes of assessing environmental justice under NEPA, the CEQ defines a minority population as one in which the percentage of minorities exceeds 50

percent or is substantially higher than the percentage of minorities in the general population or other appropriate unit of geographic analysis (CEQ, 1997).

Consideration of the potential consequences of the Proposed Action for environmental justice requires three main components:

- A demographic assessment of the affected community to identify the presence of minority or low income populations that may be potentially affected;
- An assessment of all potential impacts identified to determine if any result in significant adverse impact to the affected environment; and
- An integrated assessment to determine whether any disproportionately high and adverse impacts exist for minority and low-income groups present in the study area.

4.8.7.1 Description

In 2000, minority populations constituted 37.2 percent of the total population of Franklin County, or 3,143 individuals. This is slightly lower than the 38.6 percent minority component for the population of the State of Mississippi as a whole. Hispanic or Latino populations (of any race) represented 0.5 percent of the total population, or 45 individuals. Socioeconomically disadvantaged individuals, those living at or below the poverty line, constituted 24.1 percent of the population or 2,010 individuals in 2000 as compared with a 19.9 percent rate for the state as a whole (Census, 2000b).

Minority populations make up approximately 54 percent of the total population of Adams County, or 18,531 individuals. Hispanic or Latino residents (of any race) constitute 0.8 percent of the total population or 273 individuals. In 2000 there were 8,775 individuals living at or below the poverty level, or 25.9 percent of the population. As a result, Adams County displays a higher minority percentage of its population and a higher percentage of persons living at or below poverty than the State of Mississippi as a whole (Census, 2000c).

Of the two incorporated communities near the study area, the town of Roxie, in Franklin County contains a resident minority population of 60.3 percent, or 337 individuals (Census, 2000e) and the city of Natchez in Adams County includes a minority population of 44.2 percent or 10,189 individuals (Census, 2000f). Individuals living at or below the poverty level constitute 25.5 percent and 28.6 percent of these communities' populations respectively. Census block data for the areas in and immediately surrounding the study area indicate a minority population of 74 individuals or 55 percent of the total population of 135 residents (Census, 2000g).

4.8.7.2 Effects of Proposed Action

Minority and lower income groups are generally present in the study area and the immediately surrounding communities in greater numbers than for either county or for the State of Mississippi as a whole. However, both direct and indirect effects associated with the implementation of this alternative would be anticipated to be minimal for all populations in the immediate study area and for the surrounding communities of Franklin and Adams Counties. Therefore, no disproportionately high or adverse impacts to minority or low income communities would be expected.

4.8.7.3 Effects of No-Action

The present level of activity associated with Denbury's current commercial operations would be expected to continue with little or no additional adverse impact to the local community, its labor force, employment patterns, demographic characteristics, level of diversity, infrastructure or economic characteristics. Current operations may be expected to have a minor influence on the local social community, but any changes would be small and in keeping with the character of the existing community.

4.8.7.4 Cumulative Impacts

The proposed activity considered by this assessment would add only minimally to existing conditions in the study area and surrounding communities. As a result, any incremental impact would not be sufficient to constitute a substantial impact and would most likely be experienced evenly across all populations. Therefore, neither minority nor low-income groups within the affected community will experience proportionately greater adverse effects than other members of the community.

4.9 Human Health and Safety

4.9.1 Description

Section 4.1 above discusses the potential for local air quality impacts as a result of the Proposed Action. Air pollution causes human health problems. Air pollution can cause breathing problems; throat and eye irritation; cancer; birth defects; and damage to immune, neurological, reproductive, and respiratory systems (USEPA, 2007c). National and state ambient air quality standards represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare with a reasonable margin of safety. In addition, OSHA regulations specify appropriate protective measures for all employees.

Spills from the construction of the facility and operation are also a source of possible impacts to human health and safety. Spills can introduce soil contamination and allow exposure pathways to workers and the public. The risks and effects of a spill depend on its composition. A common material used in construction and operation at this site that can be spilled is diesel. Diesel irritates the lungs and is a skin irritant. Enough diesel exposure can cause death or nervous system damage (ATSDR, 2007). Similarly, waste management also is a source of possible human health and safety risks from exposure to contaminants (See Section 4.11).

One potential impact to human health and safety within the project site is CO_2 leaks. CO_2 is heavier than ambient air, colorless, and odorless, which makes it an invisible hazard (DOE, 2007a). Since it is denser than ambient air, leaked CO_2 will typically pool in hollows and confined spaces until dispersed by wind or other ventilation methods (DOE, 2007a; IPCC, 2005). CO_2 under pressure or at high concentration levels can cause suffocation and permanent brain injury from lack of air (DOE, 2007a). Headache, impaired vision, labored breathing, and mental confusion also can occur from exposure to CO_2 (IPCC, 2005). The pressure drop from CO_2

leaks from vessels (pipes) creates a cold hazard, which even the vapor can cause frostbite (IPCC, 2005). Generally, the pooling and large, rapid releases of the CO_2 are the situations of concern for human health and safety instead of small gradual leaks due to concentration level differences (IPCC, 2005; DOE, 2007a).

No general CO_2 exposure standards exist yet for the general public (DOE, 2007a). The immediately dangerous to life and health level of exposure for CO_2 is 5% or 40,000 ppm. For up to several hours, exposure to 0.5 to 1.5% CO_2 in the air typically is not harmful for people with normal health. However, people with impaired health (such as cerebral disease), children, and people involved in complex tasks are more susceptible to the effects of CO_2 exposure. CO_2 exposure impedes people's performance of complex tasks by causing labored breathing, headache, and mental confusion. The occupational standard of maximum allowable concentration of CO_2 in air for eight hours of continuous exposure is 0.5%, and for a short period, it is 3.0% (IPCC, 2005).

CO_2 leaked in high concentrations can cause human health issues in the water as well as air. CO_2 underground injection can contaminate groundwater if the CO_2 migrates to underground aquifers (See Section 4.3). This contamination can occur by the CO_2 causing the mobilization of chemicals such as metals in the soil into the aquifers. Despite monitoring and permitting requirements (USEPA's UIC program), the risk to human health from potable water contamination still exists from underground injection. Similar to air emissions of CO_2, gradual releases of CO_2 into water sources typically do not cause substantial harm to human health, but rapid releases could (DOE, 2007a).

Since CO_2 is neither toxic nor explosive, emergency procedures need only be rudimentary. The worst case would be a sudden, complete failure of pipe. This would release all the CO_2 in the pipe. The result would be dry ice formation at the break due to the sudden expansion, plus release of a large gas cloud as the supercritical fluid is converted to CO_2 gas. The gas is non-toxic, but a sudden, large release might displace air for nearby workers at the Cranfield Unit, but is unlikely to present a hazard at the village of Cranfield.

This scenario, though highly unlikely, will be modeled, taking into account the sudden release and its atmospheric dispersion. If the modeling, contrary to expectations, suggests a possibility of negative health effects due to air displacement, Denbury would install further automatic low-pressure shut-downs. High pressure shut-downs would be included. The effect of this would be to limit the amount of carbon dioxide that could escape in a sudden, complete failure of the pipe. This technique is in wide use for public protection in the sour gas industry in Alberta, where large amounts of highly toxic hydrogen sulfide might be released during a line break. It is evidently successful; although a few sour gas line breaks have occurred, there have never been fatalities or injuries among the public over the last 5 decades (AERCB, 2008).

The integrity of the system against carbon dioxide release will be dependent on the following:

- Continuous corrosion testing, with corrosion coupon testing as a minimum.
- Frequent moisture testing of the dehydrated gas supplied by the Sonat pipeline.
- Continuous pressure monitoring of the flow lines, with automatic shut-down systems at strategic locations within the facilities.

Between 1994 and 2006, there were 31 CO_2 pipeline accidents reported, and there were no injuries or fatalities from these incidents in the United States (DOE, 2007c). Some historical causes of CO_2 pipeline incidences are relief valve failure (4 failures), weld/gasket/valve packing failure (3 failures), corrosion (2 failures), and outside force (1 failure). The incident rate from 1990 to 2002 for CO_2 pipelines in the United States was 0.0002 mile^{-1} yr^{-1} (0.00032 km^{-1} yr^{-1}) (IPCC, 2005). This rate of failure is comparatively small. For comparison with natural gas pipelines, see Table 4.9.1.

Table 4.9.1. Comparison of Natural Gas Pipelines to CO_2 Pipelines from 1995 to 2005

Category	Natural Gas	CO_2
Miles of Pipeline	304,001 (in 2003) 490,000 km	3,300 5,300 km
# of Incidents	960	12
Property Damage per Incident	$484,000	$42,000
Injuries from Incidents	82	0
Fatalities	29	0

Source: (DOE, 2007a)

The workers on the project would be subject to the same types of health risks that are generally associated with their professions (DOE, 2007a). There is a rate of 15.2 deaths per 100,000 for construction workers, which is the third highest rate of death from injury (NIOSH, No date). The construction incident rate of total recordable cases of non-fatal occupational injuries and illnesses in 2006 was 5.9 per 100 full-time workers (BLS, 2007).

4.9.2 Effects of Proposed Action

The Proposed Action includes pipe-laying; construction and operation of compression units; transportation of CO_2; drilling of observation wells; and injection of supercritical CO_2 much of which will be conducted by Denbury even if the SECARB study is not implemented.(See Section 2.1). These all present risks to human health and safety. The materials and equipment used for construction and operation would meet prescribed standards (DOE, 2008b). Having a general public outreach program to inform the audiences about CO_2 sequestration could reduce the risks and consequences of health and safety issues like accidents.

The equipment that would be used for the implementation of the Proposed Action represents only minimal risks to human health and safety under normal operating conditions (DOE, 2007a). Thus, if Best Management Practices (BMPs), maintenance, and regulations are followed, the equipment should pose little impact to human health and safety. Drilling into pressurized formations could release flammable gases like methane. Preventative measures to minimize well blowouts or venting of dangerous gases should be implemented. Measures to avoid the equipment failure caused by high pressure would be executed (DOE, 2007a).

Since most of the construction and operation activities of the Proposed Action are on Denbury property, the increase in traffic from workers and delivery of equipment and materials would be

partially limited to onsite, which reduces risk to pedestrians and the general public. However, the Proposed Action would still represent an increase in traffic, which increases the potential for accidents. However, this incremental increase in traffic would be very limited and would be a de minimus increase to the larger and more frequent movement of materials for Denbury's EOR operations. The additional worker travel trips to and from the site would be limited to the 6 – 12 crew members during the 6 weeks of drilling operations. Minor additional travel would occur during the 4 (four), 2-weeks periods when the researchers are on site for monitoring activities.

Primary access to the site for delivery and commute trips would be from Highway 84 onto the gravel roads (Tate and Moss Grove Roads) to the well locations. None of the local access roads go through or near the Natchez State Park. Minor gravel road extensions (estimated at less than 3 miles total) may be required to reach re-conditioned well sites. Additional travel would not substantially increase the volume of traffic on local roadways as described in Section 4.8.3 and should not impact human health and safety concerns.

Air emissions from the Proposed Action are not anticipated to be regionally significant (See Section 4.1). The CO_2 used by Denbury does not contain significant concentrations of contaminants. Denbury receives weekly analyses of the CO_2 from the provider. This reduces the risk of additional air pollutants from the contaminants in case of a leak. Following the mitigation measures and BMPs will reduce any impacts to human health from air quality. Further, workers would follow OSHA procedures, which would further reduce the impact to human health. Denbury has performed similar activities for over a decade without major incident. Therefore, the risks to human health and safety due to air emissions would be expected to be below the impact significance thresholds.

The soils in the area are erodible (See Section 4.2); however, with BMPs in place, water contamination, which could lead to human health and safety risks, would not be expected to be a major issue (DOE, 2008b) (See Section 4.3). Since construction involving oil and gas development is exempt from NPDES permitting, no NPDES construction permit will be obtained. However, BMPs would be followed to minimize storm water pollutants (DOE, 2008a). Further, produced freshwater would be used for farming, and saline water would be disposed of in existing permitted oilfield disposal wells following BMPs. Wastewater would be collected in portable tanks and shipped to authorized disposal sites by truck (DOE, 2008b). This would reduce the risk of impacts to human health from wastewater. Therefore, the overall effect of the Proposed Action to surface water quality would be expected to be below the significance threshold.

No hazardous or toxic materials are used in the Denbury EOR operations at Cranfield, and none would be used during the study. If safety procedures and BMPs are followed, spills and leaks from equipment and processes would be of low concentrations as well as non-hazardous and not toxic. This would represent a low risk to human health and safety (DOE, 2007c). Under normal conditions, hazardous and toxic materials can be used safely when appropriate safety precautions are followed (DOE, 2007a). The CO_2 used in the Proposed Action has no substantial concentrations of VOC or other contaminants. Analyses of the composition of the CO_2 occur weekly, and Denbury receives these results from the CO_2 provider. Therefore, impacts to human health due to spills and leaks would be below the significance threshold.

The design of the Proposed Action's measurement, mitigation, and verification (MMV) plan is to avoid, detect, and correct any unintended CO_2 emissions. The geological seals of project site make CO_2 migration highly unlikely (DOE, 2008a) (See Section 4.2). However, groundwater monitoring would still occur to detect problems and initiate corrective action if necessary (DOE, 2008a; DOE, 2008b) (See Section 4.3). This would allow for early detection and appropriate measures to be initiated if there were any problems. This reduces the risk to human health and safety. The maximum surface injection pressure would be balanced with the anticipated fracture pressure for the area. This reduces the possibility of air and water contamination by CO_2 from fractures (See Section 4.2).

The Proposed Action calls for soil gas monitoring (DOE, 2008b). Pipeline inspection and monitoring would reduce the risks of failures and thus to human health. One of the major concerns regarding pipeline safety is water and other contaminants causing corrosion leading to pipe failure (DOE, 2007a). However, the CO_2 would be conditioned to reduce the risk from pipeline failure. As part of its commercial EOR operation, Denbury dewaters the CO_2 at the Jackson Dome source and ships it dry through the pipeline. No significant moisture or contaminants are present in the CO_2 that would increase the risk of corrosion. Pipelines are operated in accordance with the MSOGB regulations and include appropriate shut off systems in case of rupture. All the monitoring for CO_2 (Section 2.1.3) will reduce the risk for CO_2 leaks, and the mitigation measures will reduce the consequences of any incidents.

The Health and Safety Plan for the Cranfield Unit would be updated to include the Proposed Action activities should DOE choose to fund the Proposed Action. BMPs would be followed (DOE, 2008a; DOE, 2008b). One item in the Health and Safety Plan calls for backup alarms that must be operable on all equipment (Denbury, No date). This monitoring system will help detect and prevent further leaks from the system (DOE, 2008b). The workers on the project would be subject to the same types of health risks that are generally associated with their professions (DOE, 2007a). Protective equipment such as hard hats, safety shoes, hearing protection (ear plugs), gloves, and safety glasses will be worn (DOE, 2008b). Any further safety equipment needed for the possible hazards would be used such as a respirator or dust mask for someone working with equipment that generates dust. Following safety protocols would minimize occupational hazards (DOE, 2007a).

The risks to human health and safety from a rapid release of CO_2 as a result of activities associated with the Proposed Action would depend on amount released and conditions (such as wind direction and strength) at the time of the release (DOE, 2007c). A sudden and rapid release of CO_2 from equipment, such as a wellhead being removed, would likely be detected quickly. The processes for containing well blow-outs would be employed to stop such a release. Workers on-site would be the primary group affected. If concentrations of CO_2 greater than 7 to 10% in the air were created, it would cause immediate danger to humans. Depending on the amount released and the pressure, the leak could take hours to days to contain, but it could take as little as minutes (IPCC, 2005; Heinrich et al., 2004). However, the leaked CO_2 amount is likely to be minimal compared to the amount injected due to dispersion of CO_2 in the ground away from injection site (Heinrich et al., 2004; IPCC, 2005). Once the release is over, no lingering effects would occur (Heinrich et al., 2004). Since CO_2 injection would occur even in the No-Action

alternative, the increased risk from short-term testing and monitoring under the Proposed Action is minimal. Further, the oil and gas industry employs engineering and administrative controls to manage these types of hazards regularly (IPCC, 2005). Therefore, while the risk of accidents exists, the risks to human health and safety, with the proper response plans and monitoring, would be below the significance threshold.

There are buffers around the Denbury project area of undeveloped, wooded lands. This reduces the impacts to the general public as it allows more time to respond to leaks and space to vent CO_2 before it affects the general public (DOE, 2008b). A local emergency response plan would help reduce the risk of impact to the workers and the general public (DOE, 2007a). The primary human health risk from the Proposed Action to the general public would be pipeline leaks releasing CO_2 (DOE, 2007a). A rapid release of CO_2 has a very low probability due to monitoring, proper siting, and BMPs (DOE, 2007a). The risks would be minimized by having appropriate safety and operating procedures currently in place for gas processing facilities and pipelines including monitoring and inspections (DOE, 2007a). In general, CO_2 injection has occurred safely for over twenty years with oil and gas activities (NETL, 2008b). The injection associated with the Proposed Action does not present much additional risk than current Denbury CO_2 injection for the past ten years. Therefore, with proper safety procedures and plans, the risk to the general public should not exceed the significance threshold.

4.9.3 Effects of No-Action

Under the No-Action alternative, Denbury Resources would still continue oil recovery using EOR techniques. Thus, the construction and operational activities from the EOR, such as the drilling of injection wells, CO_2 compression and pipelines, and use of heavy machinery, would still occur under the No-Action alternative. These activities represent a potential risk to human health and safety as described previously. However, the data would not be collected for CO_2 storage research. Thus, the infrastructure for the data collection and increased volume of CO_2 injected, such as the extra compressor and the observation wells, would not occur. Overall, this would result in less construction and operation activities, which provides fewer opportunities to for risks to human health and safety.

As the types of activities in the No-Action alternative and Proposed Action are the same, the risks to human health and safety of the No-Action alternative are similar to the Proposed Action. The No-Action alternative activities are at reduced potential risk to human health and safety as the scale of the project is smaller under the No-Action alternative. Therefore, all of the risks to human health and safety are less than those under the Proposed Action. The exception would be in regards to the fact that the Proposed Action's purpose is to further the research for options in preventing global climate change. Possible deaths from sea levels rising, deaths from increased severity of storms, increase respiratory diseases, and increased deaths from heat are some of the wide variety of potential human health and safety impacts from global climate change (Miller, 2003). However, as many other projects are in operation or being proposed to assist in the reduction of risk for global climate change, not all of the global climate change risks are attributable to the No-Action alternative. Nevertheless, the No-Action alternative does represent some risk to human health and safety, but not a substantial one.

4.9.4 Cumulative Effects

Because of the overlying impervious seams above the injection zone, it is not likely that injected CO_2 would find its way to the surface or into freshwater aquifers after sequestration at greater than 10,000 feet (approximately 3,000 m). The main issues concerning human health and safety from EOR (whether the Proposed Action or No-Action alternative is chosen) are operational integrity ones, such as ensuring high quality cement work in the wells. The only reasonable manner in which carbon dioxide could escape back to surface and/or affect potable water resources is by way of operational error or inadequacy, such as flow of gas behind cement or poor well abandonment, exceedance of fracture pressures or fracture gradients, or overpressuring of flowlines.

The cumulative impacts of existing activities in and around the project area with the implementation of the Proposed Action does not represent a substantial risk to human health and safety with existing and upcoming mitigation and safety procedures in place. Therefore, there are no substantial cumulative effects from the Proposed Action. As described in the previous section, not funding the Proposed Action (the No-Action alternative) could have an adverse impact to the progress towards solutions for global climate change. However, since this is a single project of many, the cumulative impacts to human health and safety of the No-Action alternative would not exceed the significance threshold. Therefore, both the No-Action and the Proposed Action would pose no more than minimal risk to the health and safety of on-site workers and the local population with BMPs and mitigation in place and thus not exceed the impact significance threshold.

4.10 Cultural Resources

Cultural and historic resources are protected by a variety of laws and regulations, including the National Historic Preservation Act, as amended, and the Archaeological Resources Protection Act. Section 106 of the National Historic Preservation Act and implementing regulations (36 CFR 800) outline the procedures to be followed in the documentation, evaluation, and mitigation of impacts to cultural resources. The Section 106 process applies to any federal undertaking that has the potential to affect cultural resources. The Mississippi Department of Archives and History is the State Historic Preservation Office (SHPO) for Mississippi (MDAH, No date).

4.10.1 Description

Within two miles of the proposed project area, no known archeological or cultural sites are listed in state and federal records (EDR, 2008; MARIS, 2008; DOE, 2008a). The closest site on the National Register of Historic Places (NRHP) is Bedford Plantation, approximately 1.8 miles (approximately 2.9 km) to the north from the project boundary (MARIS, 2008). However, there are three cemeteries within the project area, Tate, Farrar, and Hickory Grove.

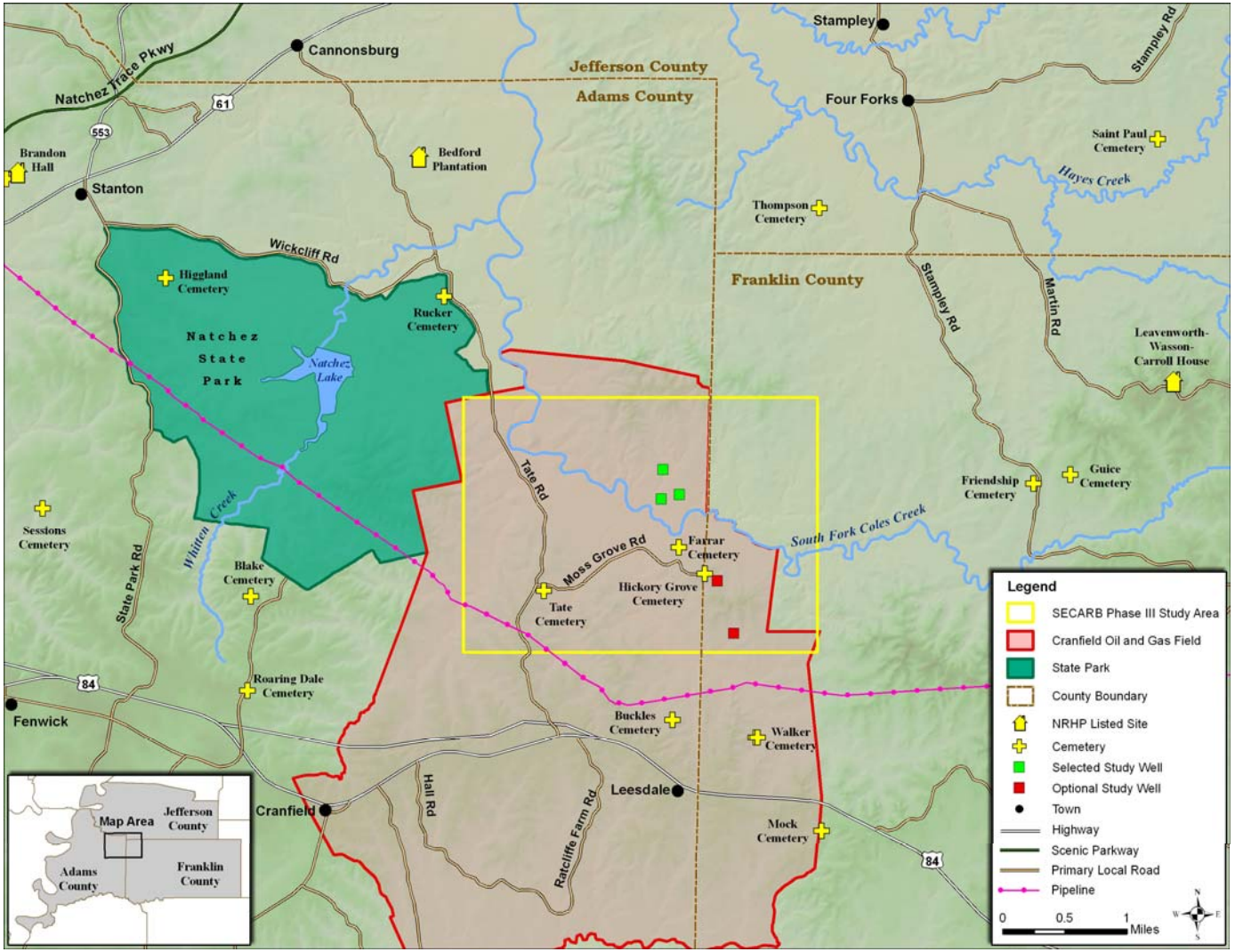

Figure 4.10.1. Map of Cultural Resources in Proximity of the Proposed Action

There are no known Native American or Tribal areas within or near the project area (EDR, 2008; DOE, 2008a; MARIS, 2008). The closet one is over 100 miles (approximately 160 km), which is the Bogue Homa community that is land owned by the Mississippi Band of Choctaw Indians (MARIS, 2008). The Mississippi Band of Choctaw Indian Reservation, which consists of multiple scattered communities and lands such as the Bogue Homa community, is approximately 200 miles (approximately 300 km) northeast, near Philadelphia, Mississippi. No federally recognized tribes have land claims or reservations in the two counties of the project area (Lavallee, 2006). Some recognized Native American Tribes with cultural interest in Mississippi according to the SHPO are Chickasaw, Choctaw Nation of Oklahoma, Mississippi Band of Choctaw Indians, Jena Band of Choctaw Indians, Quapaw Tribe of Oklahoma, and Tunica-Biloxi Indians of Louisiana. Consultation letters were sent to the Tribes (Appendix E). Only the Choctaw Nation of Oklahoma responded, and the consultation resulted in no objection to the project.

No surveys of the study area have been performed to date. A survey would provide more definitive information regarding the actual presence or absence of cultural resources including archeological.

Regarding the potential for fossils in the area; fossils are formed in sedimentary rock. Because there is no surface sedimentary rock in the project area, there are no expected accessible fossils in the project area (See Section 4.2).

4.10.2 Effects of Proposed Action

The potential for impacts to cultural resources would be greatest during the construction phase. Discovery of previously unknown cultural resources can occur during construction activities in historically undisturbed areas. The construction noise and earthmoving activities can also deteriorate the use of the area for Native American activities (DOE, 2007a).

Some construction activities occurring under the Proposed Action have the potential to disturb cultural resources such as land clearing, transporting equipment, leveling, drilling, and laying pipelines. These earthmoving activities could cause an adverse impact to cultural resources by altering drainage patterns, creating fugitive dust, and crushing the resources. Altered drainage patterns and runoff could deteriorate the artifacts or move them. Fugitive dust could cover and remove, in the case of paintings, artifacts. Spills from refueling equipment could also damage cultural resources, which could reduce the information potentially gained by the items. Further, construction activities could alter or destroy the context of the cultural resources. Operational impacts include use of heavy equipment, which is described above, and improved access to the area, which increases the possibility of illegal collection of properties (DOE, 2007a).

There would be limited additional construction occurring under the Proposed Action compared to the No-Action alternative. Thus, the Proposed Action could be expected to cause only a limited increase in potential for disturbance for cultural resources. The project area is a previously disturbed site (DOE, 2008a). Consequently, since no cultural resources have been

found to date, there is less possibility for discovering cultural resources during the Proposed Action.

As there is no surface sedimentary rock, the risk to fossils (paleontological resources) that could be used for scientific/educational purposes is negligible (See Section 4.2). Due to the trees on the project site and distance to the nearest NRHP site (1.8 miles or 2.9 km), there would be no substantial visual resources impacts to any known eligible or existing NRHP site. Consultation letters were sent to the Tribes, and no Tribal objections were voiced (Appendix E). There are three cemeteries in the project area, which would need consideration.

A consultation letter was sent to the SHPO (Appendix D). The only concern raised by the SHPO was regarding two burial sites, one off of Rice Road and one near Sibley, Mississippi. Both of these are away from the project area. Thus, the SHPO consultation resulted in no objections to the project (Noceti, 2008b).

If cultural resources were discovered during the construction, the construction would be stopped, and SHPO, any relevant Tribes, or other agencies consulted. If the cultural resources were found to be substantial, then the construction component would need to be sited elsewhere or other acceptable mitigation performed as SHPO and any relevant Tribes or agencies dictate.

Based on the information above, the Proposed Action would not be expected to exceed the significance threshold for cultural resources.

4.10.3 Effects of No-Action

Under the No-Action alternative, Denbury Resources would still continue oil recovery using EOR techniques. Thus, the construction and operational activities from the EOR, such as the drilling of injection wells and use of heavy machinery, would still occur under the No-Action alternative. These ground-disturbing activities represent a potential risk to cultural resources as described previously. However, data would not be collected for CO_2 storage research. Thus, the infrastructure for the data collection and increased volume of CO_2 injected, such as the extra compressor and the observation wells, would not be needed. Overall, this would result in less ground disturbance and provides fewer opportunities to disturb cultural resources. Further, most of the sites for the No-Action alternative are already disturbed, which reduces the possibility of finding previously unknown cultural resources (DOE, 2008a).

As the types of activities in the No-Action alternative and Proposed Action are the same, the risks to cultural resources under the No-Action alternative are similar to the Proposed Action. The No-Action alternative activities are at reduced potential risk to cultural resources as the scale of the project and disturbance is smaller under the No-Action alternative.

As there is no surface sedimentary rock, the risk to fossils (paleontological resources) that could be used for scientific/education purposes is negligible. Due to the trees on the project site and distance to the nearest NRHP site (1.8 miles or 2.9 km), there should be no substantial visual resources impacts to any known eligible or existing NRHP sites. Consultation letters were sent to the Tribes (Appendix E). No Tribal objections were voiced about this project. As mentioned

in Section 4.10.2, a letter was sent to the SHPO (Appendix D). The SHPO consultation resulted in no objections to the project. There are three cemeteries in the project area, which would need consideration.

If cultural resources were discovered during the construction, the construction would be stopped, and SHPO, any relevant Tribes, or other agencies consulted. If the cultural resources were found to be substantial, then the construction component would need to be sited elsewhere or other acceptable mitigation performed as SHPO and any relevant Tribes or agencies dictate.

Based on the information above, the No-Action alternative is not expected to exceed the significance threshold for cultural resources.

4.10.4 Cumulative Effects

Currently, the only projected types of activities in the project area will be other oil and gas activities; therefore, the Proposed Action and the No-Action alternative will be only a small component to potential cumulative impacts. Since there are no substantial impacts to cultural resources, the Proposed Action and the No-Action alternative do not substantially contribute to the cumulative impacts to cultural resources in the vicinity of the project area. As impacts to cultural resources are generally local (heavy machinery crushing resources, etc.), the Proposed Action and the No-Action alternative both are unlikely to contribute to impacts to cultural resources outside the vicinity of the project area and would not exceed the significance threshold.

4.11 Waste Management

4.11.1 Description

Whether the Proposed Action is implemented or not, a number of wastes would be generated due to ongoing EOR which could potentially include:

- Slash from tree clearing and drilling pad redevelopment,
- lubricating oils and greases,
- used solvents,
- used hydraulic fluid,
- metal parts, wire and cable,
- oily rags,
- domestic sewage,
- domestic solid waste,
- contaminated soil from spills,
- discarded cement,
- containers (metal, wood, plastic, etc.),
- produced water (oily and/or saline), and
- drilling mud and cuttings.

The project Environmental Information Volume (EIV) (DOE, 2008a), indicates that Denbury plans to dispose of associated drilling wastes generated by drilling operations in accordance with

MSOGB regulations. As appropriate, wastes may either be injected into permitted Class II UIC wells or land-farmed onsite within the Cranfield Unit.

According to the EIV (DOE, 2008a) Denbury, on behalf the SECARB project (were the Proposed Action implemented), is to inject 0.5 million metric tons of CO_2, in addition to 1 million metric tons of CO_2 that will be injected as part of the commercial EOR operations. The project EIV (DOE, 2008a) further states that during the second stage (monitoring and injection operations) there would be no fuel or waste storage areas anticipated and solid or hazardous waste would be not produced. However, the second stage would require added compression capacity for the SECARB injection wells. The operation of a compressor would generate waste products which could include:

- Used lube oil,
- Wastewater (wash water),
- Spent glycols
- Used metal parts,
- Used gaskets,
- Oily rags,
- Filters,
- Containers,
- Contaminated soils from spills and leaks, and
- Domestic wastes.

In addition, as a part of the geochemical monitoring, sampling tracers will be used and there may be some waste formation brine produced through observation well sampling. These activities will generate:

- Tracer containers, and
- Small volumes of produced water

All wastes generated during operation of drilling, compression, or other facilities at the study site will be disposed of in accordance with MDEP regulations. Existing MSOGB regulations adequately protect the environment with strict standards for the collection, containment, and disposal of solid waste; and provide for penalties and appropriate remedial actions for failure to comply.

4.11.2 Effects of Proposed Action

Four injection wells will be completed as a result of Denbury's commercial EOR operations even if the SECARB project is not conducted. Extending the four injection wells into the water leg down-dip of the Lower Tuscaloosa Formation required for the SECARB project will create only minor additional drilling muds and cuttings which would easily be managed with the wastes from the commercial EOR operations. The impacts related to these additional wastes would not be expected to exceed the significance threshold.

The drilling of the two deep SECARB project observation wells and the extension of four injection wells would require the use of 30,000 to 50,000 pounds (13,600 – 23,000 kg) of additional drilling mud. The EIV (DOE, 2008a) indicates that Denbury plans to dispose of

associated drilling wastes generated by drilling operations in accordance with MSOGB regulations. Drilling wastes may either be injected into permitted Class II UIC wells or land-farmed on site within the Cranfield Unit.

The operation of one additional compressor would be completed as part of the SECARB project and would be used to inject CO_2 through the four injection wells. The SECARB project calls for an addition 0.5 million metric tons added to the 1 million metric tons of CO_2 to be transported and injected as part Denbury's commercial EOR operations. The National Energy Technology Laboratory's (DOE, 2007a) "Carbon Sequestration Program Environmental Reference Document" estimates that 0.006 gallons (0.02 L)/metric ton CO_2 of used oil would be generated and 3.3 gal. (12.5 L)/metric ton CO_2 of wastewater would be generated from the compression and transportation of CO_2 by pipeline to injection wells (DOE, 2007a). Based on these numbers it is estimated that the SECARB project would generate 3000 gallons (11,350 L) of used oil from the dedicated compressor and a further 1.65 million gallons (6.2 L) of wastewater could also be generated from dehydration and preparation of the CO_2 for transport at its source. These waste streams, however, should not pose substantial waste management problem as they are not unique to the oil production industry and could be handled with wastes created as part of Denbury's commercial EOR program.

Geochemical tracer techniques would include (1) isotopic profiles of injected CO_2, (2) introduced noble gases, and (3) introduced perfluorocarbons. Noble gases and perfluorocarbons have no known human or eco-toxicity (DOE, 2007a). Disposal of the associated containers should not pose any substantial risk.

Any waste formation brine resulting from geochemical sampling of observation wells as proposed in the EIV (DOE, 2008a) would be transported to a MSOGB-permitted Class II disposal well.

4.11.3 Effects of No-Action

Denbury plans to develop the commercial EOR program regardless of the implementation of the SECARB project and only minor reductions in drilling waste would result with No-Action by not drilling the two observation wells. Any drilling wastes created from the drilling of the two deep SECARB project observation wells would not be created under the No-Action alternative.

The additional compressor that would allow for increased injection volumes of CO_2, 0.5 million metric tons (0.5 million short tons) associated with the SECARB project would not be installed. Therefore, no associated used oil, wastewater or other waste products would be generated from its operation.

Under the No-Action scenario no tracers would be injected; and, no waste formation brine from geochemical sampling would be produced.

4.11.4 Cumulative Impacts

Potential cumulative impacts related to drilling the observation wells include disposal of

produced brines in permitted Class II injection wells and the handling and management of additional drilling muds. Provided all regulatory requirements are met the cumulative waste impacts, related to the drilling requirements of the SECARB project, would not be expected to exceed the significance threshold.

Potential cumulative impacts related to the waste products from the compression and injection of additional CO_2 for the SECARB project relate to the volumes of lube oil and wastewater generated. Due to the Denbury's commercial EOR infrastructure and other resources available to handle these waste streams, it is not anticipated that these waste streams would have any cumulative effects that would exceed the significance threshold.

There are likely to be negligible cumulative impacts regarding wastes related to sampling and monitoring of the wells due to the small volumes of waste generated.

Overall, the proposed SECARB project would not cause air, water or soil to be contaminated with hazardous materials (assuming appropriate drilling waste management and compressor waste containment strategies are in place), to a degree that would pose a threat to human or ecological health and safety.

5.0 CONSULTATION AND COORDINATION

5.1 Preparation for Development of this Environmental Assessment

A kick-off meeting was held on May 14, 2008, at the NETL office in Morgantown, West Virginia, with representatives from NETL, the University of Texas, and Mangi Environmental Group, to formally begin the EA process.

Subsequent to that meeting a review was made of available information necessary for the completion of the EA and data gaps were submitted to NETL.

A site visit was made in May 22, 2008 by members of the team charged with the development of this EA.

5.2 Agency Coordination

The Council on Environmental Quality's regulations for implementing NEPA allows federal agencies to invite comment from tribal, state, and local agencies, as well as other federal agencies in the preparation of EAs. The purpose of this coordination is to obtain special expertise with respect to environmental and cultural issues in order to enhance interdisciplinary capabilities, and otherwise ensure successful, effective consultation in decision-making.

5.2.1 U.S. Fish and Wildlife Service

The mission of the USFWS is to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of American people. Analysis addressed issues raised by USFWS in the body of the document.

See Appendix B for letters sent to and received from agency.

5.2.2 State Historic Preservation Office (SHPO)

The National Historic Preservation Act (NHPA) requires DOE to consult with the SHPO prior to any construction to ensure that no historical properties would be adversely affected by a proposed project. DOE must also afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed project. As stated in Section 4.10, DOE reviewed issues with SHPO, and the SHPO had no objections to the project.

See Appendix D for letter sent to and received from the SHPO.

5.2.3 Bureau of Indian Affairs

The American Indian Religious Freedom Act, 42 USC § 1996, establishes policy to protect and preserve the inherent and Constitutional right of Native Americans to believe, express, and exercise their traditional religions. The law ensures the protection of sacred locations, access of Native Americans to those sacred locations and traditional resources that are integral to the

practice of their religions, and establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by construction and operation of proposed facilities. Only one Tribe responded (Choctaw Nation of Oklahoma), and the results of the consultation were no objection.

See Appendix E for letters sent to and received from the Bureau of Indian Affairs and Tribal Councils.

5.3 Public Involvement

The public comment period on the Draft EA was August 25 to September 25, 2008. An article informing the public of the availability of the Draft EA at the Natchez Public Library ran in the Natchez Democrat on August 24th and 31th and September 7th, 14th, and 21st. DOE received no comments from the public (Noceti, 2008c).

6.0 LIST OF PREPARERS

6.1 Mangi Environmental Group

Jim Mangi; Contract Management
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Dick Wildermann; Alternate Project Manager, Proposed Action, Purpose and Need, Threshold Significance Criteria, Project Location
Meghan Morse; Associate Project Manager, Document/Administrative Record Management, Human Health and Safety, Cultural Resources; Cause-Effect-Questions
Eveline Martin; Wetlands, Wildlife, Terrestrial Plants, Visual Resources
Tim Lavallee; Air Quality, Noise
Bud Watson; Legal Framework
Rick Heffner; Socioeconomics
Mark Blevins; Land Use, GIS

6.2 Wiebe Environmental Services

Jason Breakey; Operations/Program Manager
Ed Osborne; Project Management, Soils
John Railton; Review for Threshold Impact and Public Significance
Harald Thimm; Construction, Operation and Decommissioning.
Craig Robertson; Hydrology and Geology
Kai Nielsen; Waste Management
Kate Forbes; Background Research and Report Preparation.

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8.0 GLOSSARY

Ambient – The natural surroundings of a location.

Anthropogenic – Man-made.

Asphyxiation – A condition of severely deficient supply of oxygen to the body that arises from being unable to breathe normally.

Attainment areas – A zone within which the level of a pollutant is considered to meet United States National Ambient Air Quality Standards.

A-weighted decibels – An expression of the relative loudness of sounds in air as perceived by the human ear.

Best management practices – Innovative, dynamic, and improved environmental protection practices applied to oil and natural gas drilling and production to help ensure that energy development is conducted in an environmentally responsible manner.

Brine – Water saturated or nearly saturated with salt.

Capillary forces – Capillary motion, or wicking is the ability of a substance to draw another substance into it.

Carbon Sequestration – The capture and storage of carbon long-term in an effort to avoid release of that carbon as carbon dioxide in the atmosphere.

CO_2 flood – If a well has been produced before and has been designated suitable for CO_2 flooding, the first thing to do is to restore the pressure within the reservoir to one suitable for production. This is done by injecting water (with the production well shut off) which will restore pressure within the reservoir to a suitable pressure for CO_2 flooding. Once the reservoir is at this pressure, the next step is to inject the CO_2 into the same injection wells used to restore pressure. The CO_2 gas is forced into the reservoir and is required to come into contact with the oil. This easier movement of oil to the production well. Normally the CO_2 injection is alternated with more water injection and the water acts to sweep the oil towards the production zone.

Criteria pollutants – The Clean Air Act requires EPA to set standards for six common air pollutants. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead.

Cumulative effects – Those effects on the environment that result from the incremental effect of the action when added to past, present and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions.

Day-night Sound Level – The A-weighted equivalent sound level for a 24 hour period with an additional 10 dB imposed on the equivalent sound levels for night time hours of 10 p.m. to 7 am.

Decibel – A unit of measurement that expresses the magnitude of a physical quantity (usually intensity) relative to a specified or implied *reference level*. The decibel is useful for a wide variety of measurements in science (for this application, it is sound).

Directionally drilled – Wells that are drilled intentionally to a location other than directly beneath the wellhead location.

Downdip – Located down the slope of a dipping plane or surface. In a dipping (not flat-lying) oil and gas reservoir that contains gas, oil and water, the gas is updip (above) the gas-oil contact location. This oil-gas contact location is downdip (below) the gas, and the oil-water contact location is still farther downdip.

Downhole – A location in the geologic strata that is lower/below a designated location.

EA – (Environmental Assessment), A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

EIS – (Environmental Impact Statement), A detailed written statement required by Section 102(2) (C) of the National Environmental Policy Act, analyzing the environmental impacts of a Proposed Action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Environmental Justice – The confluence of social and environmental movements, which deals with the inequitable environmental burden born by groups such as racial minorities, women, or residents of developing nations.

Equivalent Sound Level – The level of a steady-state noise without impulses or tone components which is equivalent to the actual noise emitted over a period of time.

Erodible – The erodibility of soils can be described as their sensitivity to the effects of wind and water on the soil structure. This property is expressed as an erodibility index, where low values indicate high susceptibility to erosion, and high values correspondingly indicate a low susceptibility to erosion. The erodibility index is determined by combining the effects of slope and soil type, rainfall intensity and land use. These aspects are represented by terrain morphology (soil and slope), mean annual rainfall, and broad land use patterns.

FONSI – (Finding of No Significant Impact), A document prepared in compliance with the National Environmental Policy Act, supported by an Environmental Assessment, that briefly

presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Greenhouse gas – Greenhouse gases are the gases present in the earth's atmosphere which reduce the loss of heat into space and therefore contribute to global temperatures.

Hazardous Waste/Materials – Waste substances which can pose a substantial or potential hazard to human health or the environment when improperly managed.

Hertz – The frequency of sound waves.

Kilowatt – A measurement of electric power.

Leachate – The liquid that drains from an area.

Median Household Income – The median household income is commonly used to provide data about geographic areas and divides households into two equal segments with the first half of households earning less than the average household income and the other half earning more.

National Ambient Air Quality Standards – Standards established by the EPA that apply for outdoor air throughout the country. Primary standards are designed to protect human health, with an adequate margin of safety, including sensitive populations such as children, the elderly, and individuals suffering from respiratory disease.

NEPA – (National Environmental Policy Act), Requires all agencies, including Department of Energy, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (40 CFR 1500).

New Source Performance Standards – Are pollution control standards issued by the EPA. The term is used in the Clean Air Act Extension of 1070 to refer to air pollution emission standards, and in the Clean Water Act referring to standards for discharges of industrial wastewater to surface waters.

Nonattainment Areas – The Clean Air Act and Amendments of 1990 define a "nonattainment area" as a locality where air pollution levels persistently exceed national standards or that contributes to ambient air quality in a nearby area that fails to meet standards. Designating an area as nonattainment is a formal rulemaking process, and EPA normally takes this action only after air quality standards have been exceeded for several consecutive years.

Nonpoint Source Pollution – Water pollution affecting a water body from diffuse sources, rather than a point source which discharges to a water body at a single location.

Palustrine – Non-tidal wetlands.

Particular Matter – Small solid particles and liquid droplets in the sir.

Perfluorocarbons – (PFCs), Compounds derived from hydrocarbons by replacement of hydrogen atoms by fluorine atoms. PFCs are made up of carbon and fluorine atoms only.

Permeability – Formations that transmit fluids readily, such as sandstones, are described as permeable and tend to have many large, well-connected pores.

Petroliferous – Containing petroleum.

pH – The measure of the acidity or alkalinity of a solution.

Phreatic – The term is used in geology to refer to matters relating to groundwater below the static water table.

Point Source Pollution – single identifiable localized source of air, water, thermal, noise, or light pollution.

Porosity – a measure of the void spaces in a material.

Potentiometric – A potentiometric sensor is a type of chemical sensor based on the measurement of a potential under no current flow. The measured potential may then be used to determine the analytical concentration of some components of the analyte gas or solution.

Quaternary Surficial – Pertaining to or occurring on or near the earth's surface and related to a specific geologic period in time.

Riparian – The interface between land and a flowing surface water body.

Stakeholders – A person, company, group of people, etc., that have a concern and financial interest in an issue.

Standard Industry Practices – Activities in an industry that are considered a usual practice.

Stratigraphic – A branch of geology, studies rock layers, and layering.

Supercritical CO_2 – Carbon dioxide that is in a fluid state while also being at or above both its critical temperature and pressure.

Tomography – Imaging by sections.

Unitize – To separate, classify, or package in discrete units.

APPENDICES

Appendix A Air Emission Calculations

Table A-1. Drilling Emissions

Heavy Equipment Use

Equipment Type	Number of Units	Days on Site	Hours Per Day	Operating Hours
Bore/Drill Rigs	2	60	24	2880
Generator Sets	4	60	24	5760
Other Construction Equipment	3	60	24	4320

Drilling Equipment Emission Factors (lbs/hour)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Bore/Drill Rigs	0.5281	1.3416	0.1295	0.0017	0.0591	0.0591
Generator Sets	0.3461	0.6980	0.1075	0.0007	0.0430	0.0430
Other Construction Equipment	0.4504	1.1575	0.1215	0.0013	0.0503	0.0503

Source: (CARB, 2007b)

Drilling Equipment Emissions (tons)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Bore/Drill Rigs	0.7605	1.9319	0.1865	0.0025	0.0851	0.0851
Generator Sets	0.9968	2.0103	0.3095	0.0020	0.1238	0.1238
Other Construction Equipment	0.9728	2.5002	0.2624	0.0027	0.1087	0.1087
Total Equipment Emissions	**2.7300**	**6.4424**	**0.7585**	**0.0073**	**0.3176**	**0.3176**

Drilling Worker Commutes

Number of Workers	30
Number of Trips	2
Miles Per Trip	30
Days of Drilling	90
Total Miles	162000

Pollutant	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Emission Factor (lbs/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001
Total Emissions (lbs)	1708.85	178.67	174.83	1.74	13.78	8.57
Total Emissions (tons)	**0.8544**	**0.0893**	**0.0874**	**0.0009**	**0.0069**	**0.0043**

Source: (CARB, 2007b)

Total Drilling Emissions (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Heavy Equipment	2.7300	6.4424	0.7585	0.0073	0.3176	0.3176
Worker Commutes	0.8544	0.0893	0.0874	0.0009	0.0069	0.0043
Total Drilling Emissions	**3.5845**	**6.5318**	**0.8459**	**0.0081**	**0.3245**	**0.3219**

Table A-2. Construction Emissions

Construction Equipment Use

Equipment Type	Number of Units	Days on Site	Hours Per Day	Operating Hours
Graders Composite	1	90	7	630
Excavators Composite	1	90	7	630
Rubber Tired Dozers Composite	1	90	7	630
Off-Highway Trucks Composite	1	90	7	630
Air Compressors	1	60	4	240
Cement & Mortar Mixers	1	60	7	420
Cranes	1	60	7	420
Generator Sets	1	60	7	420
Tractors/Loaders/Backhoes	1	60	7	420

Construction Equipment Emission Factors (lbs/hour)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Graders Composite	0.6561	1.6191	0.1936	0.0015	0.0840	0.0840
Excavators Composite	0.5828	1.3249	0.1695	0.0013	0.0727	0.0727
Rubber Tired Dozers Composite	1.5961	3.2672	0.3644	0.0025	0.1409	0.1409
Off-Highway Trucks Composite	0.8499	2.7256	0.2730	0.0027	0.0989	0.0989
Air Compressors	0.3782	0.7980	0.1232	0.0007	0.0563	0.0563
Cement and Mortar Mixers	0.0447	0.0658	0.0113	0.0001	0.0044	0.0044
Cranes	0.6011	1.6100	0.1778	0.0014	0.0715	0.0715
Generator Sets	0.3461	0.6980	0.1075	0.0007	0.0430	0.0430
Tractors/Loaders/Backhoes	0.4063	0.7746	0.1204	0.0008	0.0599	**0.0599**

Source: (CARB, 2007b)

Construction Equipment Emissions (tons)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Graders Composite	0.2067	0.5100	0.0610	0.0005	0.0265	0.0265
Excavators Composite	0.1836	0.4173	0.0534	0.0004	0.0229	0.0229
Rubber Tired Dozers Composite	0.5028	1.0292	0.1148	0.0008	0.0444	0.0444
Off-Highway Trucks Composite	0.2677	0.8586	0.0860	0.0008	0.0312	0.0312
Air Compressors	0.0454	0.0958	0.0148	0.0001	0.0068	0.0068
Cranes	0.1262	0.3381	0.0373	0.0003	0.0150	0.0150
Generator Sets	0.0727	0.1466	0.0226	0.0001	0.0090	0.0090
Tractors/Loaders/Backhoes	0.0853	0.1627	0.0253	0.0002	0.0126	0.0126
Total Equipment Emissions	**1.4904**	**3.5582**	**0.4151**	**0.0032**	**0.1683**	**0.1683**

Delivery of Equipment and Supplies

Number of Deliveries	2
Number of Trips	2
Miles Per Trip	60
Days of Construction	90
Total Miles	21600

Pollutant (pounds/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Emission Factor (lbs/mile)	0.0219	0.0237	0.0030	0.0000	0.0009	0.0007

Total Emissions (lbs)	474.10	512.19	64.64	0.55	18.49	15.97
Total Emissions (tons)	**0.2371**	**0.2561**	**0.0323**	**0.0003**	**0.0092**	**0.0080**
Source: (CARB, 2007b)						
Worker Commutes						
Number of Workers	20					
Number of Trips	2					
Miles Per Trip	40					
Days of Construction	90					
Total Miles	144000					
Pollutant (pounds/mile)	**CO**	**NO_x**	**VOC**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Emission Factor (lbs/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001
Total Emissions (lbs)	1518.97	158.82	155.40	1.55	12.25	7.62
Total Emissions (tons)	**0.7595**	**0.0794**	**0.0777**	**0.0008**	**0.0061**	**0.0038**
Source: (CARB, 2007b)						
Total Construction Emissions (tons)						
Activity/Source	**CO**	**NO_x**	**VOC**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Construction Equipment	1.4904	3.5582	0.4151	0.0032	0.1683	0.1683
Delivery of Equipment and Supplies	0.2371	0.2561	0.0323	0.0003	0.0092	0.0080
Worker Commutes	0.7595	0.0794	0.0777	0.0008	0.0061	0.0038
Total Construction Emissions	**2.4869**	**3.8937**	**0.5251**	**0.0042**	**0.1837**	**0.1801**

Table A-3. CO_2 Emission Calculations		
Drilling and Construction		
Total Fuel	14000	Gallons
Total Fuel	52995.6	Liters
Emission Factor	2.6304	kg CO_2 per liter
Total Emissions	139399.6	kg
Total Emissions	154	Tons
Electricity Usage		
Electricity Usage (Compressor)	7462	kW
Hours	13140	Hours
Power	98050680	kWh
Emission Factor	0.6510	kg CO_2/kWh
Total Emissions	63830993	kg
Total Emissions	70342	Tons
Worker Commutes		
Number of Workers	20	Workers
Number of Trips	2	Trips
Miles Per Trip	30	Miles
Days of Operation	549	Days
Total Miles	658800	Miles
Emission Factor	1.1	lbs/mile
Total Emissions	724371.8	lbs
Total Emissions (tons)	362.2	tons

Source: (CARB, 2007b)

Total CO_2 Emissions (tons)	Emissions (tons)
Activity/Source	
Drilling and Construction	154
Electricity Usage	70342
Worker Commutes	362
Sequestration	(1653450)
Total Emissions	(1582592)

Note: kWh is kilowatt hour.

Appendix B Fish and Wildlife Service Consultations

THE MANGI ENVIRONMENTAL GROUP, INC.
7915 Jones Branch Dr. McLean VA 22102
703 760 4801 Fax 703 760 4899
www.mangi.com

Viet Nam Veteran Owned

June 11, 2008

Kathy Lunceford
Fish and Wildlife Service
Mississippi Ecological Services Field Office
6578 Dogwood View Parkway, Suite A
Jackson, MS 39213

Dear Ms. Luceford,

The Department of Energy is preparing an Environmental Assessment for the Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Early Test Project. As a contractor preparing NEPA compliance for the project, I am requesting information on federally listed or candidate plant and animal species that may occur in the project area.

The project area is about four miles northeast of the unincorporated village of Cranfield and about 12 miles due east of Natchez, Mississippi (see attached map). The project area is located in an oil and gas field that was largely abandoned in 1965. The main action of the project is to inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO2) into the brine-bearing Tuscaloosa Formation. This will entail constructing or reconditioning several wells for injection and monitoring and installation of a network of distribution pipelines to individual well sites.

If you have any questions, please contact me via email at emartin@mangi.com or at 802-246-5689.

Sincerely,

Eveline Martin

SBA Prime Contractor Of The Year Region 3

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mississippi Field Office
6578 Dogwood View Parkway, Suite A
Jackson, Mississippi 39213

June 13, 2008

Ms. Eveline Martin
The Mangi Environmental Group, Incorporated
7915 Jones Branch Drive
McLean, Virginia 22102

Dear Ms. Martin:

The U.S. Fish and Wildlife Service (Service) has reviewed the information in your letter dated June 11, 2008, requesting information regarding the presence of federally listed species on a property near Cranfield, Adams County, Mississippi. The Department of Energy is preparing an Environmental Assessment for the Southeast Regional Carbon Sequestration Partnership Phase III Early Test Project. Our comments are submitted in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

The following species could be found on or near the subject site:

The federally listed threatened **Louisiana black bear** (*Ursus a. luteolus*) occurs primarily in bottomland hardwood and floodplain forests along the Mississippi River and the southern part of the state. Although the bear is capable of surviving under a range of habitat types, some necessary habitat requirements include hard mast, soft mast, escape cover, denning sites, forested corridors, and limited human access. Forest management practices, agricultural, commercial and industrial development, and highways can cause adverse impacts to bear habitat by increasing human disturbance, fragmenting forests, and removing den trees. Den trees, bald cypress and tupelo gum with visible cavities, having a minimum diameter at breast height of 36 inches, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies, should be preserved if possible.

The endangered **red-cockaded woodpecker** (*Picoides borealis*) excavates nesting cavities in mature pine trees (60+ years old). A mated pair of birds and all helper birds forms a clan. A cluster of cavity trees where the clan nests and roosts is called a colony. All cavity trees, active and inactive, are important to the colony and should therefore be avoided. Also, older (30+ years) pine stands within a half-mile of a colony should be considered foraging habitats and should not be disturbed.

Although the **bald eagle** (*Haliaeetus leucocephalus*) was officially removed from the List of Endangered and Threatened Species as of August 8, 2007, it continues to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA).

Bald eagles nest in Mississippi from December through mid-May in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water. Nest sites typically include at least one perch with a clear view of the water or area where the eagles usually forage. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding.

The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations regarding how to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.

If you have any questions, please feel free to contact this office, telephone (601) 321-1132.

Sincerely,

Kathy W. Lunceford
Fish and Wildlife Biologist

U.S. Department of Energy

National Energy Technology Laboratory

June 25, 2008

Sam Hamilton, Regional Director
United States Fish and Wildlife Service
Southeast Region—Region Four
1875 Century Blvd., Suite 200
Atlanta, GA 30345

Dear Sir:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as enclosures.

As part of our coordination and consultation responsibilities, and to comply with both Section 7 of the Endangered Species Act of 1973, as amended, and provisions of the Fish & Wildlife Coordination Act, we would appreciate receiving any information you have on important wildlife resources, including endangered and threatened species or critical habitat, in the project area.

Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided to you for review upon availability.

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

U.S. Department of Energy

National Energy Technology Laboratory

June 25, 2008

Ray Aycock, Field Supervisor
Jackson Field Office
United States Fish and Wildlife Service
6578 Dogwood View Pkwy, Ste A
Jackson, MS 39213

Dear Sir:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

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Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided to you for review upon availability.

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

Figure 1
SECARB Phase III Study Area

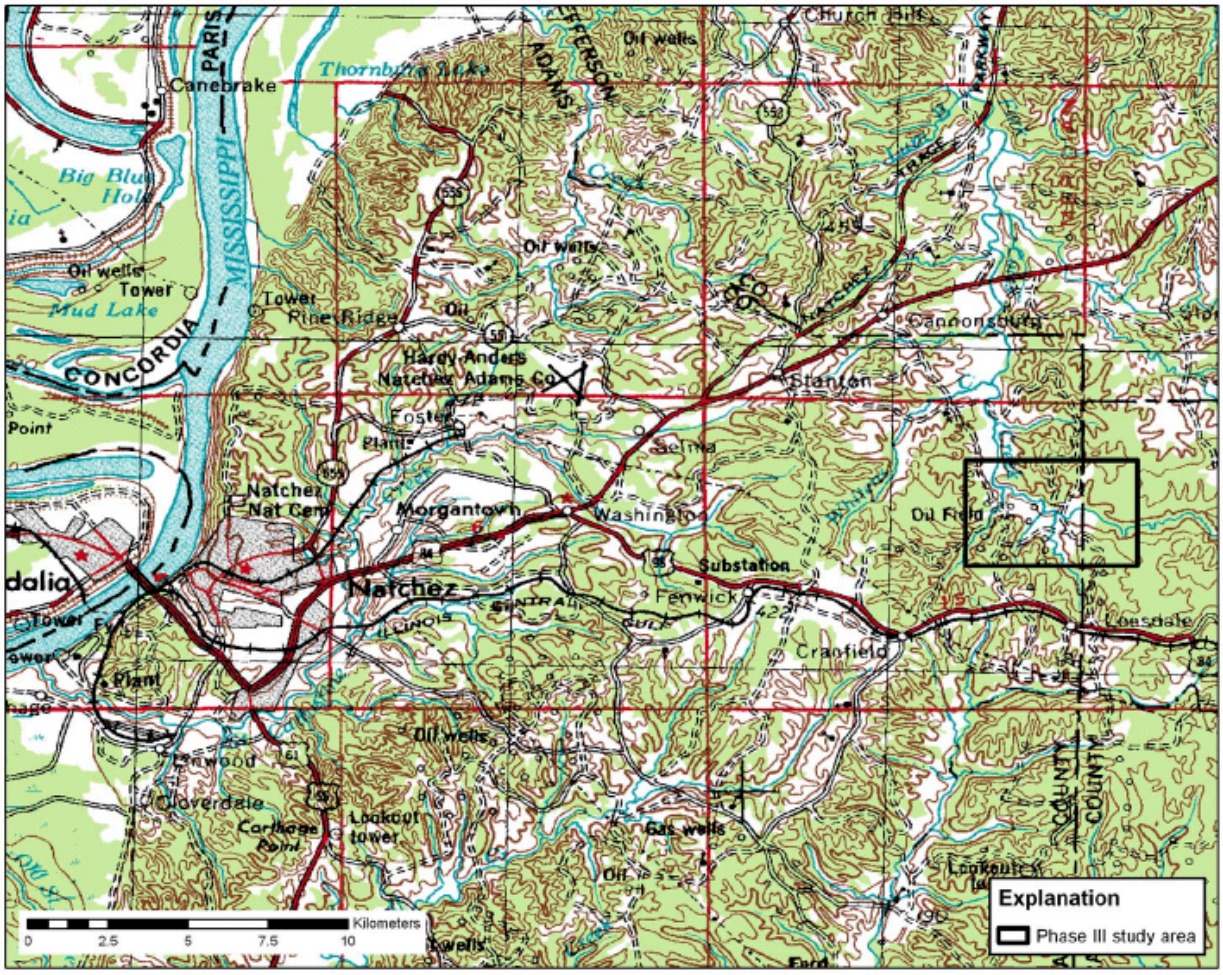


Figure 2
SECARB Phase III Topographic Map

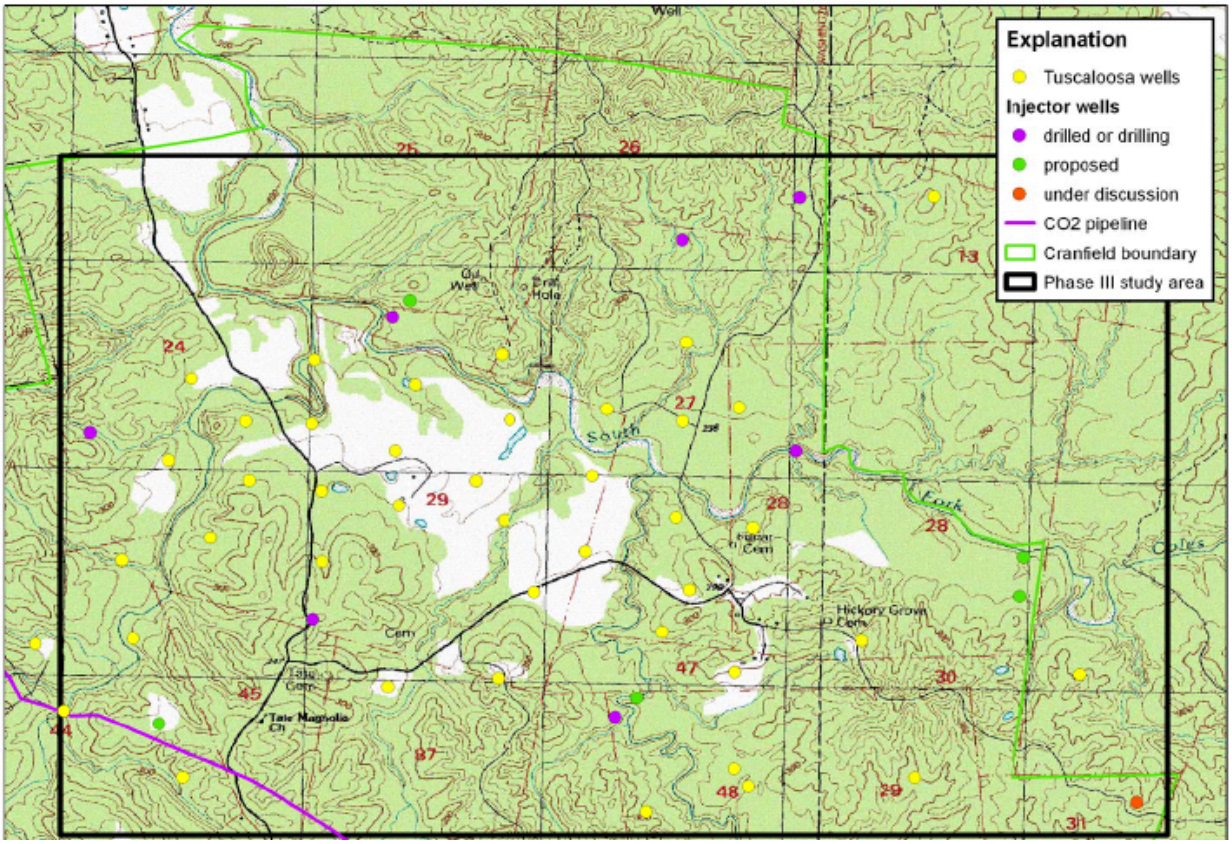
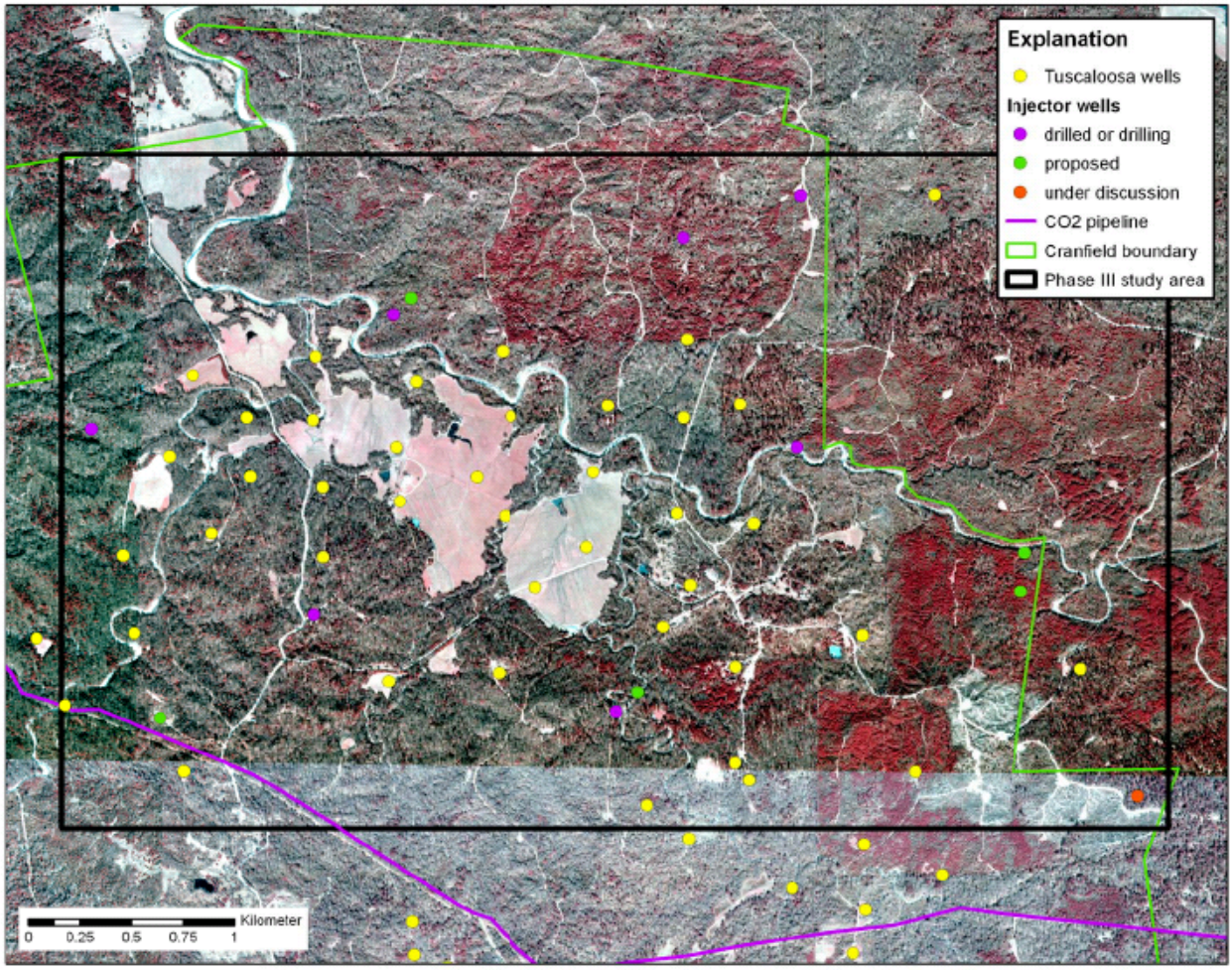


Figure 3
SECARB Phase III Aerial Map



Description of the Proposed Action

SOUTHEAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (SECARB) PHASE III EARLY TEST

The proposed action is for DOE to provide, through a cooperative agreement with the Southern States Energy Board (SSEB), financial assistance for the injection of 1.5 million metric tons of supercritical CO_2 into the Cranfield Unit, an active oilfield owned by Denbury Resources International Company (Denbury). The CO_2 would be injected into the brine-bearing Tuscaloosa Formation on the flank of the structure, down-dip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Bureau of Economic Geology (BEG) at the University of Texas at Austin.

Activities will take place in a rural area in southwestern Mississippi about 4 miles northeast of the unincorporated village of Cranfield and approximately 12 miles due east of Natchez, Mississippi. Elevations within the Cranfield Unit range from just under 280 feet above sea level near the perennial stream (South Fork of Coles Creek) in the north part of the area up to 400 feet just south of State Highway 84. The Cranfield Unit is an oil and gas field that was largely abandoned in 1965. Denbury is undertaking a commercial CO_2 flood of this field, which is in a large, closed domal structure at depths greater than 10,000 feet with a gas-tight geologic seal.

This field experiment, known as SECARB Phase III Early Test, is in a high-porosity, high-permeability formation similar to those that could eventually be used to sequester large volumes of CO_2. This project will be closely monitored to document that the CO_2 remains within the injection zone. This project is being implemented in two stages:

1) The first stage is the drilling and characterization stage when injection wells, deep observation wells, and shallow groundwater wells will be drilled; a compressor will be installed; and various tests will be conducted to verify and refine information regarding the subsurface structure of the study area. The injection well drilling, site preparation, infrastructure construction, wastewater disposal, and other activities will be permitted by the Mississippi Oil and Gas Board (MSOGB) and conducted in compliance with all applicable federal and state regulations and acceptable industry practices for environmental protection.
2) The second stage is the injection and monitoring stage when increased volumes of CO_2 (twice or 2X the volume which would be normally used by Denbury for their enhanced oil recovery (EOR) operation) will be injected into selected deep (completed greater than 10,000 ft below surface) wells by Denbury at the Cranfield Unit for a period of 18 months. SECARB will conduct rigorous monitoring of the deep injection, groundwater quality, and soil-gas conditions to assess and document the results of the study.

The injection of CO_2 for the Phase III Early Test will occur at wells already being permitted and drilled by Denbury for EOR purposes. The drilling, site preparation, and infrastructure construction will be permitted by the MSOGB and conducted in compliance with all applicable federal and state regulations and acceptable industry practices for environmental protection. The

vast majority of the project's tasks and subsequent impacts will be completed by Denbury regardless of the implementation of the SECARB Phase III Early Test. Denbury has agreed to extend at least four, but not to exceed eight, of its CO_2 injection wells into the brine water leg downdip of the formation for use in the SECARB study. Additional EOR/CO_2 injector wells injecting at the oil/brine interface at the Cranfield Unit may also be used if necessary to achieve the target CO_2 injection volume of 1.0 million metric tons per year required for the study. The wells will be directionally drilled from existing or former well pads that will be reconditioned by Denbury as part of its commercial EOR operation.

Two observation wells will also be drilled from one of the reconditioned well pads and will be dedicated full time to continuous monitoring of the formation response to the CO_2 flood. Surface-monitoring activities planned include soil-gas surveys, groundwater-level measurements, groundwater geochemical measurement, experimental EM and/or acoustic geophysical measurements, and tracer injections. Two shallow water wells drilled to 200 feet are proposed to evaluate the performance of surface-monitoring strategies.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mississippi Field Office
6578 Dogwood View Parkway, Suite A
Jackson, Mississippi 39213

July 7, 2008

Pierina Noceti
M/S: B922 R342C
National Energy Technology Laboratory
P.O. Box 10940
Pittsburgh PA 15236

Dear Ms. Noceti:

The U.S. Fish and Wildlife Service (Service) has reviewed the information in your letter dated June 25, 2008 regarding the proposed Southeast Regional Carbon Sequestration Partnership Project in Adam and Franklin Counties, Mississippi. Our comments are submitted in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

One federally listed threatened species is known to occur within Adam and Franklin Counties, Mississippi, and may require additional consultation with the Service. The threatened Louisiana black bear (*Ursus a. luteolus*) occurs primarily in bottomland hardwood and floodplain forests along the Mississippi River and the southern part of the state. Although the bear is capable of surviving under a range of habitat types, some necessary habitat requirements include hard mast, soft mast, escape cover, denning sites, forested corridors, and limited human access. Forest management practices, agricultural, commercial and industrial development, and highways can cause adverse impacts to bear habitat by increasing human disturbance, fragmenting forests, and removing den trees. The Service recommends that the proposed project avoid cutting or removing actual or candidate den trees for black bears. Den trees are defined as bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa* sp.) with visible cavities, having a diameter at breast height of 36 inches or greater, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies.

We appreciate the opportunity to provide comments during the early planning stages of the proposed activity. If you have any questions or comments, please contact our office at (601) 321-1139.

Sincerely,

David Felder
Fish and Wildlife Biologist

Appendix C Noise Calculations

Table C-1. Drilling Noise

NSA 1	**Feet** 4400	**Meters** 1341											
	Octave Band Center Frequency, Hz												
Source				**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB**
Drill Rig (@25 Feet)				93	97	94	91	92	91	88	81	76	
Power Level (PWL)				121	125	123	120	121	120	116	109	105	
Transmission Loss (TL) Enclosure (1/2" wood)				0.5	-5.5	-11.5	-17.5	-23.5	-29.5	-35.6	-41.6	-47.6	
PWL with enclosure				122	23	17	11	5	-1	-7	-13	-19	
Mud Handling (Shaker and Pump) (@25 Feet)				89	90	88	81	79	78	75	74	68	
PWL				118	119	117	110	108	107	104	103	97	
Generators (Light Plant)	**325**	**435.5**	CF	**5**	**9**	**3**	**7**	**15**	**19**	**25**	**35**	**43**	
Exhaust Noise	Lw	145.1		140.1	136.1	142.1	138.1	130.1	126.1	120.1	110.1	102.1	134
			Muffler Correction	25	25	29	29	27	25	24	23	23	
			PWL	115.1	111.1	113.1	109.1	103.1	101.1	96.1	87.1	79.1	107
			CF	**4**	**11**	**13**	**13**	**12**	**9**	**8**	**9**	**17**	
Inlet Noise	Lw	107.6	PWL	103.6	96.6	94.6	94.6	95.6	98.6	99.6	98.6	90.6	105
			CF	**22**	**14**	**7**	**7**	**8**	**6**	**7**	**13**	**20**	
Casing Noise	Lw	118.1	**PWL**	96	104	111	111	110	112	111	105	98	117
Excavator (@25 Feet)					84	85	81	81	81	78	73		
PWL				29	113	114	110	110	110	107	102	29	
Total Sound Intensity				2.4907	1.0575	1.0167	0.3944	0.2741	0.3185	0.2104	0.0725	0.0122	
Total PWL				**124**	**120**	**120**	**116**	**114**	**115**	**113**	**109**	**101**	**128**
Hemispherical Spreading				-76	-76	-76	-76	-76	-76	-76	-76	-76	
Atmospheric Absorption				0	0	0	-1	-4	-7	-12	-31	-56	
Flat Sound Level				47	44	43	38	34	32	25	1	-32	
Octave Band A-Weighted Correction				-39	-26	-16	-9	-3	0	1	1	-1	

A-Weighted Sound Level				8	18	27	29	31	32	26	2	-33	**37**
											Ldn without Barrier		**43**

Notes:
Calculations based on available data from typical equipment set-ups, actual equipment would vary dependent on results of geotechnical evaluation and site specific design.
Calculations do not account for effect of topographic features, reflection, and natural barriers
Note: Lw is sound power level, CF is center frequency, and Ldn is equivalent day night level.

Table C-2. Compressor Noise

	Feet	**Meters**
Critical Distance Calculation	**1200**	**366**

				Octave Band Center Frequency, Hz									
Source				**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB**
Reciprocating Compressor		**10000.0**	CF	**11**	**15**	**10**	**11**	**13**	**10**	**5**	**8**	**15**	
	Lw	128.7	**PWL**	118	114	119	118	116	119	124	121	114	128
Total Sound Intensity				0.5923	0.2358	0.7457	0.5923	0.3737	0.7457	2.3581	1.1819	0.2358	
Total PWL				**118**	**114**	**119**	**118**	**116**	**119**	**124**	**121**	**114**	**128**
Hemispherical Spreading				-65	-65	-65	-65	-65	-65	-65	-65	-65	
Atmospheric Absorption				0	0	0	0	-1	-2	-3	-8	-15	
Octave Band A-Weighted Correction				-39	-26	-16	-9	-3	0	1	1	-1	
A-Weighted Sound Level (without barrier)				14	23	37	43	47	52	56	48	32	**58**
												Ldn	**65**

Appendix D SHPO Consultation

U.S. Department of Energy
National Energy Technology Laboratory

June 25, 2008

Mr. H.T. Holmes, SHPO
Mississippi Department of Archives & History
P.O. Box 571
Jackson, MS 39205-0571

Dear Mr. Holmes:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi, in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as Enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966, we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided to you for review upon availability.

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Specialist

Enclosures

Figure 1
SECARB Phase III Study Area

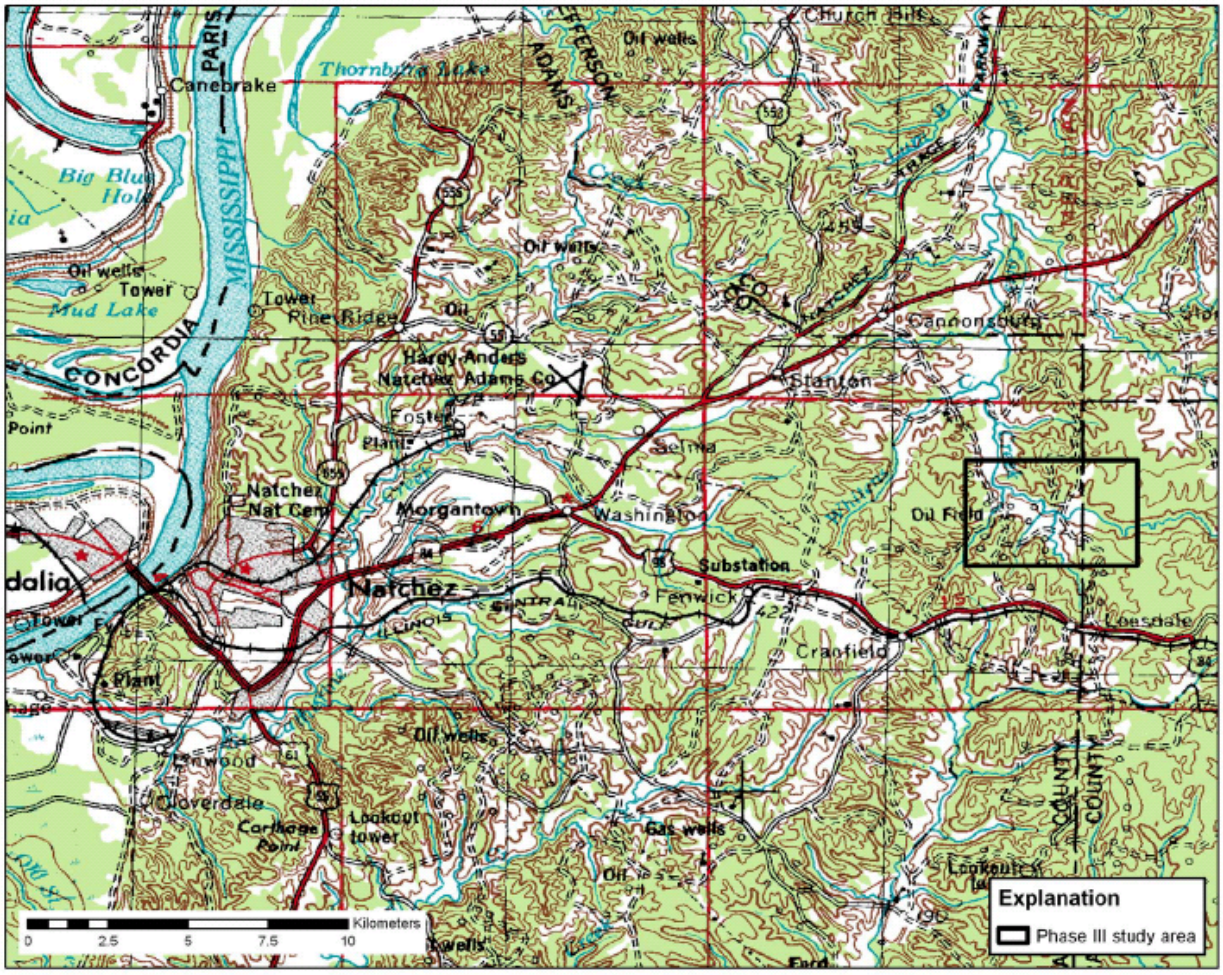


Figure 2
SECARB Phase III Topographic Map

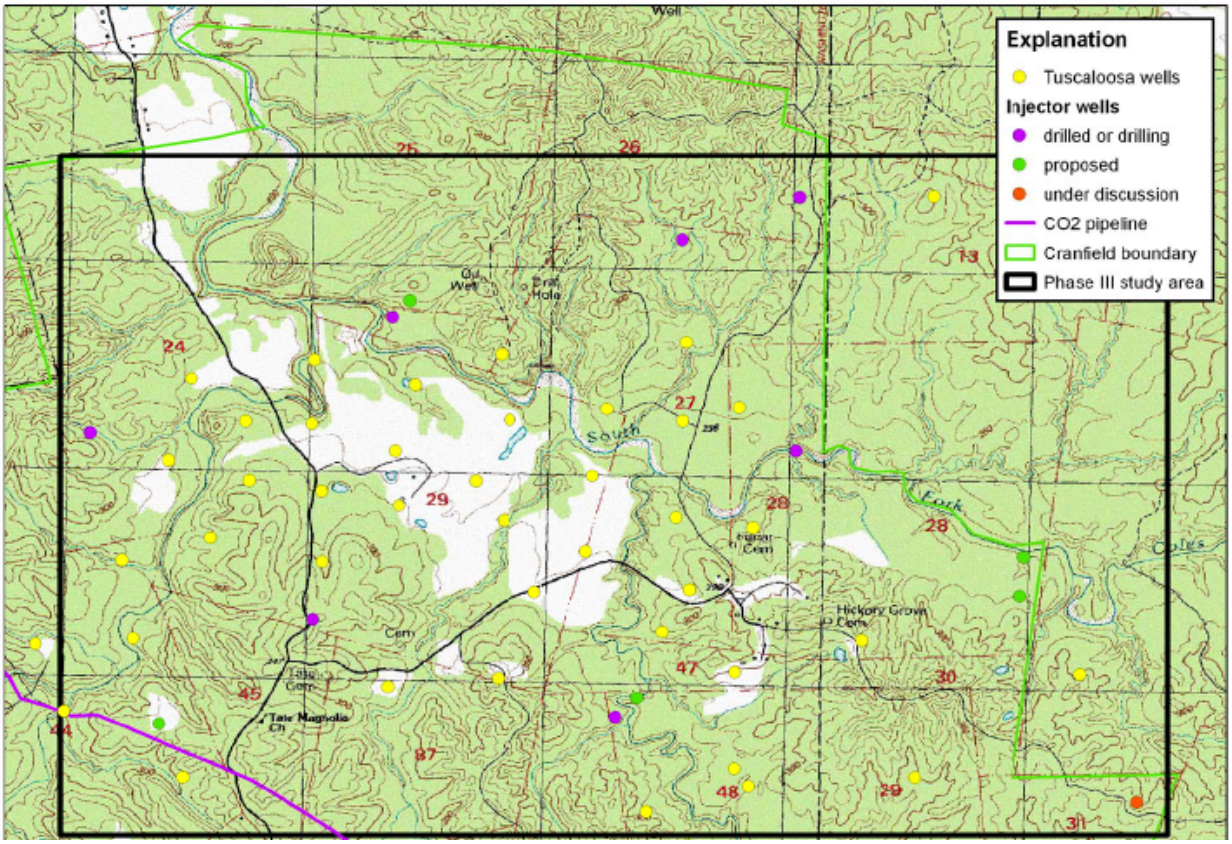
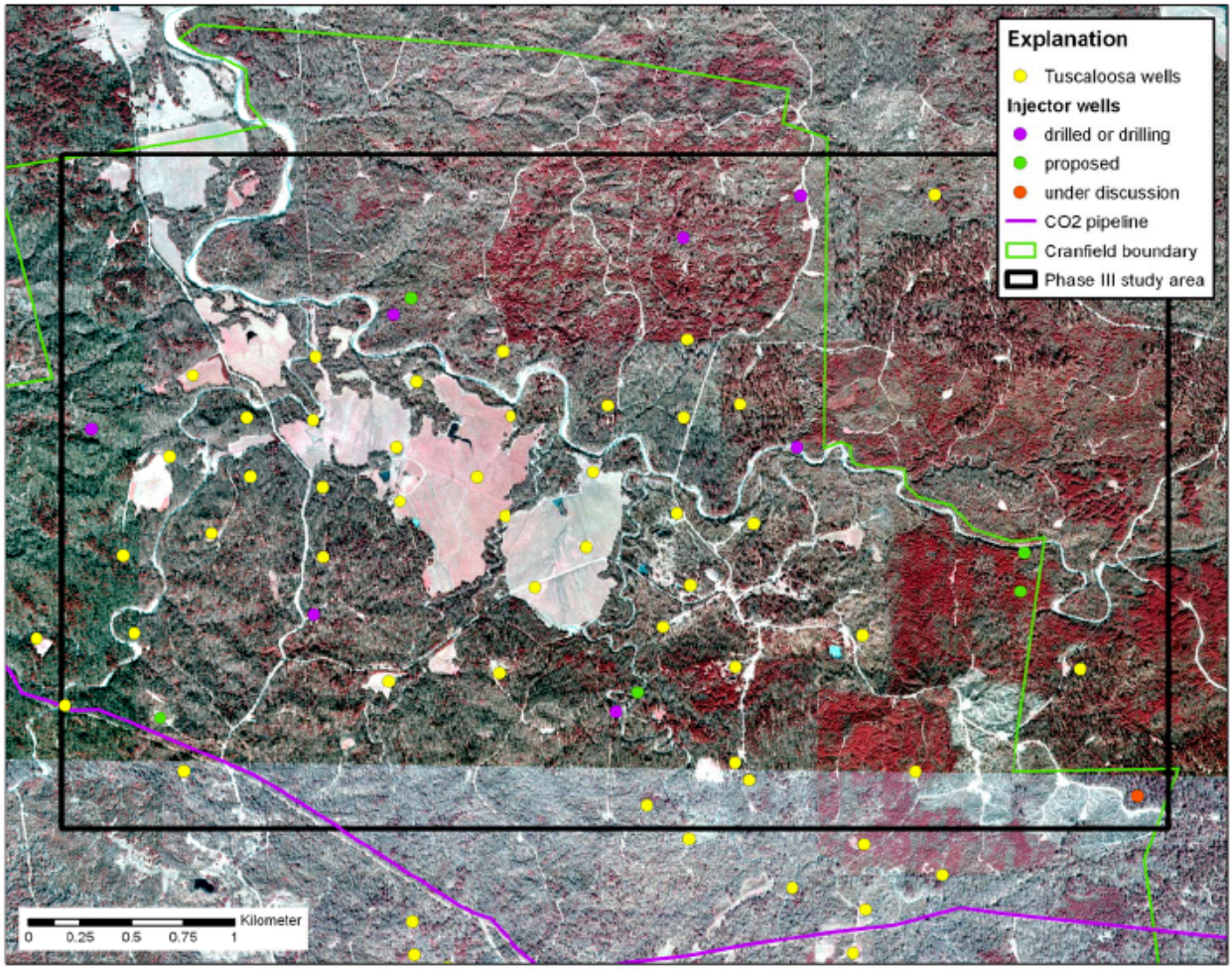


Figure 3
SECARB Phase III Aerial Map



Description of the Proposed Action

SOUTHEAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (SECARB) PHASE III EARLY TEST

The proposed action is for DOE to provide, through a cooperative agreement with the Southern States Energy Board (SSEB), financial assistance for the injection of 1.5 million metric tons of supercritical CO_2 into the Cranfield Unit, an active oilfield owned by Denbury Resources International Company (Denbury). The CO_2 would be injected into the brine-bearing Tuscaloosa Formation on the flank of the structure, downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Bureau of Economic Geology (BEG) at the University of Texas at Austin.

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federal and state regulations and acceptable industry practices for environmental protection. The vast majority of the project's tasks and subsequent impacts will be completed by Denbury regardless of the implementation of the SECARB Phase III Early Test. Denbury has agreed to extend at least four, but not to exceed eight, of its CO_2 injection wells into the brine water leg downdip of the formation for use in the SECARB study. Additional EOR/CO_2 injector wells injecting at the oil/brine interface at the Cranfield Unit may also be used if necessary to achieve the target CO_2 injection volume of 1.0 million metric tons per year required for the study. The wells will be directionally drilled from existing or former well pads that will be reconditioned by Denbury as part of its commercial EOR operation.

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MISSISSIPPI DEPARTMENT *of* ARCHIVES AND HISTORY

MDAH

HISTORIC PRESERVATION
Ken P'Pool, director • Jim Woodrick, acting director
PO Box 571, Jackson, MS 39205-0571
601-576-6940 • Fax 601-576-6955
mdah.state.ms.us

January 7, 2009

Pierina N. Fayish
U. S. Department of Energy
National Energy Technology Laboratory
P. O. Box 10940
Mailstop B922/ R342C
Pittsburgh, Pennsylvania 15236

RE: Proposed Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Early Test, MDAH Project Log #06-233-08, Adams and Franklin Counties

Dear Pierina:

We have reviewed the information, originally provided on June 30, 2008, regarding the above referenced project, in accordance with our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. As you know, we had previously requested that a cultural resources survey be conducted in the project area. However, after further consultation, our archaeological staff has determined that a cultural resources survey will not be necessary and that the project is not likely to affect any know cultural resources. As such, we have no objection with the proposed undertaking.

Should there be additional work in connection with the project, or any changes in the scope of work, please let us know in order that we may provide you with appropriate comments in compliance with the above referenced regulations.

If we can be of further assistance, please do not hesitate to contact us at (601) 576-6940. Again, I apologize for the delay in our response.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

Appendix E Contact with the Bureau of Indian Affairs and Tribal Councils

U.S. Department of Energy

National Energy Technology Laboratory

July 9, 2008

Michell Hicks, Principal Chief
Eastern Band of Cherokee Indians
P.O. Box 455
Cherokee, NC 28719

Dear Chief Hicks:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966 and Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided to you for review upon availability.

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

U.S. Department of Energy
National Energy Technology Laboratory

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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

U.S. Department of Energy
National Energy Technology Laboratory

July 9, 2008

Phillip Martin, Chief
Mississippi Band of Choctaw Indians
P.O. Box 6010, Choctaw Branch
Philadelphia, MS 39350

Dear Chief Martin:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

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U.S. Department of Energy
National Energy Technology Laboratory

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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

U.S. Department of Energy
National Energy Technology Laboratory

July 9, 2008

Ray Thomas, Field Representative
Bureau of Indian Affairs
Choctaw Agency
421 Powell Street
Philadelphia, MS 39350

Dear Representative Thomas:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

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U.S. Department of Energy
National Energy Technology Laboratory

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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U.S. Department of Energy
National Energy Technology Laboratory

July 9, 2008

Dean White, Superintendent
Bureau of Indian Affairs
Cherokee Agency
P.O. Box 1959
Cherokee, NC 28719

Dear Superintendent White:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as enclosures.

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U.S. Department of Energy
National Energy Technology Laboratory

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
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U.S. Department of Energy

National Energy Technology Laboratory

August 4, 2008

Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Tribe
P.O. Box 1589
151 Melacon Drive
Marksville, LA 71351

Dear Chairman Barbry:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966 and Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided to you for review upon availability.

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

U.S. Department of Energy
National Energy Technology Laboratory

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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U.S. Department of Energy

National Energy Technology Laboratory

August 4, 2008

Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
Drawer 1210
Durant, OK 74702

Dear Chief Pyle:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966 and Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided to you for review upon availability.

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Sincerely,

Pierina Noceti
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U.S. Department of Energy

National Energy Technology Laboratory

August 4, 2008

John Berrey, Chairman
Quapaw Tribal Business Committee
P.O. Box 765
Quapaw, OK 74363

Dear Chairman Berrey:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

A description of the proposed project and graphics depicting its location are provided as enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966 and Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

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U.S. Department of Energy
National Energy Technology Laboratory

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Sincerely,

Pierina Noceti
NEPA Document Manager

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U.S. Department of Energy

National Energy Technology Laboratory

August 4, 2008

Christine Norris, Principal Chief
Jena Band of Choctaw Indians
P.O. Box 14
Jena, LA 71342

Dear Chief Norris:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

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Sincerely,

Pierina Noceti
NEPA Document Manager

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U.S. Department of Energy

National Energy Technology Laboratory

August 4, 2008

Steve Cadue, Chairman
Kickapoo Tribe in Kansas
1107 Goldfinch Rd
Horton KS 66439-9537

Dear Chairman Cadue:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

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U.S. Department of Energy

National Energy Technology Laboratory

August 4, 2008

Bill Anoatubby, Governor
Chickasaw Nation
P.O. Box 1548
Ada, OK 74821

Dear Governor Anoatubby:

The U.S. Department of Energy (DOE) is considering co-funding a project with the Southern States Energy Board near Cranfield, Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Texas Bureau of Economic Geology (BEG) at the University of Texas at Austin. The proposed project site is within an active oil field owned by Denbury Resources International Company (Denbury).

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U.S. Department of Energy
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Sincerely,

Pierina Noceti
NEPA Document Manager

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Figure 1
SECARB Phase III Study Area

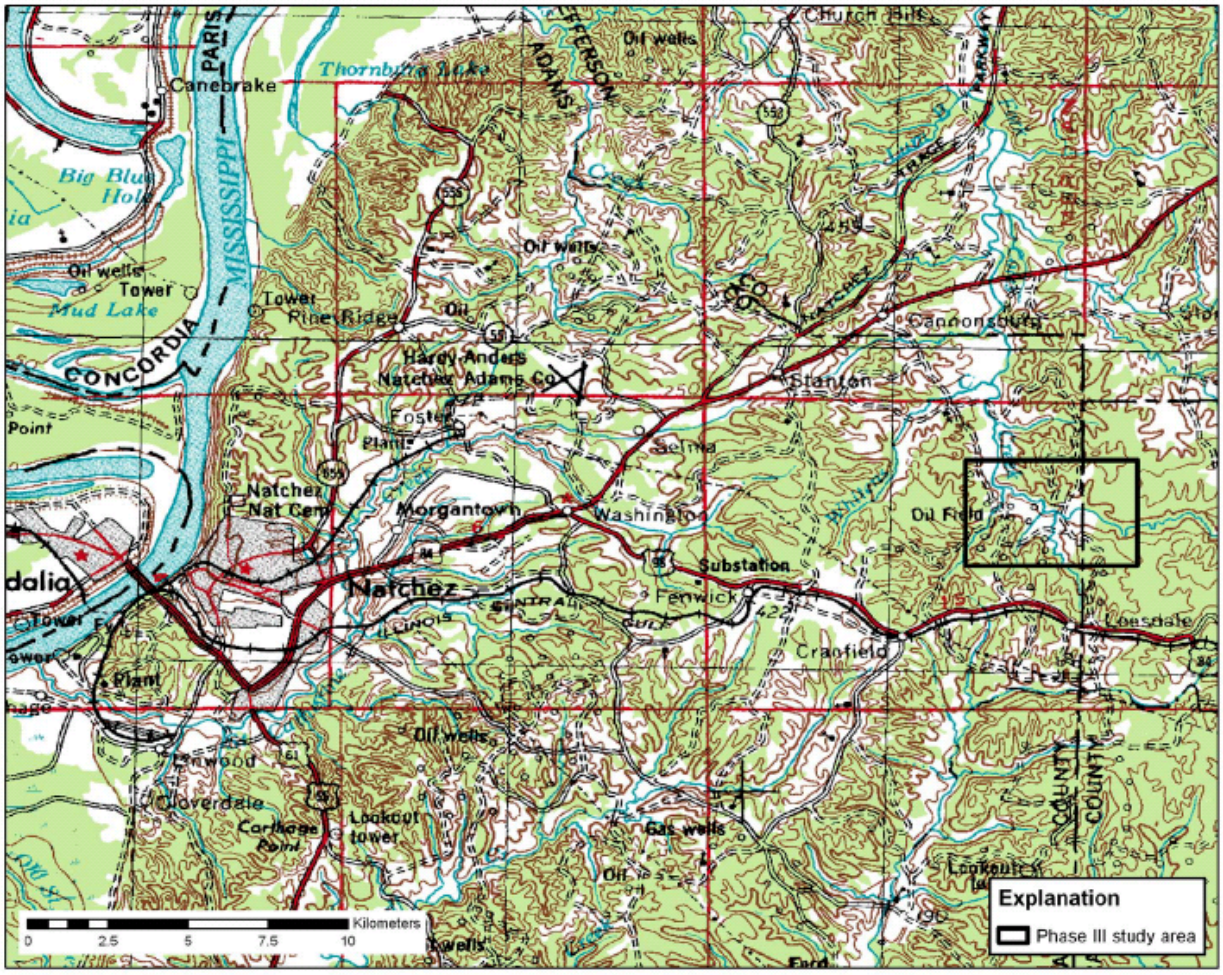


Figure 2
SECARB Phase III Topographic Map

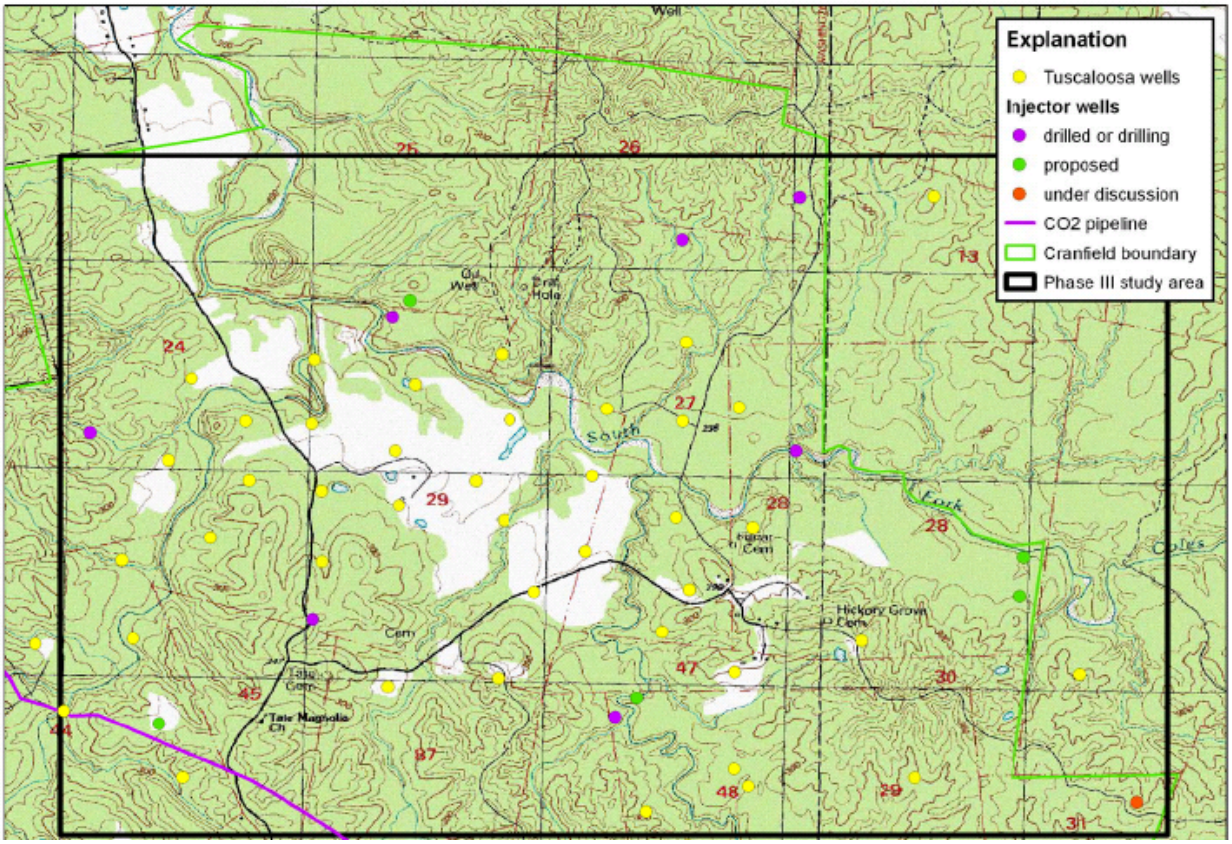
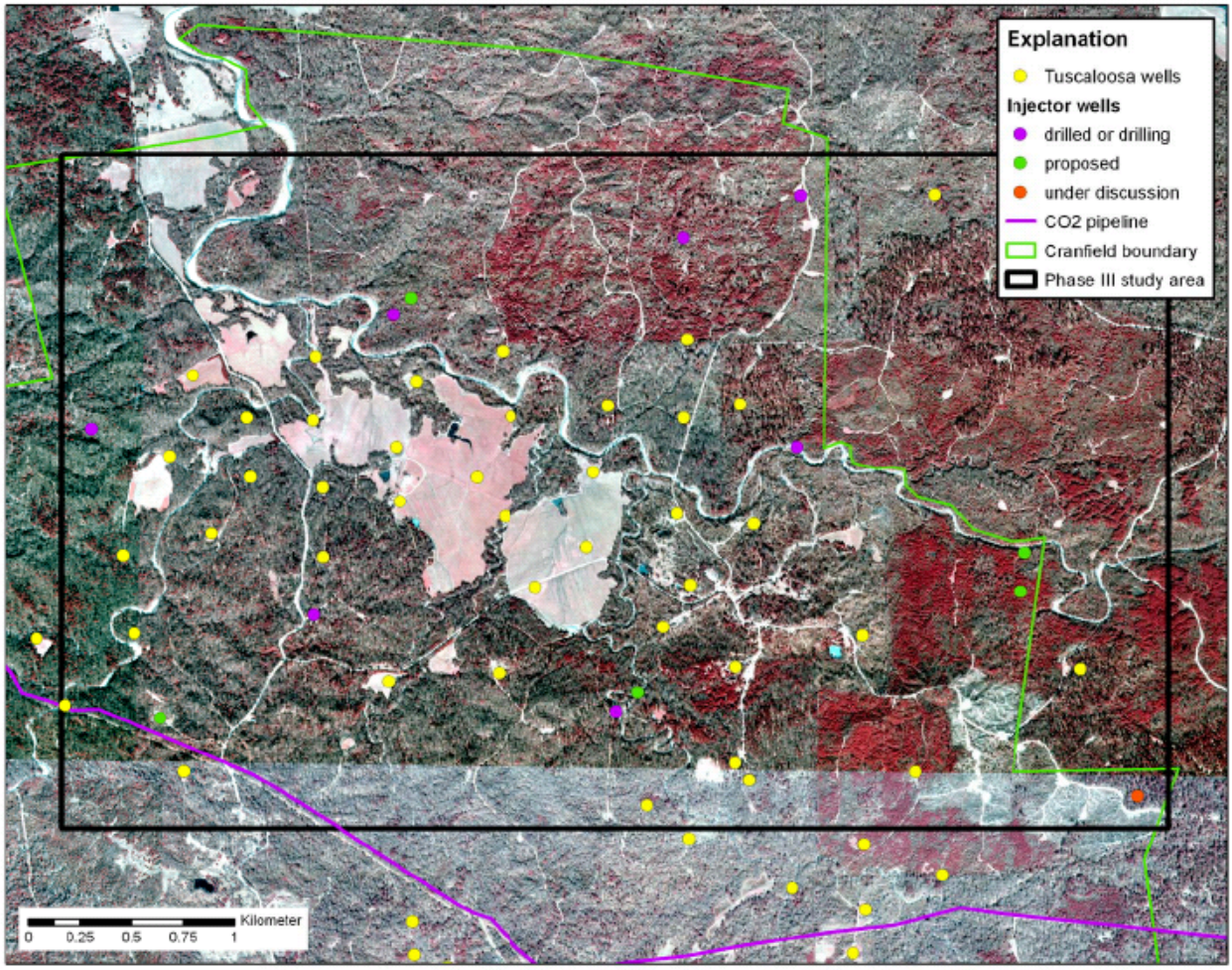


Figure 3
SECARB Phase III Aerial Map



Description of the Proposed Action

SOUTHEAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (SECARB) PHASE III EARLY TEST

The proposed action is for DOE to provide, through a cooperative agreement with the Southern States Energy Board (SSEB), financial assistance for the injection of 1.5 million metric tons of supercritical CO_2 into the Cranfield Unit, an active oilfield owned by Denbury Resources International Company (Denbury). The CO_2 would be injected into the brine-bearing Tuscaloosa Formation on the flank of the structure, downdip of the oil-bearing zone. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring. The primary subcontractor will be the Bureau of Economic Geology (BEG) at the University of Texas at Austin.

Activities will take place in a rural area in southwestern Mississippi about 4 miles northeast of the unincorporated village of Cranfield and approximately 12 miles due east of Natchez, Mississippi. Elevations within the Cranfield Unit range from just under 280 feet above sea level near the perennial stream (South Fork of Coles Creek) in the north part of the area up to 400 feet just south of State Highway 84. The Cranfield Unit is an oil and gas field that was largely abandoned in 1965. Denbury is undertaking a commercial CO_2 flood of this field, which is in a large, closed domal structure at depths greater than 10,000 feet with a gas-tight geologic seal.

This field experiment, known as SECARB Phase III Early Test, is in a high-porosity, high-permeability formation similar to those that could eventually be used to sequester large volumes of CO_2. This project will be closely monitored to document that the CO_2 remains within the injection zone. This project is being implemented in two stages:

1) The first stage is the drilling and characterization stage when injection wells, deep observation wells, and shallow groundwater wells will be drilled; a compressor will be installed; and various tests will be conducted to verify and refine information regarding the subsurface structure of the study area. The injection well drilling, site preparation, infrastructure construction, wastewater disposal, and other activities will be permitted by the Mississippi Oil and Gas Board (MSOGB) and conducted in compliance with all applicable federal and state regulations and acceptable industry practices for environmental protection.
2) The second stage is the injection and monitoring stage when increased volumes of CO_2 (twice or 2X the volume which would be normally used by Denbury for their enhanced oil recovery (EOR) operation) will be injected into selected deep (completed greater than 10,000 ft below surface) wells by Denbury at the Cranfield Unit for a period of 18 months. SECARB will conduct rigorous monitoring of the deep injection, groundwater quality, and soil-gas conditions to assess and document the results of the study.

The injection of CO_2 for the Phase III Early Test will occur at wells already being permitted and drilled by Denbury for EOR purposes. The drilling, site preparation, and infrastructure construction will be permitted by the MSOGB and conducted in compliance with all applicable

federal and state regulations and acceptable industry practices for environmental protection. The vast majority of the project's tasks and subsequent impacts will be completed by Denbury regardless of the implementation of the SECARB Phase III Early Test. Denbury has agreed to extend at least four, but not to exceed eight, of its CO_2 injection wells into the brine water leg downdip of the formation for use in the SECARB study. Additional EOR/CO_2 injector wells injecting at the oil/brine interface at the Cranfield Unit may also be used if necessary to achieve the target CO_2 injection volume of 1.0 million metric tons per year required for the study. The wells will be directionally drilled from existing or former well pads that will be reconditioned by Denbury as part of its commercial EOR operation.

Two observation wells will also be drilled from one of the reconditioned well pads and will be dedicated full time to continuous monitoring of the formation response to the CO_2 flood. Surface-monitoring activities planned include soil-gas surveys, groundwater-level measurements, groundwater geochemical measurement, experimental EM and/or acoustic geophysical measurements, and tracer injections. Two shallow water wells drilled to 200 feet are proposed to evaluate the performance of surface-monitoring strategies.

Choctaw Nation of Oklahoma

P.O. Box 1210 • Durant, OK 74702-1210 • (580) 924-8280

Gregory E. Pyle
Chief

Gary Batton
Assistant Chief

November 12, 2008

Pierina M. Noceti
P.O. Box 10940
Pittsburgh, PA 15236

Dear Pierina M. Noceti:

We have reviewed the following proposed project (s) as to its effect regarding religious and/or cultural significance to historic properties that may be affected by an undertaking of the projects area of potential effect.

Project Description: Southeast Regional Carbon Sequestration Partnership

Project Location: Cranfield, Mississippi

County: Adams and Franklin Counties

Comments: After further review of the above-mentioned project (s), we are **unable** to determine adverse effect on any historic properties in the project's area of potential effect. Until we have received a SHPO letter. In addition, the 30-day response period will be the date we receive the requested information. If you have any questions, please call the Choctaw Historic Preservation Office at 1-800-522-6170 ext. 2137.

Sincerely,

Terry D. Cole
Tribal Historic Preservation Officer
Choctaw Nation of Oklahoma

By: Caren A. Johnson
Caren A. Johnson
Administrative Assistant

CAJ:vr

U.S. Department of Energy

National Energy Technology Laboratory

January 13, 2009

Terry D. Cole
Tribal Historic Preservation Officer
Choctaw Nation of Oklahoma
P.O. Box 1210
Durant, OK 74702-1210

Dear Terry:

I am writing to you in response to your letter of November 12, 2008, requesting a copy of the clearance letter from the Mississippi State Historic Preservation Officer. A copy of the letter is attached. Please excuse the delay in our response.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966 and Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," we would appreciate receiving any information you have regarding historic or cultural properties in the project area, which is located at the Cranfield Unit oil field near Cranfield Mississippi in Adams and Franklin Counties. The proposed project would inject and closely monitor the flow of 1.5 million metric tons of supercritical carbon dioxide (CO_2) into the brine-bearing Tuscaloosa Formation on the flank of the structure and downdip of the oil-bearing zone. The injection wells will be drilled on well pads that were abandoned in the 1950's. The proposed injection period for the Phase III Early Test is 18 months, followed by at least one year of post-injection monitoring.

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.fayish@netl.doe.gov.

Sincerely,

Pierina N Fayish

Pierina Fayish
NEPA Document Manager

Enclosures

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Choctaw Nation of Oklahoma

P.O. Box 1210 • Durant, OK 74702-1210 • (580) 924-8280

Gregory E. Pyle
Chief

Gary Batton
Assistant Chief

February 24, 2009

Pierina M. Noceti
P.O. Box 10940
Pittsburgh, PA 15236

Dear Pierina M. Noceti:

We have reviewed the following proposed project (s) as to its effect regarding religious and/or cultural significance to historic properties that may be affected by an undertaking of the projects area of potential effect.

Project Description: Southeast Regional Carbon Sequestration Partnership

Project Location: Cranfield, Mississippi

County: Adams and Franklin Counties

Comments: After further review of the above-mentioned project (s), to the best of our knowledge, it will have no adverse effect on any historic properties in the project's area of potential effect. However, should construction expose buried archaeological or building materials such as chipped stone, tools, pottery, bone, historic crockery, glass or metal items, or should it uncover evidence of buried historic building materials such as rock foundations, brick, or hand-poured concrete, this office should be contacted immediately @ 1-800-522-6170 ext. 2137.

Sincerely,

Terry D. Cole
Tribal Historic Preservation Officer
Choctaw Nation of Oklahoma

By: Caren A Johnson
Caren A. Johnson
Administrative Assistant

CAJ:vr