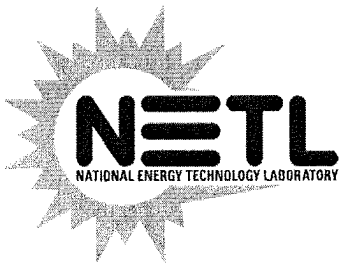
DOE/EA-1642

DESIGN AND CONSTRUCTION OF AN EARLY LEAD MINI FISCHER-TROPSCH REFINERY AT THE UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH NEAR LEXINGTON, KENTUCKY

ENVIRONMENTAL ASSESSMENT



U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

July 2009

COVER SHEET

Responsible Agency: U.S. Department of Energy

Title: Design and Construction of an Early Lead Mini Fischer-Tropsch Refinery, Draft Environmental Assessment (DOE/EA-1642)

Location: University of Kentucky Center for Applied Energy Research, Fayette County Kentucky near Lexington.

Contact:

For further information or copies Copies of this Environmental Assessment, contact:

Roy Spears, Document Manager
National Energy Technology Laboratory
U.S. Department of Energy
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
(304) 285-5460 or fax (304) 285-4403
roy.spears@netl.doe.gov

For general information on the Department of Energy's process for implementing the National Environmental Policy Act, contact:

Carol Borgstrom, Director
Office of NEPA Policy
Compliance (GC-20)
U.S. Department of Energy
1000 Independence Ave, SW
Washington, DC 20585-0103
(202) 586-4600 or leave message at
(800) 472-2756

Abstract:

The United States Department of Energy (DOE), National Energy Technology Laboratory prepared this Environmental Assessment (EA) to analyze the potential environmental impacts of providing funding for the proposed Early Lead Mini Fischer-Tropsch Refinery. The early lead facility (i.e., the facility requires 2 to 3 years lead time for engineering design, procurement, and construction) would be located at the University of Kentucky (UK) Center for Applied Energy Research (CAER) in Fayette County Kentucky just north of Lexington on land owned by the Commonwealth of Kentucky. The facility would be operated by the CAER.

The funding for DOE would advance the design and construction of a dedicated research facility at the UK CAER. The facility would carry out research on coal-to-liquid (CTL) fuel using synthetic gas (syngas) produced by reforming natural gas. Research would include experiments on water-gas-shift and Fischer-Tropsch processes as well as on catalyst structure-function properties with the ultimate goal of reducing the costs of the process and helping produce a more environment-friendly liquid fuel from domestic coal. Through successful research, the proposed project would help manage and reduce carbon dioxide emissions from CTL facilities and from use of the fuels and would help to

develop facilities and personnel to sustain a domestic coal synthetic fuels industry thereby reducing the United States' dependence on foreign oil.

The Proposed Action currently being evaluated is for DOE to provide $1,370,065 in Federal funding to the Coal Fuel Alliance (CFA), a consortium of the Southern Illinois Coal Research Center, the University of Kentucky Center for Applied Energy Research, and the Energy Center at Purdue University. The funding provided would build on previous work at the CAER and would include the design and construction of a 2700 square foot research facility at the UK CAER.

The ultimate cost of the refinery is estimated to be around $12 million. The incremental funding in the proposed action would advance the design and construction of the mini-refinery building at the UK CAER by allowing the CFA to:

- Evaluate and select technologies and technology providers for primary process units including: Fischer-Tropsch, Fluid Catalytic Cracking, Hydrocracking, Dehydrogenation and Alkylation;
- Complete a Front End Engineering and Design (FEED) study of process units;
- Complete Architectural/Engineering Plans and Specifications for the Refinery Building;
- Construct the Refinery Building and Utility System; and
- Provide Project Management and Reporting.

The proposed project builds on previous work conducted by the CAER. The results of that earlier work included preliminary process flow diagrams of major equipment items and key instrumentation and process control loops, mass and energy balances, and preliminary sizing of key components.

Public Participation:

DOE encourages public participation in the NEPA process. Comments were invited on this Draft EA for a period of 30 days after publication in the *Lexington Herald-Leader* of the Notice of Availability beginning May 10, 2009. Copies of the Draft EA were made available for review at the Lexington Public Library Northside Branch located at 1733 Russell Cave Road and also at the UK CAER main receptionist located at 2540 Research Park Drive. The public was encouraged to submit comments to Roy Spears at the address, phone number, or e-mail listed above by close of the comment period on June 10, 2009. No comments on the Draft EA were received from the public.

Table of Contents

Section **Page**

List of Figures

List of Tables

List of Acronyms and Abbreviations

AAQS	Ambient Air Quality Standard
ARPA	Archeological Resources Protection Act
BCE	Before the Common Era
BMP	Best Management Practice
ca	*circa*
CAA	Clean Air Act
CAMEO	Computer-Aided Management of Emergency Operations
CAER	Center for Applied Energy Research
CE	Common Era
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFA	Coal Fuel Alliance
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CTL	Coal-to-Liquids
CWA	Clean Water Act
DAQ	Division of Air Quality, Kentucky Department of Environmental Protection
DOE	U.S. Department of Energy
EA	Environmental Assessment
EHS	Environment, Health, and Safety
EPA	U.S. Environmental Protection Agency
FCC	Fluid Catalytic Cracking
FEED	Front End Engineering and Design
FEMA	Federal Emergency Management Agency
ESA	Endangered Species Act
FIRM	Flood Insurance Rate Map
FT	Fischer-Tropsch
GHG	greenhouse gas(es)
GMWSS	Georgetown Municipal Water and Sewer Service
GWPP	Groundwater Protection Plan
ha	Hectares, a unit of area equal to 10,000 square meters (~2.5 acres)
HAP	Hazardous Air Pollutant
IDLH	Immediate Danger to Life and Health
KAR	Kentucky Administrative Regulation
KAWC	Kentucky American Water Company
KDEP	Kentucky Department of Environmental Protection
KDAQ	Kentucky Division for Air Quality
KGS	Kentucky Geological Survey
LFUCG	Lexington-Fayette Urban County Government
m	meters
m^3	cubic meters

MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NETL	National Energy Technology Laboratory
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen dioxide (*a NAAQS criteria pollutant)*
N_2O	nitrous oxide (*a greenhouse gas*)
NPS	National Park Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standard
NWI	National Wetlands Inventory
O_3	Ozone
OEM	Office of Emergency Management
OSHA	Occupational Safety and Health Administration
Pb	Lead
$PM_{2.5}$	Particulate matter of less than 2.5 micron size
PM_{10}	Particulate matter of less than 10 micron size
PPA	Pollution Prevention Act
PSD	Prevention of Significant Deterioration
PTE	Potential to Emit
PWSID	Public Water System Identification
RCRA	Resource Conservation and Recovery Act
SCBR	Slurry Column Bubble Reactor
SDWA	Safe Drinking water Act
scf	standard cubic feet
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
TMDL	Total Maximum Daily Load
tpy	ton(s) per year
UK	University of Kentucky
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile organic compound
WGS	Water Gas Shift
WHPA	Wellhead Protection Area
WHPP	Wellhead Protection Program
^oF	temperature in degrees Fahrenheit
µg	Micrograms (1×10^{-6} grams)

Summary of Changes to the Draft Environmental Assessment

Comments on the Draft Environmental Assessment (EA) were received from the State Environmental Review Officer. Comments by the Division for Air Quality identified state administrative regulations pertaining to permitting and advised that requirements to control fugitive emissions would apply to construction activities. Comments by the Division of Water – Watershed Management advised that a "stream construction permit application" will need to be submitted. [This requirement was subsequently clarified and would apply only if the Proposed Action involved construction within the 100-year floodplain. No construction within the 100-year floodplain would occur under the Proposed Action.] Also, the area of the proposed project is within a Zone 1 Wellhead Protection Area for Georgetown's water supply; a Groundwater Protection Plan would be required once operations begin. The Division of Energy Development and Independence noted that the Draft EA does not address the cumulative impacts on wildlife, habitat, or water resources from mining due to the increased demand for coal. The letter transmitting these comments is included in this Final EA in Appendix B Comments Received.

NETL has responded to these comments in the section of the EA appropriate to the comment. The following sections were revised from the Draft EA.

Section 3.2.2 Groundwater
Section 4.2 Water Quality
Section 4.3 Air Quality
Section 4.5 Waste and Hazardous Materials Management
Section 4.9 Cumulative Impacts
Section 4.10 Mitigation Measures
Section 6.0 References

No other comments were received on the Draft EA.

1.0 INTRODUCTION

The United States Department of Energy (DOE), National Energy Technology Laboratory (NETL) prepared this Environmental Assessment (EA) to analyze the potential environmental impacts of providing funding for the proposed Early Lead Mini Fischer-Tropsch Refinery (Mini FT Refinery). This facility would be located at the existing University of Kentucky (UK) Center for Applied Energy Research (CAER) in Fayette County Kentucky just north of Lexington. The Mini FT Refinery would be located on land owned by the Commonwealth of Kentucky and would by operated by the CAER.

The DOE funding would advance the design and construction of a dedicated research facility at the UK CAER. The facility would carry out research in converting synthetic gas (syngas) that could be derived from coal to liquid fuel. Research would include experiments on water-gas-shift and Fischer-Tropsch processes as well as on catalyst structure-function properties with the ultimate goal of reducing the costs of the process and helping produce a more environment-friendly transportation fuel from domestic coal. Through successful research, the proposed project would help manage and reduce carbon dioxide emissions from coal-to-liquid (CTL) facilities and from use of such fuels and would help to develop facilities and personnel to sustain a domestic coal synthetic fuels industry thereby reducing the United States' dependence on foreign oil.

1.1 Background

There are two different methods for converting coal to liquid fuel: Direct Liquefaction and Indirect Liquefaction. Direct coal liquefaction converts coal to a liquid by dissolving the coal in a solvent at high temperature and pressures. With indirect coal liquefaction, coal is first gasified with steam to form a mixture of hydrogen and carbon monoxide. This synthetic gas mixture, or "syngas", is then converted to liquid fuels in a second process using the Fischer-Tropsch reaction (World Coal Institute, 2006).

Section 417 of the Energy Policy Act of 2005 authorized the U.S. Department of Energy to carry out a program to evaluate the commercial and technical viability of advanced technologies for the production of transportation fuels manufactured from Illinois Basin coal using the Fischer-Tropsch process. As noted above, the Fischer-Tropsch process (also referred to in the literature as the Fischer-Tropsch reaction, Fischer-Tropsch synthesis, or Fischer-Tropsch technology) is an indirect process for converting coal to liquid fuels. The process was discovered by German scientists in the early part of the 20th century and was used extensively to make fuels during World War II. The Fischer-Tropsch process causes hydrogen to bond with oxides of carbon producing higher, predominantly straight hydrocarbons in the range of $C_4 - C_{10}$. (Anderson, 1984). The Fischer-Tropsch reaction involves the use of catalysts, substances that change the rate at which a chemical reaction takes place but are not being chemically changed in the reactions. The catalysts commonly used in the Fischer-Tropsch process are iron or cobalt.

Congress also authorized DOE to enter into agreements for capital modifications and construction of new facilities at the Southern Illinois University Coal Research Center, the University of Kentucky CAER, and the Energy Center at Purdue University. The universities subsequently entered into a Memorandum of Understanding with each other to form the Coal Fuel Alliance (CFA) to support complementary and joint research focusing on applied and developmental needs for CTL.

During its planning, the CFA identified one early lead foundational capability that was critically needed to support the other universities; that being, the development of a "mini Fischer-Tropsch refinery" to be constructed at UK CAER. Such a facility requires significant lead time for Front End Engineering and Design (FEED), procurement and construction in the range of two to three years. The proposed Mini FT Refinery is considered to be the "workhorse" of the CFA and is intended to produce research quantities of Fischer-Tropsch liquids and finished fuels for subsequent testing by the other universities; for example, in Purdue's extensive engine test stands sponsored by Rolls Royce, Caterpillar, and Cummins Engines.

The CAER is housed in a 55,000 square foot research facility located on the University of Kentucky's 125-acre research park at 2540 Research Park Drive near Lexington, KY (Figure 1.1). In addition to the CAER building the facilities staff manages the research park, which is also a home to the Asphalt Institute, Council of State Governments, and the Kentucky Community and Technical College System Administration. The Kentucky Geological Survey also maintains a core storage facility at the CAER.

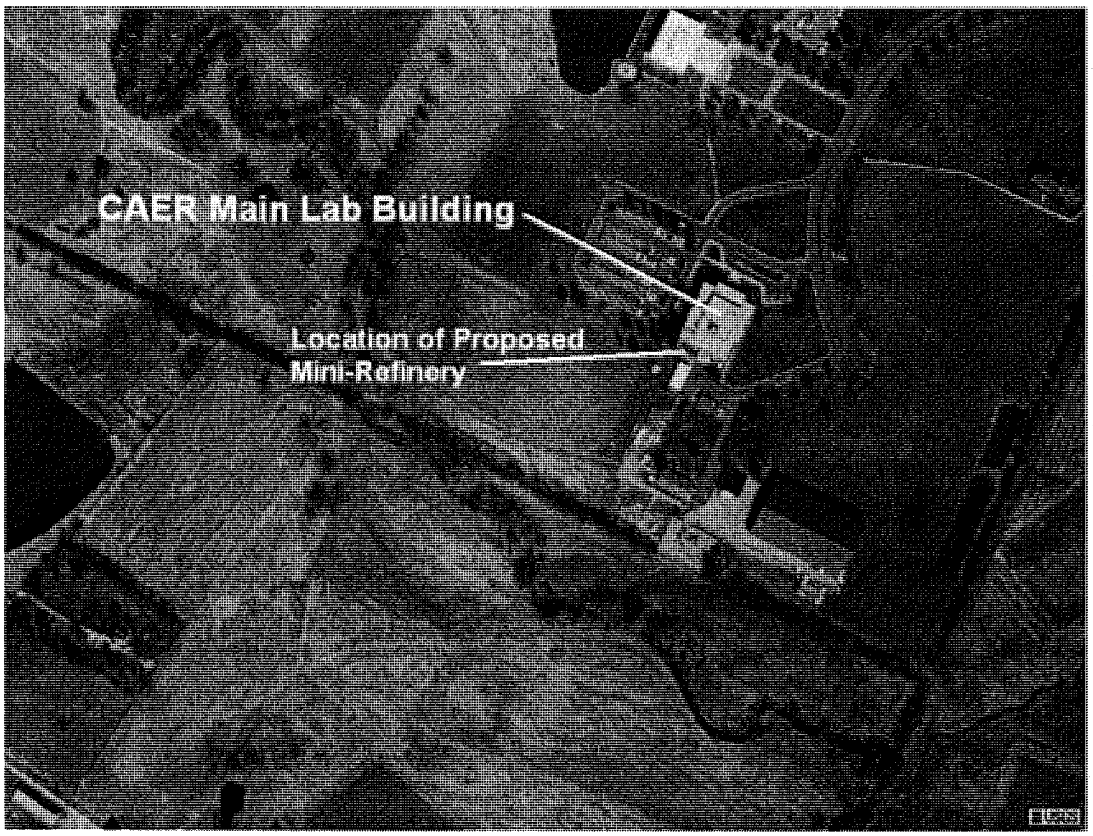


Figure 1.1 Aerial view of the UK CAER Facility showing the location of the proposed Mini FT Refinery adjacent to the existing main building

The proposed Mini FT Refinery would be located on the southwest side and adjacent or proximate to the existing CAER main building (Figure 1.2). The new facility would be similar in height to the existing building.

1.2 Purpose and Need

DOE's Proposed Action, providing incremental funding to advance the design and eventual construction of the Early Lead Mini Fischer-Tropsch Refinery at the UK CAER, serves the purpose of accelerating the availability of CTL fuels for transportation. Transportation accounts for over one third of all CO_2 emissions in the United States (EIA, 2008). Further, transportation is the least energy–diverse sector in the nation's economy, with petroleum accounting for more than 95 percent of the fuel consumed (U.S. DOE, 2006).

The need for the proposed project is for DOE NETL, through incremental funding, to continue research, development, and demonstration of CTL fuels with the objective of reducing costs and improving the performance of these fuels. The use of such fuels

would lessen the United States' dependence on imported oil and reduce CO_2 emissions from the transportation sector.

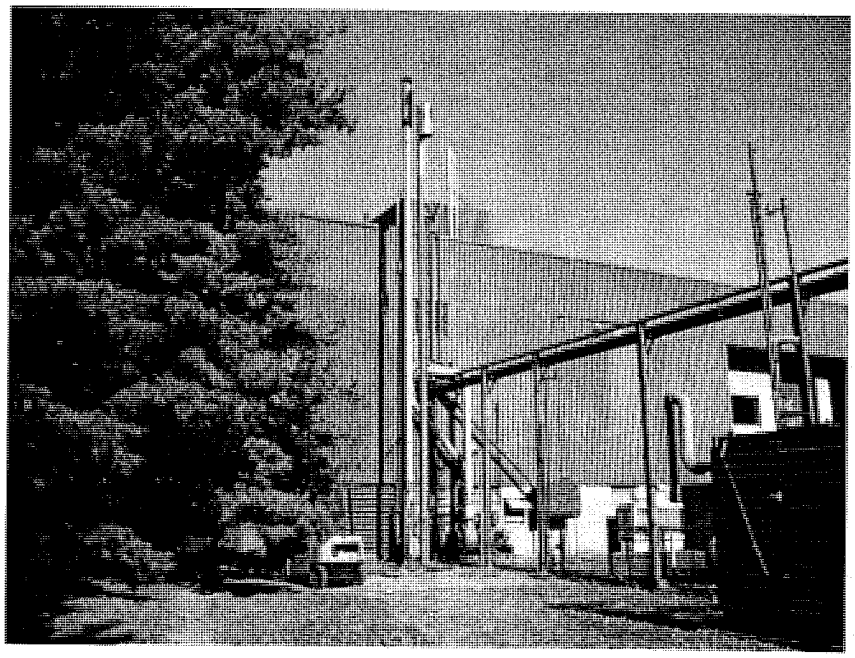


Figure 1.2 Photo showing the location of the proposed new facility on the southwest side of the existing CAER main lab building

The Proposed Action would build on work already conducted by the CAER. In its earlier effort using financial resources provided by the Commonwealth of Kentucky, the CAER designed a simplified block diagram of the proposed Mini FT Refinery. Further, the CAER contracted Zeton, Inc., of Burlington, Ontario, Canada to develop a cost estimation and feasibility study focusing on the design of a refinery with the following capacities:

Fischer-Tropsch design capacity:	1.0 BPD
Fluid Catalytic Cracking (FCC) design capacity:	0.2 BPD
Hydrocracking design capacity:	0.5 BPD
Dehydrogenation design capacity:	0.17 BPD
Alkylation design capacity:	0.17 BPD

The agency's Proposed Action, considered in this EA, would advance the facility several more steps by:

- Selecting technologies and technology providers;
- Completing a Front End Engineering and Design (FEED) Study;

- Completing the Architectural and Engineering plans and specifications of the refinery building; and
- Constructing the refinery building itself and associated plant utilities and infrastructure.

1.3 Scope of the EA

This DOE EA analyzes the environmental impacts that could result from the Proposed Action and the No Action Alternative. This EA was prepared in compliance with the National Environmental Policy Act of 1969 (P.L. 910190), the Council on Environmental Quality (CEQ) regulations dated 28 November 1978 (40 CFR Parts 1500-1508), and the DOE NEPA Implementing Procedures (10 CFR 1021).

Key goals of NEPA are to help Federal agency officials make well-informed decisions about agency actions and to provide a role for the general public in the decision-making process. The study and documentation mechanisms associated with NEPA seek to provide decision-makers with sound knowledge of the comparative environmental consequences of the courses of action available to them. NEPA studies and the documents recording their results, such as this EA, focus on providing input for the particular decisions faced by the relevant officials.

This EA identifies, describes, and evaluates the potential environmental impacts that could results from the implementation of the Proposed Action and the No Action alternative, taking into consideration possible cumulative impacts of other actions that could foreseeably follow from the proposed action. As appropriate, the affected environment and environmental consequences of the action will be described in both site-specific and regional contexts. In instances where mitigation measures may lessen any potential adverse impacts, this EA identifies such measures that may be implemented to further minimize environmental impacts.

The following resource areas have been identified for study within this EA: soil and geology, water resources (including groundwater, wetlands, and floodplains), air quality, biological resources (including threatened and endangered species), waste and hazardous materials management, human health and safety, cultural resources, and socioeconomics. Resource areas considered but dismissed from further analysis are discussed below.

1.3.1 *Resource Areas Dismissed from Further Analysis*

Some resource areas and possible impacts and issues associated with these areas were considered as part of DOE's internal scoping for the proposed project. These resources areas were not considered to warrant more detailed analysis in this EA because they were either: 1) outside the scope of the proposed action; 2) already decided by law, regulation, or other higher level decisions: 3) not relevant to the decision to be made by DOE; or 4) conjectural and not supported by current scientific or factual evidence. The basis for eliminating these resources areas from further analysis is provided below.

Wild and Scenic Rivers

The National Wild and Scenic Rivers Act is administered by four federal agencies: the Bureau of Land Management, the National Park Service, the U.S. Fish and Wildlife Services (USFWS), and the U.S. Forest Service (USFS). The Act protects selected rivers and the immediate environments, which possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. In the Commonwealth of Kentucky, there is only one National Wild and Scenic River, the Red River, a tributary of the Kentucky River.

The Red River lies in the central subbasin of the Kentucky River Basin, and occupies all of parts of Wolfe, Morgan, Menifee, and Powell counties located southeast of the proposed project site. Public Law 130-170 (December 2, 1993) added a total of 19.4 miles (9.1 miles wild and 10.3 miles recreational) of the Red River to the National Wild and Scenic Rivers system under the administration of the U.S. Forest Service.

The proposed project site is located in the lower subbasin of the Kentucky River Basin and is down drainage from the central subbasin and the Red River watershed. The Red River and its watershed will not be affected by the proposed project. Therefore, this resource area is dismissed from further analysis.

Land Use

The site of the proposed project would be located at the existing CAER facility, adjacent or proximate to the existing main building, within the 125-acre Research Park. The laboratory facility will occupy a small footprint (approximately 2700 square feet) of new construction on land which is already designated and actively used for university research facilities. No changes in on-site land use would result from implementing the Proposed Action, and no changes in the vicinity land use or land use designations would occur. Therefore, this topic is dismissed from further analysis.

Traffic and Transportation

The proposed site is located on Research Park Drive, accessible from Kentucky Route 1973 which runs east-west just north of the site. In addition to the CAER, the Research Park currently houses the Asphalt Research Center, the Kentucky Community and Technical College System, the Council of State Governments, and the Kentucky Geological Survey Well Sample and Core Library. Under the Proposed Action, some additional deliveries to the CAER would be expected. Additionally, researchers from Purdue University and Southern Illinois University would pick up research non-commercial quantities of refined products from CAER. Any additional traffic from deliveries and product pick-ups are expected to be minimal, perhaps one or two additional trips per day, compared to the normal traffic to/from the various entities located on the Research Park, and no impacts to traffic or transportation are anticipated to result from the Proposed Action. Therefore, this topic is dismissed from further analysis,

Community Noise

In 1972, the United States Congress passed the Noise Control Act (42 USC 4901 *et seq*). In its statement of intent in passing the Act, Congress noted that "*inadequately controlled noise presents a growing danger to the health and welfare of the Nation's population, particularly in urban areas*". Congress also noted that "*the major sources of noise include transportation vehicles and equipment, machinery, appliances, and other products in commerce*". While recognizing that the primary responsibility for regulating and controlling noise rested with state and local governments, Congress declared as national policy "*to promote an environment for all Americans free from noise that jeopardizes their health or welfare*". Environmental noise is explicitly defined in Section 4902 of the Noise Control Act to mean "*the intensity, duration, and the character of sounds from all sources*". The term environmental noise is used somewhat synonymously with the term "community noise". The latter term, while not defined statutorily in the Noise Control Act, generally refers to noise to which a particular population may be exposed in the community outside of the work place.

Stated simply, noise may be generally defined as unwanted sound. Under the Proposed Action, both construction and operation activities would produce noise. Construction activities producing noise would include excavation and grading, pouring of footers and slab, installation of structural elements, and assembly of pre-fabricated metal sheeting. These activities would be consistent with normal light construction activities, and would be conducted during daylight hours. No unusual noise associated with construction is anticipated. Operational activities producing noise would include transportation for delivery and product pick-up, which are similar to existing site activities and which would occur at ground level where propagation offsite would not be expected to occur.

Pollution control equipment is anticipated to include an elevated flare, which could be a source of noise. The CAER currently has a flare from a previous project. There have been no noise concerns associated with the existing flare. The existing flare would be decommissioned and removed and a new flare installed before operations would commence. Noise from an elevated source, such as a flare, would propagate (spread) spherically and would become less intense as distance from the flare increases. The closest residence to the proposed site is located in Spindletop Estates approximately 2,000 feet to the WNW. Expected attenuation (reduction) of noise by geometric divergence, also known as spreading losses, at this distance would exceed 55 decibels.

Because the Proposed Action includes the design of the Mini FT Refinery, the specifications for the new flare are not known. However, it is anticipated that the new flare would be similar in size and height to the existing flare, and shrouding, if indicated, would be installed as a Best Management Practice (BMP). No additional impacts due to noise from operations are anticipated. Therefore, this topic is dismissed from further analysis.

Environmental Justice
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, require all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Low-income populations make up a higher percentage in the Commonwealth as a whole (16.3%) than in the United States (12.7%). However, low-income populations are lower in Fayette County (14.2%) than Kentucky as a whole. Minority populations are present in residential areas near the site of the Proposed Action, but these populations are not disproportionately high. Moreover, the Proposed Action is not anticipated to impact these areas due to the distance of the site from the nearest residential areas. Therefore, this topic is dismissed from further analysis.

Recreation
The research park in which the CAER is located is open to the public. Unused lands are made available to the community, which currently uses the land for youth soccer leagues. The Proposed Action would be located behind the CAER building (relative to the areas used for community recreation) and would not be anticipated to diminish current or future uses of these open lands. Because no change in current recreational opportunities is anticipated, this topic is dismissed from further analysis.

1.3.2 *Compliance with Laws and Executive Orders*

This project complies with NEPA, CEQ regulations (40 CFR 1500-1508), and DOE regulations for compliance with NEPA (10 CFR 1021). This EA also addresses all applicable laws and regulations, including but not limited to the following:

- National Historic Preservation Act (NHPA),
- Archeological Resources Protection Act (ARPA),
- The Noise Control Act of 1972, as amended,
- Executive Order 12898 (addressing Environmental Justice),
- Clean Air Act (CAA),
- Clean Water Act (CWA),
- Executive Order 11990 (Protection of Wetlands),
- Executive Order 11988 (Floodplain Management),
- Endangered Species Act (ESA),
- Pollution Prevention Act (PPA),
- Resource Conservation and Recovery Act (RCRA),
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- LFUCG Code of Ordinances 16A Hazardous Materials

Implementation of the Proposed Action will help DOE meet the goals and requirements set forth in the National Energy Policy as enacted by the Energy Policy Act, as amended.

2.0 PROPOSED ACTION AND ALTERNATIVE ACTIONS

2.1 Alternative 1: Proposed Action – Implementation of Early Lead Mini Fischer-Tropsch Refinery at the CAER

The Proposed Action is for DOE to provide funding for the design and construction of the Early Lead Mini Fischer-Tropsch Refinery to be housed in a dedicated new facility at the CAER north of Lexington in Fayette County, KY. This action is consistent with DOE's 2006 Strategic Plan goal of increasing America's energy options and reducing the nation's vulnerability to disruption in its energy supply (U.S. DOE, 2006). The Proposed Action also directly supports the objectives of the Energy Policy Act of 2005 which authorizes the Secretary of Energy to carry out a program to evaluate the commercial and technical viability of advanced technologies for the production of Fischer-Tropsch transportation fuels and other transportation fuels from domestic coal (42 USC 15801 Section 417).

The Mini FT Refinery, the major process components of which are depicted in Figure 2.1, would produce research quantities of Fisher-Tropsch liquids and finished fuels for subsequent testing at other universities. It would also provide open-access facilities and information in the public domain that would aid the wider scientific and industrial community in testing and evaluating the commercial viability of Fischer-Tropsch technology. These facilities would provide a means for independently verifying vendor claims as well as validating fuel performance and quality. A primary objective of the research conducted on fuels produced by the Mini FT Refinery would be to evaluate environmental considerations – particularly how to manage and reduce carbon dioxide emissions from coal-to-liquid facilities and from the use of such fuels.

Under the Proposed Action, DOE would provide $1,370,065 in Federal funding to the Coal Fuel Alliance, a consortium of the Southern Illinois Coal Research Center, the UK CAER, and the Energy Center at Purdue University. The Mini FT Refinery is expected to be operational within two to three years at a total cost of approximately $12 MM. The incremental funding provided under DOE's proposed action considered in this EA would allow the CAER under the CFA to select technologies and technology providers of process equipment to be used in the Mini FT Refinery and completing the Front End Engineering and Design Study. In addition, the incremental funding provided by DOE would allow CAER to prepare the A&E plans and specifications of the refinery building and construct the refinery building itself and the associated plant utilities and infrastructure.

Syngas for the Mini FT Refinery would be produced on-site by reforming approximately 10,000 standard cubic feet (scf) per day of natural gas using a skid-mounted reformer located within the new facility. Reforming natural gas would require running a natural gas line approximately 450 feet from an existing 6-inch natural gas header located on the southern edge of the property to the new facility.

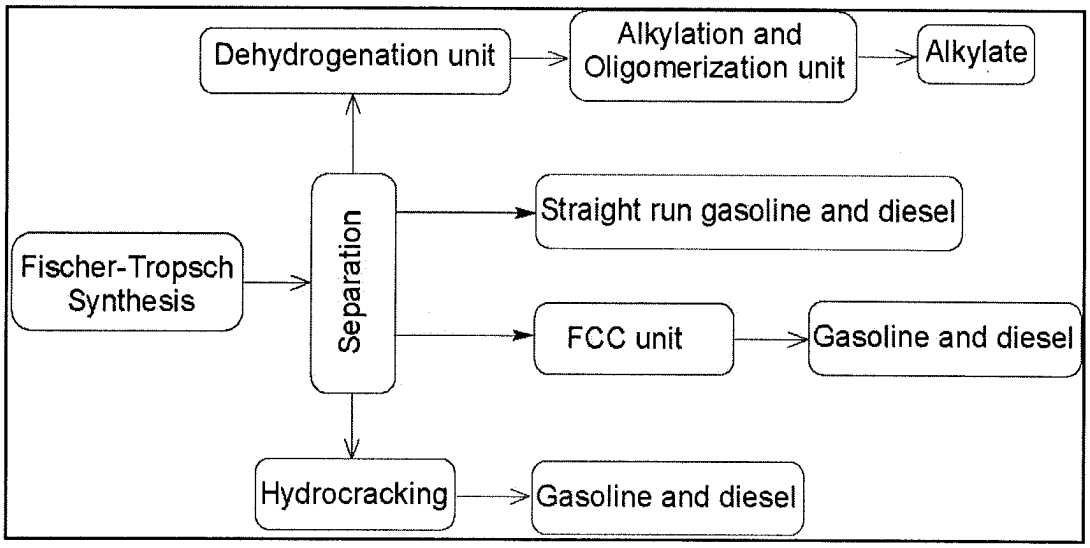


Figure 2.1 Simplified Block Diagram Showing the Major Process Components of the Mini FT Refinery

Fischer-Tropsch synthesis would occur in a Slurry Bubble Column Reactor (SBCR) containing iron or cobalt catalysts. The SBCR would be small measuring approximately five inches in diameter with a height of 3.8 meters. The expected yield of Fischer-Tropsch liquids is approximately 5g of hydrocarbon/g of catalyst/hr. The SBCR would be designed to operate continuously producing approximately 1 barrel of hydrocarbons per day. Because of the research nature of the intended operations, CAER anticipates operating the SBCR about four times per year for a duration of about one month each time. CAER researcher anticipate that the SBCR would run continuously during the process runs for periods not expected to exceed 20 consecutive days. The remaining time during a one-month test would be used for start-up, shutdown, etc. and would include changing out the catalyst in the SBCR. Other processes would operate in a batch mode.

2.2 Alternative 2: No Action Alternative

Under the No Action Alternative, the DOE would not provide funding for the design and construction of the Early Lead Mini Fischer-Tropsch Refinery at the CAER. If DOE funding is not provided, the possible outcomes would be that the CFA secures funding from non-federal sources and proceeds with the project either as currently planned or with some reduction in scope. The most likely scenario, and the only scenario considered reasonable for the purposes of this analysis, is that the CFA would not proceed with the project and the Mini FT Refinery would not be constructed at the CAER. Project cancellation would mean that the dedicated research facility would not be available to provide the desired research results that would accelerate the development of Fischer-Tropsch fuels for transportation and the deployment of infrastructure to make these fuels for use most likely resulting in the continued use of fuels derived for petroleum as the primary transportation fuel used in the United States.

3.0 AFFECTED ENVIRONMENT

3.1 Geology and Soils

3.1.1 *Geology*

The project area in the northern part of Fayette County lies within the Inner Blue Grass Physiographic Region of Kentucky. The Inner Blue Grass Region is characterized by gently rolling hills and rich, fertile soils. Local reliefs are generally less than 100 feet, with elevations at the project site between 860 and 870 feet above sea level. The hills developed by weathering of relatively thick-bedded limestone that characterize the Ordovician strata of central Kentucky that has been pushed up along the crest of the Cincinnati Arch. Weathering of the limestones also commonly produces features like sink holes, sinking streams, springs, and caves common to karst topography. The Geologic Map of Kentucky (Kentucky Geological Survey, 2008) shows most of Fayette County, including the Lexington area and the area of the proposed project (Figure 3.1) as lying within an area ranked as "intense" for karst potential.

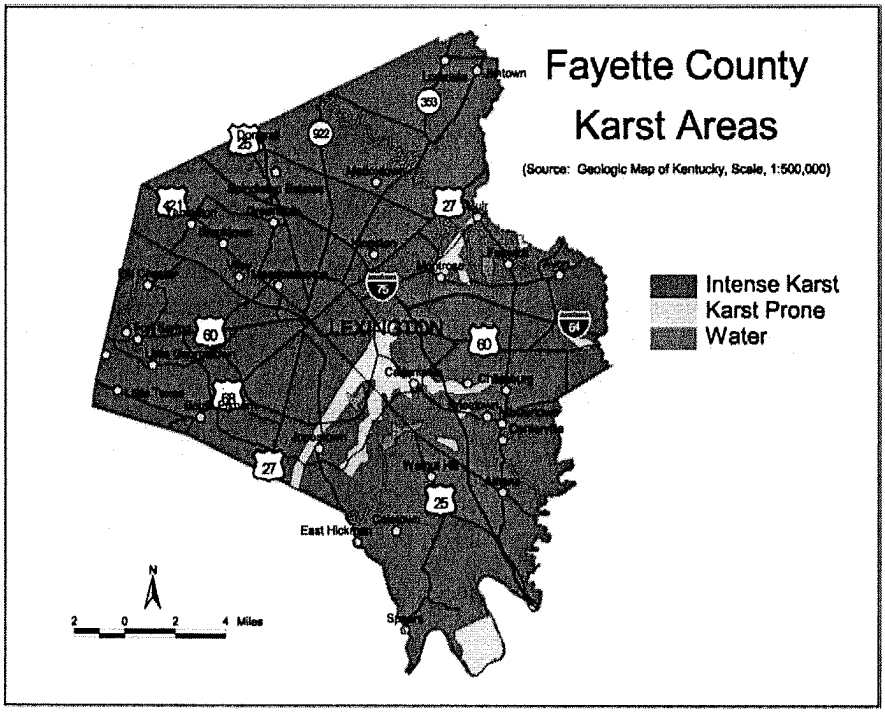


Figure 3.1 Geologic Map of Fayette County Showing Predominance of Karst Geology

The bedrock in the center of the state is composed of limestones and shales from the Ordovician Period (510 to 440 million years ago). Much of the Ordovician rock layers lie buried beneath the surface. The oldest rocks exposed on the surface in Fayette County are from the High Bridge Group, and were deposited in shallow seas 490 million years ago during the Ordovician Period. In the Late Ordovician the seas became relatively

shallow, as indicated by the amounts of mud (shale) in the sediments. Over the last million years, unconsolidated Quaternary sediments have been deposited along the larger streams and rivers.

Ordovician limestones are commonly quarried for use in construction. Some of the limestones also produce natural spring water that is bottled and sold for drinking water. The city of Lexington was founded at McConnell Springs, which flows from Ordovician limestones (Kentucky Geological Survey, 2008a; Carey and Stickney, 2005).

3.1.2 *Soils*

The fertile soils in the area result from the phosphate minerals (e.g., apatite) contained in the Ordovician limestones (Kentucky Geological Survey, 2008b). The project site is located in an area dominated by the Maury series of soils, typical to the Inner Blue Grass Region of Kentucky. The Maury series consists of deep, well drained, moderately permeable soils formed in silty material and weathered limestone, or sometimes old alluvium. These soils occur on uplands with slopes ranging from 0 to 20 percent. These soils are typically found on broad ridgetops and the gentle side slopes of karst plains. These soils formed in 1 to 2 feet of silty loess-like material overlying limestone residuum or old alluvium and are typically high in phosphate content. The underlying limestone is often cavernous and some areas have karst topography. Near the type location the average annual air temperature is 54 degrees F and the average annual precipitation is 45 inches. (Natural Resource Conservation Service, 2008)

Specific soil types at the project site are shown in Figure 3.2, and include the following:

- MIA is a Maury silt loam found in the immediate area of the existing main buildings and at the proposed project location. MIA typically occurs on slopes of 0-2 percent (ridges).
- MIB is a Maury silt loam found on the surrounding areas of the project site and typically immediately adjacent to MIA on slopes of 2-6 percent (ridges).
- MIC is a Maury silt loam found on the more outlying areas of the project site and typically adjacent to MIB on slopes from 6-12 percent (ridges and side slopes)
- Hu is a Huntington silt loam found in the lower flood-prone areas associated with Cane Run. Hu is a well-drained silt loam to silty clay loam typical to floodplains in the area.
- MnC is a McAfee silt loam found on the more outlying area of the project site on slopes from 6-12 percent (ridges and shoulders). MnC is a well-drained soil typically associated with the Maury series.

3.2 Water Resources

3.2.1 *Surface Water*

Three surface water bodies are located within one-half mile of the project site. These include Cane Run and two un-named ponds.

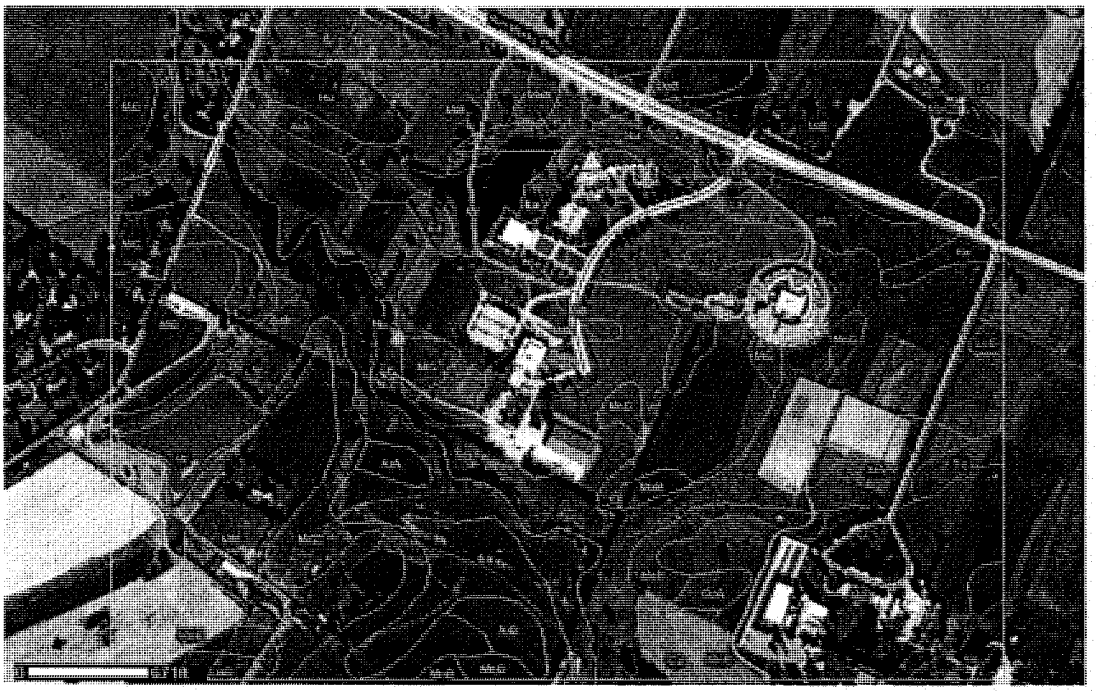


Figure 3.2 Soil Map of the UK CAER Site

Cane Run

Cane Run is located approximately 590 feet from the southwest corner of the existing main building, and 190 feet south from the temporary fuel product storage pad. At this location, Cane Run is an intermittent stream that flows northwest to where it meets North Elkhorn Creek, a major tributary to the Kentucky River, approximately 12 linear miles away. During a site visit in early November of 2008, Cane Run below the site of the proposed project was dry (Figure 3.3), although debris strandlines provide evidence of higher flows in recent months.

Flows at a USGS gaging station on Berea Road (approximately 0.5 miles downstream from the site) near Donerail, KY illustrate the intermittent nature of the flows in Cane Run near the project site (Figure 3.4).

Cane Run is included on the 2008 State of Kentucky 303(d) list of impaired water bodies (first listed in 1998). Cane Run [KY488799_03 in Fayette Co. (7.8 miles); and KY488799_01 and KY488799_02 in Scott Co. (9.6 miles)] is part of the Lower Kentucky Watershed. Section KY488799_03 (river miles 9.6 to 17.4) is listed as impaired since it does not support the beneficial uses for warm water aquatic habitat and primary contact recreation water. Listed pollutants include: fecal coliforms, nutrient/eutrophication biological indicators; and organic enrichment (sewage) biological indicators. The state lists causes as livestock (grazing or feeding operations) and unspecified urban stormwater. The Kentucky Water Resources Research Institute (KWRRI) is currently developing total maximum daily loads (TMDLs) for Cane Run in

Figure 3.3 Cane Run at Zero Flow During Site Visit in Early November 2008

cooperation with the Kentucky Department for Environmental Protection, Division of Water. The two small un-named ponds are man-made ponds. The closest pond is located approximately 600 feet to the north. The second pond is located approximately 1380 feet west and across the Cane Run floodplain. These ponds are estimated to be less than five acres in size and are discussed further in the wetlands section below.

3.2.2 *Groundwater*

The quality of groundwater in the Bluegrass Region varies considerably depending on location and is determined by its geologic source. In Fayette County, groundwater is hard to very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet. Salt and hydrogen sulfide are the two most common natural constituents that make water in the Bluegrass Region objectionable for domestic use.

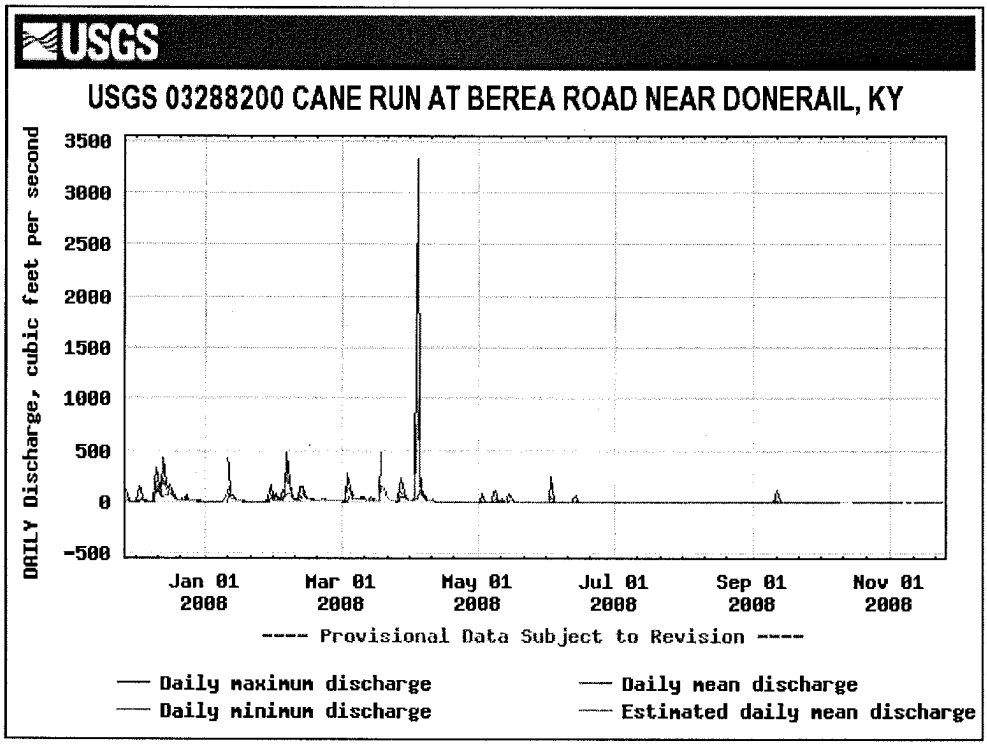


Figure 3.4 Summary of 2008 daily discharge data for Cane Run at Berea Road USGS gaging station

SOURCE: USGS, 2008

In Fayette County, water can be obtained from consolidated sedimentary rocks of Ordovician age and from unconsolidated sediments of Quaternary age. Geologic formations in Fayette County that are currently usable for groundwater include:

- Limestones
  - Upper part of Lexington Limestone (Ol) (Strodes Creek, Millersburg, Tanglewood Limestone, Devils Hollow, Stamping Grounds, Sulfur Well, Brannon Members)
  - Lower part of Lexington Limestone (Ol) (Grier, Logana, Curdsville Members)
  - High Bridge Group (OhB) (Tyrone Limestone, Oregon Formation, Camp Nelson Limestone)
- Dolomites
  - Knox Group (Okx)
- Interbedded clay shales, siltstones, and sandstones
  - Garrard Siltstone (Okc)
- Interbedded limestones and shales
  - Clays Ferry Formation (Okc)

(Carey, Daniel I. and John F. Stickney, *op. cit.*)

The area around the UK CAER is underlain by the groundwater basin for Royal Spring, a source of drinking water for the Georgetown Municipal Water and Sewer Service (GMWSS). Royal Spring (KGS No. 2442) provides an estimated 10 cubic feet per second to the GMWSS (PWSID No. 1050157), and is the primary source of the facility's 4 million gallon per day capacity. Royal Spring is located in Scott County, which is adjacent to Fayette County and approximately 5.5 miles northwest of UK CAER.

The 1986 amendments to the Safe Drinking Water Act (SDWA) established requirements for states to develop a Wellhead Protection Program (WHPP) to protect drinking water wells and drinking water recharge areas through the delineation of Wellhead Protection Areas (WHPA), the surface and subsurface areas surrounding a water well, well field, or recharge area supplying public drinking water systems. WPHAs are further delineated based on geology and time of travel of water within the aquifer. A Zone 1 area (WHPA-1) is the WHPA closest to the wellhead where surface contamination could have the greatest potential to reach the aquifer. The U.S. EPA approved Kentucky's Wellhead Protection Program (WHPP) in 1993. Kentucky's WHPP is coordinated by the Groundwater section of the Kentucky Department of Environmental Protection Division of Water.

The largest portion (~ 80%) of the recharge area for Royal Spring is located in northern Fayette County, which is underlain by karst geology (see discussion in Section 3.2.1). Karst aquifers are characterized by a network of conduits and voids formed by chemical dissolution of the limestone matrix. These dissolution features can include sinkholes and swallets that permit surface water to flow directly into the aquifer. Because of these dissolution features, karst aquifers are more vulnerable to contamination from surface sources. A Phase 1 Wellhead Protection Plan for Royal Spring was developed in 1996. The final Wellhead Protection Plan for Royal Spring was prepared in 2003 (Royal Spring Water Supply Protection Committee, 2003). The primary recharge area for Royal Spring, protected as WHPA-1, is an area approximately 0.75 miles wide centered on and following Cane Run. The total WHPA for Royal Spring includes the secondary and transitional recharge areas (*ibid.*) for a total recharge area of approximately 25 square miles. The groundwater catchment basin for Royal Spring is shown in Figure 3.5.

3.2.3 *Wetlands and Floodplains*

Wetlands

Two wetlands have been identified within one half mile of the proposed project site (Figure 3.6). The closest wetland is a small man-made pond estimated to be less than five acres in size and located approximately 600 feet to the north. This wetland is classified as PUBHx for [P] Palustrine, [UB] Unconsolidated Bottom, [H] Permanently Flooded, [x] Excavated. The second wetland is another man-made pond, also estimated to be less than five acres in size, located approximately 1380 feet west and across the

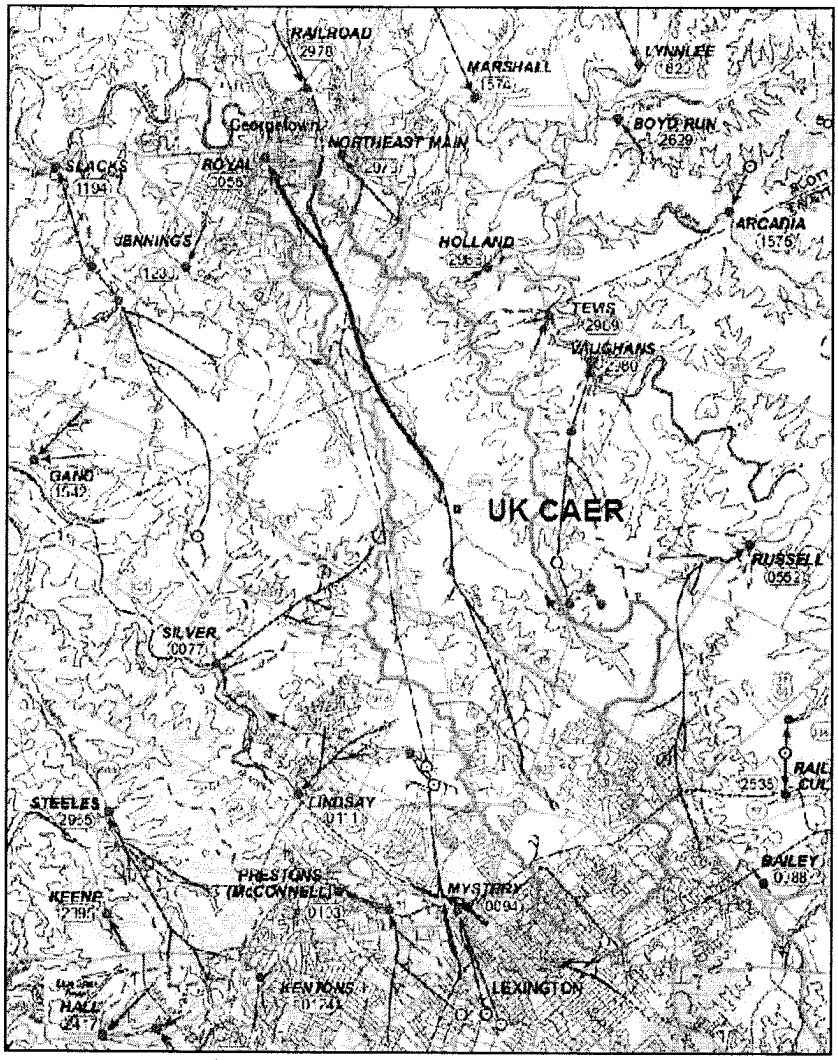


Figure 3.5 Groundwater catchment basin for Royal Spring (highlighted in orange)

The red arrow depicts the inferred perennial groundwater flow path; surface expression of sinks and swallets are depicted in blue (Information extracted from Currens and Paylor, 2003. Highlights and location of UK CAER added for emphasis)

Cane Run floodplain. This wetland is classified as PAB4Hh for [P] Palustrine, [AB] Aquatic Bed, [4] Floating Vascular, [H] Permanently Flooded, [h] Diked/Impounded.

Floodplains

As discussed above, the project site is adjacent to Cane Run, an intermittent stream. The 100-year floodplain associated with this section of Cane Run roughly follows the 860 foot contour line at the southern end of the proposed site. The Base Flood Elevation for this section of Cane Run is 861 feet above sea level approximately 500 feet upstream of the site, and 859 feet above sea level approximately 500 feet downstream from the site.

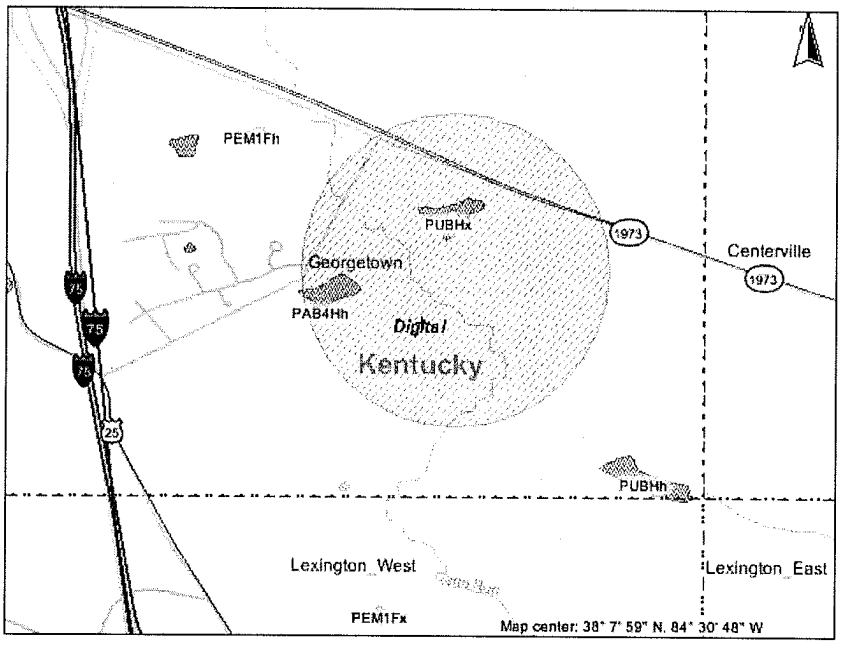


Figure 3.6 Wetlands located within 0.5 miles (0.8 km) of the Proposed Site

A FIRMette developed from the online version of Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 2100670020D is shown in Figure 3.7 (FEMA, 2008). The proposed project building site sits above the 100-year floodplain with the temporary product storage location is adjacent to but outside of the floodplain.

3.3 Air Quality

Air quality is described by the concentration of various pollutants in the atmosphere. The significance of a pollutant concentration is determined by comparing the concentration in the atmosphere to applicable national and/or state ambient air quality standards for that pollutant. These standards represent the maximum allowable atmospheric concentration that would still be protective of public welfare.

The federal Clean Air Act (42 U.S.C. 7401-7671), as amended by Congress in 1970, 1977, and 1990, directs the U.S. EPA to establish National Ambient Air Quality Standards (NAAQS) defining maximum allowable ambient (outdoor) concentrations for criteria pollutants. *Criteria* refers to the fact that EPA must establish standards (criteria) for these pollutants based on the requirements to protect human health and welfare. Each criteria pollutant has a Primary Standard, which is designed to protect human health, and a Secondary Standard, which is designed to protect public welfare. Public welfare includes damage to plants and animals, impairment to visibility, and damage to property.

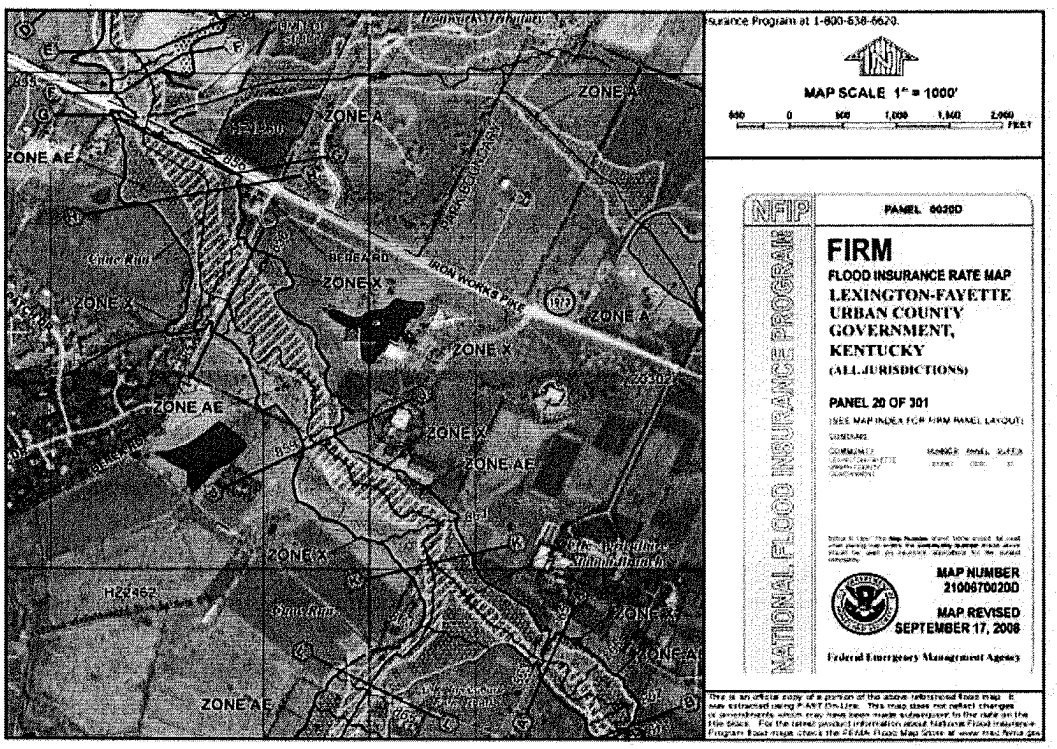


Figure 3.7 **Portion of Flood Insurance Rate Map for area of the proposed project site Existing UK CAER main building is visible near center (circled in red for emphasis)**

This section is a description of ambient air quality in Fayette County with respect to attainment of these national standards and the identification of air quality regulations applicable to the CAER for the contraction and operation of the Mini FT Refinery.

3.3.1 *National Ambient Air Quality Standards and Attainment Status*

USEPA Region 4 and the Kentucky Department of Environmental Protection Division for Air Quality regulate air quality in the Commonwealth of Kentucky. The Clean Air Act (CAA) (42 USC 7401 – 7671q), as amended, gives USEPA the responsibility to establish the primary and secondary NAAQS (40 CFR 50) that set acceptable concentration levels for seven criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x) represented by nitrogen dioxide (NO_2), ozone (O_3), fine particulate matter (PM_{10}), very fine particulate matter ($PM_{2.5}$), and sulfur dioxide (SO_2). USEPA has established standards for short-term (1-, 8-, and 24-hours) periods for criteria pollutants contributing to acute health effects and standards for long-term (annual averages) periods for pollutants contributing to chronic health effects. Each state has authority to adopt more stringent requirements than the NAAQS established by USEPA

under the federal program. The Commonwealth of Kentucky accepts the federal standards for criteria pollutants with minor additions. Applicable air standards for criteria pollutants are shown in Table 3.1.

Table 3.1 National Ambient Air Quality Standards (NAAQS) [1]

Pollutant	MAXIMUM CONCENTRATION	
	Primary Standard	Secondary Standard
Carbon Monoxide		
8-hour average	9 ppm	None[++]
1-hour average	35 ppm	None[++]
Lead		
Calendar quarter average	1.5 µg/m^3	Same as primary
Nitrogen Dioxide		
Annual average	0.053 ppm[++]	Same as primary
Ozone		
8-hour average	0.075 ppm (2008 std) 0.08 ppm[++]	Same as primary
Particulate Matter (measured as $PM_{2.5}$)		
24-hour average	35 µg/m^3	Same as primary
Annual average	15 µg/m^3	
Particulate Matter (measured as PM_{10})		
24-hour average	150 µg/m^3 [++]	[++]
Sulfur Oxides		
24-hour average	0.14 ppm	---
Annual average	0.03 ppm	---
3-hour average	---	0.5 ppm

[1] SOURCE: 40 CFR part 50 Available @ http://www/epa/gov/air/criteria.html

[++] More restrictive Kentucky Ambient Air Quality Standards (Appendix A to 401 KAR 53-010)

- Secondary Standard for CO is same as primary standard
- Primary Standard for NO_2 is 0.05 ppm
- Maximum hourly average for ozone is 0.12 ppm
- Annual Arithmetic Mean for PM_{10} not to exceed 50 µg/m^3; Secondary Standard same as primary
- Commonwealth of Kentucky also has AAQS for gaseous and total fluorides and for odor.

Carbon monoxide (CO)
CO is a colorless, odorless, poisonous gas produced by the incomplete combustion of fuels containing carbon. The main source of CO in ambient air is the exhaust of motor vehicles, including those on highways and those operating off-road such as construction equipment.

The main health effect of CO is its tendency to reduce the oxygen carrying capacity of blood. CO enters the human body by inhalation through the lungs where it enters the bloodstream. It binds chemically to hemoglobin in the red blood cells. The bond between CO and hemoglobin is 200 times stronger than the bond between hemoglobin and oxygen. Therefore, when CO is present, the amount of oxygen absorbed in the blood is reduced. Effects, which depend on the concentration of the CO in the air and the length of exposure to excessive CO concentrations, can include fatigue, headaches, impaired vision and reflexes. At high concentration, effects can include unconsciousness and death.

Lead (Pb)
Lead is a naturally occurring, bluish-gray metal that is found in small quantities in the earth's crust. Pure, elemental lead is insoluble in water, but lead compounds vary in solubility from insoluble to water soluble. Lead is a very toxic element. Long-term exposure to lead in humans can result in effects on the blood, the central nervous system, blood pressure, kidneys, and vitamin D metabolism. Children are particularly sensitive to the chronic effects of lead with reported effects that include slowed cognitive development and reduced growth.

The largest source of lead in the atmosphere has been from the combustion of leaded gasoline. Tetraethyl lead was used in gasoline to increase the octane rating until the use of lead additives in gasoline was phased out and ultimately eliminated by the USEPA in 1996.

Nitrogen dioxide (NO_2)
NO_2 is a reddish brown gas that is produced during high temperature combustion during which atmospheric nitrogen and oxygen are oxides to form a family of highly reactive gases called nitrogen oxides, which include NO_2 and nitrogen oxide (NO), which may, in the presence of sunlight, undergo a photochemical reaction to form NO_2. Major combustion sources of NO_2 include motor vehicles, power plants, incinerators, boilers, and chemical processes.

The primary health effect of NO_2 is as a lung irritant, which can lead to an increase in respiratory rate, a decrease in pulmonary function, and increased susceptibility to respiratory infections. Secondary effects of NO_2 include the formation of acid precipitation, which can damage plant and aquatic life as well as cause deterioration of stone or masonry exposed to the elements. Nitrogen oxides, including NO_2, can also react with ammonia to form ammonium nitrate, a component of very fine particulate

matter ($PM_{2.5}$). Nitrates are a key component in regional haze that can contribute to poor visibility and impaired vistas.

Ozone (O_3)

Ozone, a colorless gas, is not emitted directly into the atmosphere from sources. Rather, O_3 forms in the atmosphere from a photochemical reaction between volatile organic compounds (VOCs) and nitrogen oxides in the presence on sunlight. Sources of VOCs include exhaust from motor vehicles, evaporation of gasoline from fuel storage and transfer facilities, and from processes the use of solvents such as dry cleaning and painting.

In the upper atmosphere, naturally occurring O_3 shields the earth's surface from harmful ultraviolet rays. At ground level, prolonged exposure to O_3, a reactive gas, can damage lung tissue as well as ecosystems.

Fine Particulate Matter ($PM_{2.5}$)

Fine particulate matter is a mixture of solid particles and liquid droplets that have an aerodynamic diameter or 2.5 microns of smaller. Sources of $PM_{2.5}$ include power plants, wood burning, industrial processes, and fuel combustion. $PM_{2.5}$ is also formed in the atmosphere when gases, such as nitrogen oxides, are transformed through chemical reactions.

Due to its small diameter, $PM_{2.5}$ can penetrate into the deepest parts of the lung causing chronic respiratory symptoms in sensitive populations and contributing to premature deaths in the elderly. $PM_{2.5}$ also contributes to regional haze and to acid precipitation.

Particulate Matter (PM_{10})

PM_{10} is a mixture of solid particles and liquid droplets that have an aerodynamic diameter of 10 microns or smaller. Sources of PM_{10} include open burning, construction activities agricultural practices and smokestacks. PM_{10} can aggravate respiratory and cardiovascular disease. The elderly, children, and people with chronic lung disease are most sensitive to particulate matter.

Sulfur dioxide (SO_2)

SO_2 is a colorless gas produced by the combustion of sulfur containing fuels, ore smelting, petroleum processing, and in the manufacture of sulfuric acid. In concentrations exceeding 0.5 ppm, SO_2 has a pungent odor. Nationwide, coal-fired power plants are the largest sources of SO_2. Other sources include petroleum refineries and paper mills.

The primary health effect of SO_2 is the aggravation of pre-existing respiratory, cardiovascular, and pulmonary disease. Asthmatics, children, and the elderly are particularly susceptible to the effects of SO_2 pollution. SO_2 also reacts with atmospheric moisture to form sulfuric acid, a component of acid precipitation. Acid precipitation makes soil and water more acidic and can harm plant and animal life and damage

structural surfaces. SO_2 can also react in the atmosphere to form sulfates, a major component of $PM_{2.5}$, which contributes to regional haze, poor visibility, and impaired vistas.

3.3.2 *Class I and II Areas*

Visibility, or how far one can see on a clear day, is a major air quality issue in cities and in rural and wilderness areas. Regional haze, which results from the presence of certain fine particulates in the lower atmosphere, reduces visibility and impairs the distant scenic views, or vistas, of many recreational resources such as national parks and wilderness areas. Without the effects of pollution, the natural visual range in the eastern states would be 90 miles, while in the West it would be approximately 140 miles. However, soil dust, sulfates from sulfur dioxide, carbon monoxide, nitrates from nitrogen oxide emissions, soot, ozone haze, and other contaminants, as well as natural events like volcanic explosions, have reduced visual range to 15 to 25 miles in the East and 35 to 90 miles in the West (EPA 2008).

In 1980 the US EPA adopted visibility protection provisions under the Clean Air Act (CAA) to help protect certain areas, designated as Class I Areas nationwide. Class I Areas, as defined under the CAA, are national parks and wilderness areas over 6,000 acres and national memorial parks over 5,000 acres as well as international parks in existence as of August 7, 1977. The Commonwealth of Kentucky has only one designated Class I Area, Mammoth Cave National Park located 108.2 miles (174.1 km) to the southwest of the site of the proposed action.

Class II Area are areas protected under the CAA, but subject to less stringent protections from the effects of air pollution than Class I Areas.

3.3.3 *Local Ambient Air Quality*

The Kentucky Division for Air Quality (KDAQ) has operated an ambient air quality monitoring network in the Commonwealth since July 1967 (KDAQ, 2008). Since that time, the network of monitors has been expanded in accordance with U.S. EPA regulations to consist currently of 177 monitors at 44 stations in 34 counties. The monitoring stations are operated by KDAQ, the Louisville Metro Air pollution Control District, and the National Park Service.

Carbon monoxide (CO)

There were no exceedances for carbon monoxide (CO) in 2007. The last exceedance of a standard occurred in January 1998 in Ashland when an 8-hr average of 11.7 ppm was recorded. Statewide and regional CO levels have declined substantially since 1980 due to improved emissions controls on motor vehicles (KDAQ, 2007). Because of the substantial drop in monitored levels, statewide CO monitoring was discontinued in 2003 except for Jefferson County. All Kentucky counties are currently in attainment for CO.

Lead (Pb)
With the phase out of lead in fuels, ambient levels have fallen near to zero statewide. KDAQ currently does not operate lead monitors but each year emission inventories are reviewed to look at industrial source emissions to determine if a network is needed. All Kentucky counties are currently in attainment for Pb.

Nitrogen dioxide (NO_2)
Nitrogen dioxide is monitored within Fayette County on the grounds of the Fayette County Health Department located at 650 Newtown Pike Lexington (KDAQ, 2008). The monitoring site is located approximately 4.7 miles SSE from the proposed project site. The Newtown Pike monitoring location, which was last inspected on October 31, 2007 and found to be is good condition, is representative of urban-scale population exposures for nitrogen dioxide.

During 2007, the last year for which reporting is currently available, there were no exceedances of the nitrogen dioxide (NO_2) standard within the Commonwealth, nor have there been any exceedances since the inception of sampling in 1970. Statewide averages for NO_2 have been trending downward since 1980 (KDAQ, 2008). For fiscal year 2007, the annual arithmetic mean for NO_2 was 0.0109 ppm (KDAQ, 2007), or approximately 20% of the NAAQS of 0.053 ppm. The air quality at the site of the proposed project is considered in attainment for NO_2.

Ozone (O_3)
Ozone is monitored from March 1st through October 31st each year when meteorological conditions are most conducive to the formation of ozone. The NAAQS for ozone is 0.08 ppm. The standard is attained when the fourth highest daily 8-hr average for each of the three most recent years is less than 0.085 ppm. On May 27, 2008, the U.S. EPA revised the 8-hr standards to 0.75 ppm. Ozone is monitored within Fayette County at the Fayette County Health Department location on 650 Newtown Pike. Ozone was previously monitored at a location on Iron Works Pike. This second location was discontinued in 2007. The 8-hr 4th Maximum 3 Year average for ozone in Fayette County is 0.74 ppm and 0.064, measured at the Newtown Pike and Iron Works Pike locations respectively (KDAQ, 2007). Both results meet the revised 8-hr NAAQS. The air quality at the site of the proposed project is considered in attainment for ozone.

Fine Particulate Matter ($PM_{2.5}$)
Generally, statewide $PM_{2.5}$ levels have declined from 2000 to 2007. There were 14 exceedances of the 24-hr $PM_{2.5}$ standard and seven exceedances of the annual standard in 2007. A total of eight samplers exceeded the three year 24-hr standard for 2005-2007; seven samplers exceeded the three year (2005-2007) annual standard. The samplers were located in Bell, Bullitt, Hardin, Jefferson, Kenton, McCracken, and Warren counties. Fayette County is currently in attainment for the $PM_{2.5}$ standards.

In 2006, USEPA strengthened the NAAQS for the 24-hr $PM_{2.5}$ standard reducing it from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. KDAQ monitors $PM_{2.5}$ in Fayette County at two locations: the

Fayette County Health Department location at 650 Newtown Pike and UK Lexington at 533 South Limestone. Fayette County is currently in attainment for $PM_{2.5}$. However, measurements taken in 2007 were 35.1 $\mu g/m^3$, which exceeds the standard. Attainment is based on a 3-year average of the 98th percentile concentration of $PM_{2.5}$, so the monitored exceedance in 2007 does not currently affect Fayette County's attainment status.

Particulate Matter (PM_{10})
There were no exceedances of the annual PM_{10} standard in 2007. The last exceedance for PM_{10} within the Commonwealth occurred on January 7, 2000 at a monitoring site in Louisville. All Kentucky counties are currently in attainment for the PM_{10} standard, and statewide and regional PM_{10} levels have been on a declining trend over the past 20 years.

Sulfur dioxide (SO_2)
There were no exceedances of any of the SO_2 standards in 2007. The last exceedance for SO_2 within the Commonwealth occurred in November 1981 at a monitoring site in Louisville. All Kentucky counties are currently in attainment for the SO_2 standard, and statewide and regional SO_2 levels have been on a declining trend since 1980.

KDAQ monitors SO_2 in Fayette County at the Fayette County Health Department location at 650 Newtown Pike. For fiscal year 2007, the annual arithmetic mean for SO_2 was 0.0041 ppm or approximately 14% of the NAAQS of 0.03 ppm. The 24-hr concentration for SO_2 for 2007 was 0.017 ppm, or approximately 12% of the NAAQS 24-hr standard of 0.14 ppm. The 3-hr concentration for SO_2 for 2007 was 0.044 ppm, or approximately 9% of the NAAQS 3-hr standard of 0.50 ppm. The air quality at the site of the proposed project is in attainment for SO_2.

3.3.4 *Regional Emissions*

Federal regulations designate Air Quality Control Regions (AQCRs) that do not meet applicable air quality standards as being in nonattainment. Areas in nonattainment are categorized as marginal, moderate, serious, severe, or extreme based on the degree of nonattainment and the seriousness of health risk posed to the public by not being in attainment for a particular pollutant. AQCRs that are at or below applicable air quality standards are designated as "attainment" areas. AQCRs previously designated as a nonattainment area for a particular criteria pollutant that have subsequently been redesignated as being in attainment are categorized as "maintenance areas" for a probationary period through implementation of maintenance plans. The UK CAER and the proposed Mini FT Refinery lie entirely within the Bluegrass Intrastate Air Quality Control Region, which includes Anderson, Bourbon, Boyle, Clark, Estill, Fayette, Franklin, Garrard, Harrison, Jessamine, Lincoln, Madison, Mercer, Nicholas, Powell, Scott, Woodford counties.

3.3.5 *Greenhouse Gases and Global Warming*

Greenhouse gases (GHG) are components in the earth's atmosphere that contribute to the

greenhouse effect and to global warming. These are widespread effects affecting entire ecosystems and climates and populations worldwide. Some GHG occur naturally in the atmosphere while others result from human activities such as burning fossil fuels. According to the Kyoto Protocol and the California Climate Action Registry, 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, 2008).

3.4 Biological Resources

3.4.1 *Vegetation*

Ecoregion

The USDA Forest Service developed a system (Bailey, 1995) to classify and describe large ecosystems based on climate and vegetation to aid in ecosystem management and conservation. The proposed project site is located in the Broadleaved Forests, Continental Province (222) within the Hot Continental Division (220) of the Humid Temperate Domain (200). This province is dominated by broadleaf deciduous forest, but the smaller amounts of precipitation favor the drought-resistant oak-hickory association, with both species in abundance. Widespread dominants are white oak (*Quercus alba*), red oak (*Quercus rubra*), black oak (*Quercus velutina*), bitternut hickory (*Carya cordiformis*), and shagbark hickory (*Carya ovata*). The understory is usually well developed, often with flowering dogwood (*Cornus florida*). Other understory species include sassafras (*Sassafras albidum*) and hophornbeam (*Ostrya virginiana*). The shrub layer is distinct, with some evergreens. Many wildflower species occur. Wetter sites typically feature an abundance of American elm *(Ulmus americana)*, tuliptree (*Liriodendron tulipifera*), and sweetgum (*Liquidambar styraciflua*) (USFS, 2008).

The proposed project site is small and will occupy land between or adjacent to existing buildings that were previously disturbed by facility construction and operation activities. Current vegetation in the immediate area includes manicured grasses (lawn) and a few planted tree species.

3.4.2 *Wildlife*

Oak-hickory forests generally produce a large supply of acorns and hickory nuts, providing an abundant food source for the ubiquitous Eastern gray squirrel (*Sciurus carolinensis*) and also used by the white-tailed deer (*Odocoileus virginianus*). Additionally, fox squirrels (*Sciurus niger*) are often found, as are eastern chipmunks (*Tamias striatus*). Roving flocks of blue jays (*Cyanocitta cristata*) also feed on forest nuts. In summer, scarlet and/or summer tanagers (*Piranga olivacea and P. rubra*), rose-breasted grosbeaks (*Pheucticus ludovicianus*) and ovenbirds (*Seiurus aurocapillus*) are common. The wild turkey (*Meleagris gallopavo*) is also commonly found in this area. The cerulean warbler (*Dendroica cerulea*) is common in the beech-maple forest, and occurs elsewhere as well (USFS, 2008).

This area of central Kentucky is very rich in species diversity, as is typical of eastern temperate forests. The Kentucky Department of Fish and Wildlife (KDFW) lists wildlife observations for the state and the results for Fayette County can be summarized as follows: 55 fish species, 15 amphibian species, 126 bird species, 3 bivalve species, 24 mammal species, and 7 reptile species (KDFW, 2008).

3.4.3 *Threatened and Endangered Species*

The US Fish and Wildlife Service (USFWS) identified four federally-listed endangered species for Fayette County. The Indiana bat (*Myotis sodalis*), which is also state-listed as endangered, is known to occur in the county. The gray bat (*Myotis grisescens*), which is not state-listed, has the potential to occur in the county based on its historic range. The running buffalo clover (*Trifolium stoloniferum*), which is state-listed as threatened, is also known to occur in the county. The American burying beetle (*Nicrophorus americanus*) is considered to be extirpated on the Federal and state list. The globe bladderpod (*Lesquerella globosa*) is a federal candidate species and is state-listed as endangered. Many additional vascular plant, insect, amphibian, bird, mammal species are state-listed as threatened, endangered, or species of special concern. (USFWS, 2008 and Kentucky State Nature Preserves Commission, 2008).

3.5 Waste and Hazardous Materials Management

The CAER currently uses hazardous materials such as gases, solvents, chemicals and reagents common to most research universities. Current activities at the CAER generate hazardous waste, mainly lab chemicals, waste solvents, and other flammables. The CAER is a registered hazardous waste generator (ID No. KYD086193141) and ships approximately 2,500 pounds of waste annually through a licensed waste handler (Environmental Enterprises, Inc, Cincinnati, OH) under contract with the University of Kentucky Environmental, Health and Safety Office. Waste is properly manifested and disposed of at a licensed treatment, storage, and disposal facility. Hazardous wastes awaiting shipment and disposal are accumulated on-site in a covered and secured area (Figure 3.8).

Hazardous waste operations at the CAER are subject to both internal audits by the UK EH&S Office as well as state and Federal regulators. An inspection by the Kentucky Division of Waste Management in spring of 2006 noted some inspection and recordkeeping violations, and a Notice of Violation was issued by the state on April 25, 2006. A follow-up inspection by the state on May 3, 2006 found that all violations had been corrected, and no new violations were observed.

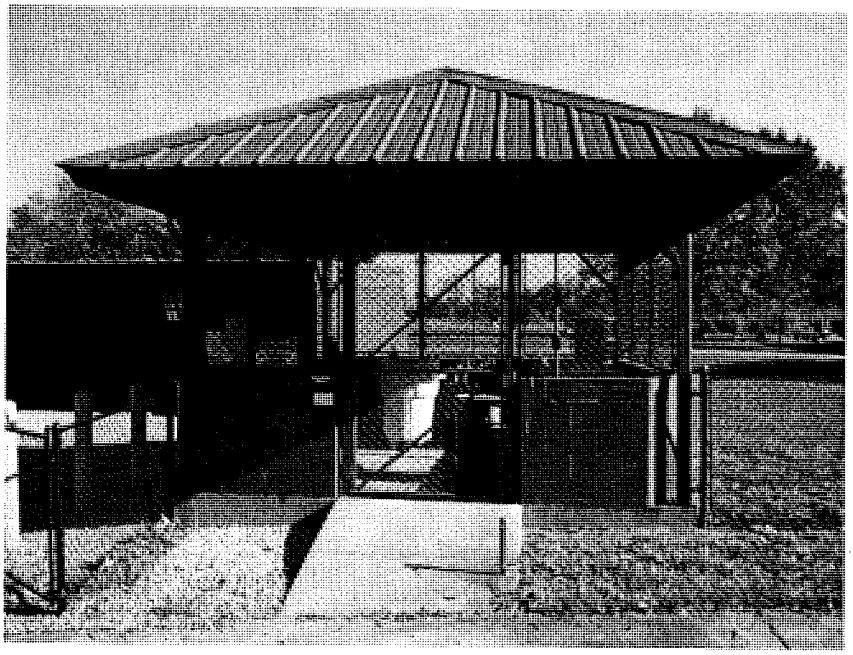


Figure 3.8 On-site Hazardous Waste Storage Area

3.6 Human Health and Safety

Primary concerns to human health and safety for current activities at the CAER include exposure lab personnel to chemicals in use at the lab and exposure to high temperatures and pressures. Activities at the CAER are conducted under the auspices of the UK Environmental, Health, and Safety (EHS) Office. UK has a fully compliance EHS program that include a chemical hygiene program to protect lab personnel from accidental exposure to lab chemicals and other hazardous substances, such as industrial gases, normally present or used in conjunction with normal lab operations.

The CAER also has a specific Safety and Security program that addresses lab safety. The program, which is available on-line at http://www.caer.uky.edy/misc/safety/safetips.htm, includes a Chemical Hygiene Plan specific to CAER activities as well as a Respiratory Protection Plan and Hot Work Program Manual. The responsibility for ensure that training requirements for personnel working at the CAER is assigned to lab supervisors. All programs at the CAER are subject to audit by the UK EHS Office.

3.7 Cultural Resources

Cultural and historical resources are protected by a variety of laws and regulations, including the National Historic Preservation Act (NHPA) 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 to

document, evaluate, and mitigate impacts to cultural resources. The Section 106 process applies to any federal undertaking that has the potential to affect cultural resources. The Kentucky Heritage Council serves as the State Historic Preservation Office in Kentucky (Kentucky Heritage Council, 2008). The executive director of the Kentucky Heritage Council is also the State Historic Preservation Officer.

Historic Sites

No historical sites or federal or state historic places occur within the area of the Proposed Action. The closest National Register of Historic Places (NHRP) property, Hurricane Hall, is approximately 7000 feet west of the project site, and across Interstate Highway 75 (NPS, 2008; and Historic Places Database, 2008). One unique property that may be eligible for future listing on the NRHP is Spindletop Hall. This property may be eligible based on its age (>50 years) and the fact that it was associated with the lives of persons significant in our past. Spindletop Hall was built by Mrs. Pansy Yount, heir to her deceased husband, Miles Frank Yount, who earned his fortune developing the Spindletop Oil Field near Beaumont, Texas. This historic structure lies on 60 acres approximately 2000 feet southeast of the proposed project. Spindletop Hall is currently owned by the University of Kentucky and houses the UK Faculty, Staff and Alumni Club.

Archeological Sites

Kentucky's archeological resources are extensive. These resources include five pre-historic contexts: Paleoindian (ca 9,500 to 8,000 BCE), Archaic (ca 8,000 to 1,000 BCE), Woodland (ca 1,000 BCE to 1,000 CE), and the Mississippian and Fort Ancient periods (ca, 900-1,000 to 1,700-1,750 CE). With the exception of the Mississippian and Fort Ancient periods, these archeological contexts are statewide. To deal with the geographic extent of these archeological contexts, Kentucky is divided into seven management areas. The Proposed Action is located in the Bluegrass Management Area, which encompasses 29 counties in the north central part of the state.

The Bluegrass Management Area lies in the Bluegrass physiographic region of the Interior Low Plateaus physiographic province. The Bluegrass physiographic region is further subdivided into the Inner Bluegrass, Eden Hills, Outer Bluegrass, and Knobs subdivisions. The Proposed Action lies in the Inner Bluegrass physiographic subdivision, which is characterized by a karstic, gently rolling plain underlain by limestone of Ordovician age. The *major streams in this subdivision are deeply entrenched with extremely narrow floodplains that are poorly suited for human habitation* (Kentucky Heritage Council, 2008). Because of these narrow floodplains, groups of the Woodland and Fort Ancient periods tended to settle along rolling ridgetops that provided productive soils and springs (Lewis, 1996).

The Bluegrass Management Area, which is further subdivided into the Central, Northern, and Eastern Bluegrass Sections, has a large number of archeological sites (nearly 18% of all known sites within the state). The majority of these sites are found within the Central Bluegrass Section, which includes Fayette County. Most of the over 4,200 sites within the Bluegrass Management Area are described as *Open Habitation w/out mound(s)*

(Kentucky Heritage Council, *op cit*). This site type includes both small (generally less than 1 ha) and large (generally greater than 1 ha) habitations that *vary considerably in size, intensity of occupation, and range of activities performed.* The larger habitations, which can include base camps and villages, often contain *substantial middens* (refuse deposits), and both small and large habitations may contain evidence of *structural remains* and other features. *Human interments* may also be present (Kentucky Heritage Council, *op cit*).

Of the more than 4,200 known archeological sites located in the Bluegrass Management Area, 2,470 are located in the Central Bluegrass Section. Of these sites, over 70% (1,789) are Open Habitation w/out mound(s). According to a staff archeologist with the Kentucky Heritage Council (personal communication, February 17, 2009 from Lori Stahlgren), archeological sites are known to exist near the existing buildings on the site of the proposed action.

3.8 Socioeconomics

Socioeconomics describes the social and economic demographics of the human population of a region. The region of influence for the proposed action is Fayette County. The total population of Fayette County as of 2006 was 275,915 (Workforce Kentucky). The unemployment rate for Fayette County as of November 2008 was 4.8%.

According to the U.S. Census Bureau, the 2006 median value of owner-occupied housing is $110,800 for the Lexington-Fayette region. This compares quite favorably to the median value of $86,700 for the Commonwealth as a whole. Home ownership rates for the region are less than for the state as a whole, which may reflect, in part, the transient nature of university communities. Education levels are higher in the Lexington-Fayette region than for the Commonwealth as a whole with 35.6% having a bachelor's degree of higher. For the Commonwealth as whole, the figure is 17.1% (USCB, 2008).

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND ALTERNATIVES

As noted in the description of the Proposed Action in Section 2.1, funding provided by DOE would allow the CFA to construct a new 2700 square foot research facility at the UK CAER and complete the design and specify equipment for the new Mini FT Refinery that would be housed in that new research facility. The immediate environmental consequences of the Proposed Action would be limited to those consequences associated with the construction of the new building. These consequences are described herein. In addition, this section identifies and analyzes, to the extent practicable, the reasonably foreseeable consequences of the operation of the Mini FT Refinery that could eventually be built at the UK CAER. Recognizing that some consequences may not be fully quantifiable until the Front End Engineering and Design Study is completed, environmental consequences from the operation of the Mini FT Refinery discussed in this section are conservative and may overstate the actual consequences resulting from the future operations.

4.1 Geology and Soils

4.1.1 *Alternative 1: Proposed Action*

Geology

The project site is located in an area characterized by gently rolling hills and rich, fertile soils. These features are underlain by deep thick-bedded limestone formations. The Proposed Action would occur on land which was previously developed for the existing UK CAER. During construction of a new 2700 sq. ft. building, only limited land disturbance would occur to an area adjacent to and between existing buildings. No impacts to the geological features are anticipated.

Soils

The project site is located in an area dominated by deep well-drained soils of the Maury series, typical to the Inner Blue Grass Region of Kentucky. The Proposed Action would occur on land which was previously developed for the existing UK CAER. During construction of a new 2700 sq. ft. building, only limited soil disturbance would occur to an area adjacent to and between existing buildings. No impacts to native soils are anticipated.

4.1.2 *Alternative 2: No Action*

The No Action Alternative will not result in any impacts to geology or soils as no construction activities or project operations would be expected.

4.2 Water Quality

4.2.1 *Alternative 1: Proposed Action*

Surface Water

The Proposed Action would occur on land which was previously developed for the existing UK CAER. During construction of a new 2700 sq. ft. building, only limited land disturbance would occur to an area adjacent to and between existing buildings. No impacts to surface water are anticipated. Best Management Practices typical to small construction products would be utilized to control surface runoff during construction.

No discharge to Cane Run or other surface waters from project operations would be expected. Product from Mini FT Refinery would be stored on site outside in a secured area. The storage area, shown in figure 4.1, is paved and diked. Product from the Mini FT Refinery would be temporarily stored on site in closed 55-gallon drums awaiting pick-up by researchers from Purdue and Southern Illinois Universities. The drums of product would be stored on spill pallets or in the diked area to prevent accidental releases of product from reaching adjacent surface waters. Oily wastewater from the process would be drummed and stored on site awaiting disposal.

Figure 4.1 Storage Area to be Use for Fischer-Tropsch Product Awaiting Pickup

Water Use and Discharge

Existing facilities at the CAER use water supplied by a private utility, Kentucky American Water Company (KAWC), for process and drinking water, and discharges wastewater to municipal wastewater treatment facilities. The Proposed Action would tie

into these existing lines. Other than small incremental increases in water use and wastewater produced, no additional impacts on water quality are anticipated.

Groundwater

The Proposed Action would not use groundwater resources to supply process water or drinking water. Process and drinking water would be supplied by existing water lines serviced by KAWC. The main water sources for the Lexington area are the Kentucky River and Jacobson Reservoir (KAWC, 2007).

The UK CAER is located with the Zone 1 Wellhead Protection Area (WHPA-1) for Royal Spring, the main source of water for the Georgetown Municipal Water and Sewer Service (GMWSS), a public water system, located approximately 5.5 miles to the northwest. GMWSS serves a customer base of over 11,000 in the communities of Georgetown, Sadieville, Stamping Ground, Midway, and Lexington (GMWSS, 2009). The Royal Spring Aquifer is one of the largest springs in the state serving as a public water supply (Royal Spring Water Supply Protection Committee, 2003). GMWSS obtains 85% of its total water demand from Royal Spring (*ibid*).

The new 2700 square foot facility would be constructed next to the exiting UK CAER and would also be located in the WHPA-1 for Royal Spring. The Fischer-Tropsch fuel produced at the new facility would be temporarily stored on-site at the UK CAER until it could be transported to other universities. UK CAER anticipates generating an average of 8 drums of product and 10 drums of oily wastewater per campaign. The product would be stored in 55-gallon drums on spill pallets in a dedicated and secured storage area on the UK CAER property. The wastewater would be stored on site in the hazardous waste accumulation area, which would be enlarged to accommodate the drum storage and better protect the area storage area from the influx of rainwater.

Groundwater Protection Plans are required under 401 KAR 5:037 for storing, handling or transporting bulk quantities of finished or intermediate substances or products for commercial or industrial operations. As defined in 401 KAR 5:037 Section 1.(5), bulk quantities include undivided quantities equal to or greater than 55 U.S. gallons transported or held in an individual container. The proposed Mini FT Refinery would produce bulk quantities of finished product that would be stored and transported. Prior to start of operations UK CAER would prepare a Groundwater Protection Plan to identify and document practices designed to minimize the potential for releasing product during storage and transport. Construction of the facility could also present some risk of groundwater pollution (for example, from on-site refueling of construction vehicles). If indicated, Groundwater Protection Plans would be required of contractors during building construction.

Based on the storage facilities and best practices described above, no impact to local or regional groundwater supplies either from additional demand or from contamination during construction or operation of the Mini FT Refinery would be expected.

Wetlands and Floodplains
Two wetlands were identified within a half mile of the proposed project site. The two wetlands are small man-made ponds (< 5 acres each) located between 600 and 1380 feet away from the proposed building site. However, the Proposed Action would occur on land which was previously developed for the existing UK CAER. During construction of a new 2700 sq. ft. building, only limited land disturbance would occur to an area adjacent to and between existing buildings. Furthermore, any runoff from the proposed site should not flow toward the wetlands. No impacts to the two identified wetlands are anticipated.

The proposed project building site sits above the 100-year floodplain for Cane Run with the temporary product storage location immediately adjacent to the floodplain. No construction activities within the 100-year floodplain would occur, and no impacts to the Cane Run floodplain are anticipated.

4.2.2 *Alternative 2: No Action*

The No Action Alternative will not result in any impacts to water quality, including the surface water, water use and discharge, groundwater, and wetland components discussed above. The No Action Alternative would result in no new construction activities or project operations at the project site.

4.3 Air Quality

4.3.1 *Alternative 1: Proposed Action*

Estimated Emissions and General Conformity
Construction of the 2700 sq. ft. research building that would house the Mini FT Refinery would result in some minor emissions to ambient air. Site preparation and excavation would produce some particulates in the form of dust from disturbed soils. Off-road equipment used in the site work and construction would most likely be powered by internal combustion engines fuels with gasoline and diesel fuel resulting in some increase in emissions of criteria pollutants other than lead. Given the small footprint of the building to be constructed, these emissions would be expected to be minor and localized to the immediate project area.

Operation of the Mini FT Refinery, which is the eventual expected outcome of the Proposed Action, would result in emissions of 1500 pounds of carbon monoxide per year in addition to some light hydrocarbons. Both the CO and the hydrocarbons would be incinerated in a flare so that no discernible contributions to concentrations of criteria pollutants in ambient air would be expected.

Regulatory Review
A major source under Federal and Commonwealth regulations is one that has the potential to emit greater than 100 tons per year (tpy) of any criteria pollutant. Guidance from Kentucky Division for Air Quality's website (KDAQ, 2009) advises that no permit

or registration is required if a source's Potential to Emit (PTE) is:

- < 2 tpy of a Hazardous Air Pollutant (HAP)
- < 5 tpy of combined HAPs
- <10 tpy of a Regulated Air Pollutant; and
- The source is not subject to a New Source Performance Standards (NSPS) or New Emission Standard for Hazardous Air Pollutants (NESHAP)

One objective of the Proposed Action is to advance the design of the Mini FT Refinery. During the final design, which would include specification of equipment and vendors, UK CAER will develop a better understanding of expected emissions. However, based on the preliminary design, the proposed project would not have the potential to emit any criteria pollutant above threshold quantities that would qualify the Mini FT Refinery as a major source under Kentucky air regulations. Further, with the greatest expected emission being 1500 pounds per year (0.75 tpy) of CO, most of which would be incinerated prior to release, the Mini FT Refinery is expected to fall below thresholds requiring either permit or registration.

The site previously had an air permit (Permit No. O-84-144) issued July 2, 1984 covering emissions from a Fluidized Bed Coal-Fired Indirect Heat Exchanger and associated structures. The permit, issued to the Kentucky Energy Research Center (File No. 102-1160-0059), imposed limitations on emissions of particulate matter (0.56 lbs/MMBTU of heat input), sulfur dioxide (5.0 lbs/MMBTU of heat input), and opacity (<20%). The emission source for which the permit was required has not operated for many years, and the permit was deleted in December of 2002. CAER would apply for a new permit for the proposed facility if required by the final design.

Greenhouse Gasses and Global Warming

The proposed project is not expected to emit discernible quantities of GHGs. Trace amounts of light volatile organic compounds from the process would be passed through a flare which would incinerate those compounds. Approximately one tpy of CO_2 could be emitted by the flare operating within design specifications. The contribution of this CO_2 would not have a discernible effect on global warming.

The Proposed Action is expected to answer performance and environmental questions related to transportation fuels produced through the Fischer-Tropsch process. If successful, this research could accelerate the available of technologies and fuels derived from domestic coal, which could either reduce the quantity of petroleum-derived fuels used in transportation or offset some future demand for such petroleum-derived fuels. Assuming that transportation fuels continued to be used in amounts similar to the present, the availability of fuels that have a lower life-cycle carbon footprint would be beneficial in addressing the threat of global warming and climate change.

4.3.2 *Alternative 2: No Action*

The No Action Alternative will not result in any impacts to air quality discussed above. The No Action Alternative would result in no new construction activities or project operations at the proposed site.

4.4 Biological Resources

4.4.1 *Alternative 1: Proposed Action*

Vegetation and Wildlife

The Proposed Action would occur on land which was previously developed for existing UK CAER operations. This land is now mostly covered by mowed grasses (lawn and athletic fields), scattered trees, office and laboratory buildings, sidewalks and parking lots. Only limited land disturbance would occur to an area adjacent to and between existing buildings. No impacts to vegetation and wildlife are anticipated. Some loss of grass (lawn) and possibly a couple previously planted trees may occur, depending on the exact location of the building.

Threatened and Endangered Species

No impacts to state or federally-listed threatened, endangered, or candidate species are anticipated to result from the Proposed Action. Consultation regarding the Proposed Action was initiated with the USFWS on January, 12, 2009 to ensure that the proposed project results in no impacts to listed species. Result of consultation is included in Appendix A.

4.4.2 *Alternative 2: No Action*

The No Action Alternative will result in no impacts to wildlife or vegetation, as no additional construction activities or project operations are expected to occur at this existing research facility. Additionally, the No Action Alternative is not anticipated to result in any impacts to threatened or endangered species found in the vicinity of the project site.

4.5 Waste and Hazardous Materials Management

4.5.1 *Alternative 1: Proposed Action*

Other than approximately 8 barrels of Fischer-Tropsch fuel per project run, no additional hazardous materials are expected under the Proposed Action. Fisher-Tropsch fuel is combustible, and would be a regulated hazardous material under Chapter 16A Hazardous Materials of the Lexington-Fayette Urban County Government (LFUCG) Code of Ordinances. Under Chapter 16A, UK CAER would be required to register with the urban county government and within 30 days of commencement of operations, provide to the urban county government an inventory of the type, quantity and location of hazardous materials on the site. UK CAER would also be required to report any discharge of petroleum product of ten gallons of more or any discharge that results in a visible sheen

or film on the surface water. UK CAER would also be required to prepare, maintain, and implement a Spill Prevention and Control Plan as specified in Section 16A-11 of the LFUCG Code of Ordinances.

Some increase in waste generated (used catalysts possibly contaminated with light hydrocarbons, additional lab chemicals, and process wastewater) could be expected once the Mini FT Refinery becomes operational. Other than the process water (slightly over one barrel per day during project runs) which could contain minor amounts of light hydrocarbons, waste volume would not be expected to increase noticeably due to the Proposed Action.

4.5.2 *Alternative 2: No Action*

The No Action Alternative will result in no impacts to current waste and hazardous materials management as no additional construction activities or project operations related to the Mini FT Refinery are expected to occur at this existing research facility.

4.6 Human Health and Safety

4.6.1 *Alternative 1: Proposed Action*

The UK CAER has a formal and well documented safety program. Operations are subject to audit by both the University EHS Office and state and Federal regulators. Training requirements for personnel are established, and completion of required training is tracked and subject to audit. The Proposed Action is consistent with the mission of and current research activities conducted at the CAER. No additional hazards or hazardous activities unfamiliar to site personnel or outside of the established EH&S procedures is expected to occur as a result of the Proposed Action.

Syngas for the Fischer-Tropsch process would be produced by reforming approximately 10,000 scf per day of natural gas. Reforming natural gas would entail running a gas line from an existing 6-inch natural gas header on the southern edge of the site to the main CAER building. The natural gas would supply a skid mounted Natural Gas Reformer located in the proposed new facility.

Reforming natural gas, which is predominantly methane (CH_4), produces H_2 and CO for the Fischer-Tropsch process. Producing these feed gases through reforming would allow the CAER to eliminate bulk quantities of H_2 and CO currently used on-site to support other on-going research, including a smaller, lab-scale Fischer-Tropsch reactor. This would eliminate deliveries of bulk gases reducing the potential for transportation accidents involving bulk deliveries.

4.6.2 *Alternative 2: No Action*

The No Action Alternative will result in no impacts to human health and safety as no additional construction activities or project operations related to the Mini FT Refinery are

expected to occur at the existing research facility.

4.7 Cultural Resources

4.7.1 *Alternative 1: Proposed Action*

The proposed project would have no impacts to cultural resources. No historical sites, federal or state historic places, or Native American reservations occur in the proposed project area. Additional construction related to the proposed project would occur immediately adjacent to existing structure, with little to no disturbance of pristine soils.

The proposed action should pose no significant impact to the nearby Spindletop Hall property. The minor facility changes and new activities associated with this proposed project are similar in nature to the ongoing mission and activities of the existing CAER.

DOE initiated consultation (Appendix A) regarding the Proposed Action with the Kentucky Heritage Council on January 12, 2009 to ensure that the proposed project results in no impacts to historic or archeological resources and to fulfill its commitments under Section 106 of the National Historic Preservation Act. Because of the high number of archeological sites within Fayette County and the proximity of known archeological sites to the existing buildings, the Kentucky Heritage Council requested additional information on the site of the proposed Mini FT Refinery. This additional information, which included the area of disturbance of other planned construction unrelated to the Proposed Action, is included in Appendix A-1. The additional site construction unrelated to the Proposed Action is discussed in Section 4.9

Although archeological sites are known to exist in proximity to the proposed project, there are no known or suspected archeological sites within the footprint of the proposed project. This assessment was confirmed by the SHPO in response DOE consultation on the proposed project (Appendix A-1).

4.7.2 *Alternative 2: No Action*

The No Action Alternative will result in no impacts to cultural resources as no additional construction activities or project operations related to the Mini Fischer-Tropsch Refinery are expected to occur at the existing research facility.

4.8 Socioeconomics

4.8.1 *Alternative 1: Proposed Action*

No permanent increases to the workforce are expected from the Proposed Action, which would be expected to neither increase nor decrease the regional labor requirements nor alter the general employment and labor mix (industrial and services, agricultural, educational, and government) in Fayette County.

The Proposed Action would result in some minor construction, a 2700 sq. ft. research

building adjacent and connected to the existing CAER main building. Approximately 9% of the male workforce in Fayette County in employed in the construction industry. The workforce required to complete the construction anticipated under the Proposed Action would not be appreciable. The new 2700 square facility would be small (less than 0.5%) compared to the size (55,000 square feet) of the existing facility, and would not alter the existing academic/research character of the CAER facility.

The total value of the proposed action is $1,370,065, which is approximately .01% ($1/100^{th}$ of 1 percent) of the total annual income base in Fayette County. The proposed action would not appreciably alter the existing economic base of Fayette County.

If successful, deployment of Fischer-Tropsch technology could be advanced by research conducted under the proposed action, which could expedite the commercial availability of this technology and contribute to the development of a sustainable coal synfuels program in Kentucky.

The proposed action would not be expected to alter the socioeconomics of the region. The extent to which successful research would expedite the commercial deployment of Fischer-Tropsch synfuels derived in whole or in part from domestic coal would depend on factors, such as future world energy supply and demand, future oil prices, and international geopolitics, that are either speculative or beyond the scope of this EA.

4.8.2 *Alternative 2: No Action*

The No Action Alternative will result in no impacts to socioeconomics as no additional construction activities or project operations are expected to occur at this existing research facility.

4.9 Cumulative Impacts

Council on Environmental Quality NEPA regulations (40 CFR 1508.7) require an analysis of the cumulative impacts that could result when the incremental impacts of a federal action are added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes these other actions. Cumulative impacts can result from actions that, taken individually, would have only minor impacts, but which, taken collectively, could prove significant. This section of the EA addresses cumulative impacts arising from the Proposed Action in combination with other ongoing and planned actions at the UK CAER. Additionally, the section of the EA addresses reasonably foreseeable impacts of a successful outcome of research conducted under the Proposed Action, which could lead to the development of a commercial-scale CTL industry in the Commonwealth of Kentucky and the greater use of Fischer-Tropsch fuels within the transportation sector.

UK CAER
In addition to the proposed Mini FT Refinery analyzed in this EA, UK CAER anticipates

additional construction not related to the Proposed Action. A new 6400 sq. ft. Mineral Processing Building will be built southwest of the proposed Mini FT Refinery beside an existing structure. In addition, a new 2500 sq. ft. greenhouse for the study of algae-CO_2 will be constructed in an open area south of the proposed Mini FT Refinery and southwest of the existing hazardous waste storage area. Both new buildings will be completed by late spring of 2009. The approximate locations of these new facilities are shown in Figure 4.2.

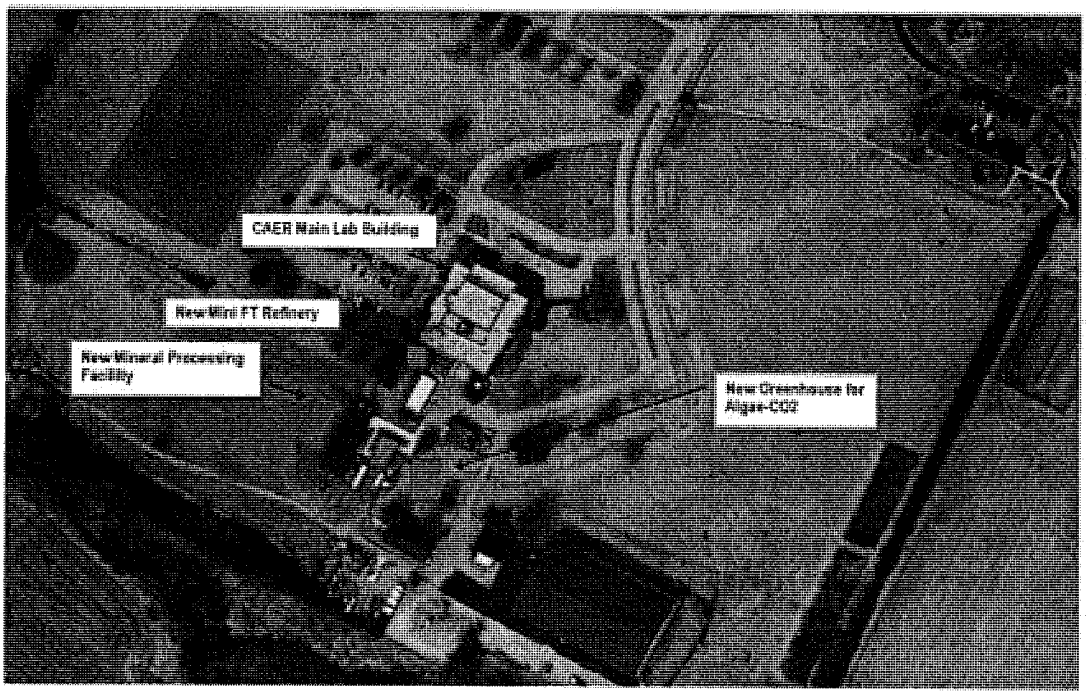


Figure 4.2 Location of Unrelated Planned Construction

The aggregate footprint of the anticipated new construction is 8900 square feet, which is much smaller than the existing CAER facilities and consistent with the general, planned development of the research facilities at the CAER. Further, all planned new construction would continue the research-scale work on the CAER. Taken collectively, no significant cumulative impacts at the UK CAER would be expected to occur.

Development of CTL Industry and Greater Availability of FT Fuels in Transportation
Quantifying the extent to which widespread commercialization and early deployment of Fishcer-Tropsch fuels made from domestic coals would result from the research conducted as a result of the Proposed Action would be speculative. However, a desired outcome of the Proposed Action consistent with the DOE's mission and United States' energy policy is that such commercialization would occur.

In assessing the impacts of a wider use of Fischer-Tropsch fuels from domestic coals,

NETL prepared a study related to Fischer-Tropsch fuel production that considered the emission of greenhouse gases over the life-cycle of the process (NETL, 2001). As part of this investigation, emissions of air pollutants were calculated on a per barrel of produced fuel basis for a number of fuel stocks and process types. Using Illinois No. 6 coal under a scenario designed to maximize distillate production (Table 4 *op cit*), the following emissions could be expected per barrel (bbl) of fuel produced:

Table 4.1 Estimated Emissions for Fischer-Tropsch Production

Estimated Emissions for Fischer-Tropsch Production (grams/barrel of FT Liquid Product)[1]	
Feedstock	Illinois #6 coal
Upgrading	Maximum Distillate
Pollutant	Emissions (gm)
SO_x	197.64
NO_x	89.08
CO	15.66
VOCs	61.40
Particulate Matter	50.40
Greenhouse Gases	Emissions (gm)
CO_2	534311
CH_4	58.55
N_2O	2.16

[2] SOURCE: Life-Cycle Greenhouse Gas Emissions Inventory for Fischer-Tropsch Fuels (NETL, 2001)

Assuming that commercial Fischer-Tropsch production using Illinois No. 6 coal was to occur as a result of the Proposed Action, and that the production from such refineries reached one million barrels annually, the following annual emissions could be expected using the above life-cycle emission factors:

$$\text{Emissions (tpy)} = \frac{\text{emission factor (gm/bbl) x production (bbl/yr)}}{\text{453.6 gm/lb x 2000 lb/ton}}$$

$$\text{Example, Annual emissions of CO (tpy)} = \frac{15.66 \times 1MM}{907200} = 17.26.$$

Using the above factors and calculations, annual emissions to ambient air from producing one million barrels of Fischer-Tropsch fuel from Illinois No. 6 coal would be expected to be:

Criteria Pollutants

Carbon monoxide	17.26 tpy
Sulfur oxides	217.9 tpy
Nitrogen oxides	98.19 tpy
Volatile organic compounds (ozone precursors)	54.45 tpy
Particulate matter	55.56 tpy

Greenhouse Gases	
Carbon Dioxide	589,000 tpy
Methane	64.54 tpy
Nitrous oxide	2.381 tpy

The emission factors in the above table were developed for commercial Fischer-Tropsch operations using current processes and technologies. Results of research which would eventually be conducted through the CFA under the Proposed Action could reduce emissions from Fischer-Tropsch fuels. One advantage of producing transportation fuel from local sources in a reduction in emissions associated with transporting fuel from its point of origin. Currently, the United States imports over 65% of the crude oil used domestically. Much of this crude oil is transported by ocean tanker. A life-cycle approach to emissions incorporates emissions estimates not just from the final combustion of the fuel, but also emissions from extraction of the raw energy source (crude oil or coal) as well as the refining necessary to convert the fuel to a usable fuel for transportation.

Generally, fuels derived from local coal have lower emissions from transportation, but larger emissions from refining processes. For Fischer-Tropsch fuels derived from domestic coals to be "greener" over the full life-cycle than transportation fuels refined from petroleum, emissions from the refining steps need to be reduced. The research anticipated to result from the Proposed Action could help to achieve such reduction.

Growth in the demand for crude oil in the United States is expected to continue. Over the next 20 years, the Energy Information Administration forecasts that U.S. consumption of crude oil will grow by over six million barrels a day. Some of this new demand could be met from Fischer-Tropsch fuels derived from domestic coal. Thus, the emissions from such fuels do not represent additional emissions. Rather, these emissions would offset emissions from conventional transportation fuels not consumed because of the availability of fuel derived from domestic coal.

The continued use of domestic coal as part of the energy portfolio of the United States for the foreseeable future is a national policy decision. An underlying assumption of this policy decision is that domestic coal will continue to be available as a commodity at market prices. Coal resources in the United States are dispersed with proven reserves in 26 states. Methods of extraction also vary depending on local environmental, economic, regulatory, and technical factors. In preparing this EA, DOE assumed that coal will continue to be extracted in the United States in compliance with applicable federal and state regulations. Quantifying environmental impacts associated with mining coal to supply a future commercial CTL industry would be speculative and is beyond the scope of the EA.

4.10 Mitigation Measures

Impacts to the environment from the Proposed Action are expected to be small, and without any mitigations measures, it does not appear that the adverse environmental impacts would be expected. Nevertheless, the following "industry standard", and "best management" practices would further reduce the potential for adverse environmental consequences and would be implemented under the Proposed Action:

- Silt fences would be installed to catch runoff during construction to prevent excess sediment loading to Cane Run and other surface water bodies.

- Areas where Fischer-Tropsch products are temporarily stored while awaiting shipment would be bermed or diked or the product stored on appropriately sized spill pallets. Best practices will be followed when transporting barrels or drums containing Fischer-Tropsch product to the temporary on-site storage area and when loading drums for shipment to a participating university.

- Fugitive emission of dust would be controlled by best management practices. Construction vehicles hauling materials with a potential to become airborne would be covered.

- UK CAER would develop and implement a Groundwater Protection Plan as required under 401 KAR 5:037.

With these measures in place, construction of the new dedicated research building at the UK CAER and design and operation of the Mini FT Refinery would not be expected to adversely impact physical or human environment or present any unusual hazard to human health and safety.

This Page Intentionally Left Blank

5.0 LIST OF PREPARERS

The contractor responsible for preparing this EA:

RDS, LLC
Suite 200
3604 Collins Ferry Road
Morgantown, WV 26505
(304) 599-5941

The following employees of EG&G, a principal partner and subcontractor under RDS, LLC, a site support contractor to DOE NETL, were the principal contributors to this EA:

Randy Moore, B.S. Geology
Mr. Moore has more than 30 years of varied professional and managerial experience supporting government and private concerns. His technical experience includes more than 18 years in environmental, safety, and health support including managing contractor Risk Management operations at a Federal facility and serving in the Emergency Response Organization. He has conducted Accident/Incident Investigations, Human Health Risk Assessments, Noise Surveys, and Environmental Audits at a number of Federal facilities and operations. He has prepared and reviewed NEPA documentation for a number of Federal energy projects stateside and abroad, and has assessed environmental impacts of surface mining operations on groundwater regimes.

Mark Lusk, B. S., M.S. Biology
Mr. Lusk has more than 27 years of varied professional experience supporting government and private concerns. His technical experience includes extensive experience conducting assessing environmental consequences of fossil energy projects as well as legacy management sites within the DOE complex. His most recent NEPA experience includes technical review Environmental Impact Statements and Environmental Assessments as well as participating as a subject matter expert for Section 216 (10 CFR 1021.216) reviews of applications received in response to round 3 of DOE's Clean Coal Power Initiative and the Restructured FutureGen Funding Opportunity Announcements.

This Page Intentionally Left Blank

6.0 REFERENCES

(Anderson, R. B., 1984). The Fischer-Tropsch Synthesis, Academic Press, Orlando, FL, 1984.

(Bailey, Robert G., 1995). Description of the Ecoregions of the United States, 2d ed. (1st ed. 1980), Misc. Publ. 1391 (rev.), USDA Forest Service. 108 p. with separate map at 1:7,500,000, Washington, D.C. Accessed November 2008 at: http://www.fs.fed.us/land/ecosysmgmt/index.html.

(Carey, Daniel I. and John F. Stickney, 2005). Groundwater Resources of Fayette County, Kentucky. Kentucky Geological Survey, County Report 34, Series XII, ISSN 0075-5567. Accessed November 2008 at: http://www.uky.edu/KGS/water/library/gwatlas/Fayette/Foreword.htm.

(Currens, James C. and Paylor, Randall L., 2003). Mapped Karst Groundwater Basins in the Lexington 30 x 60 Minute Quadrangle, Kentucky Geological Survey, September 2003. Accessed July 2009 at: http://kgsweb.uky.edu/olops/pub/kgs/mc35_12.pdf.

(EIA, 2008). *Emissions of Greenhouse Gases Report*, Energy Information Administration Office of Energy Statistics from the U.S. Government, DOE/EIA-0573(2007), December 3, 2008. http://www.eia.doe.gov/oiaf/1605/ggrpt/carbom.html.

(EPA, 2008). U.S. Environmental Protection Agency, Visibility Basic Information, Accessed December 2008 at: http://www.epa.gov/visibility/what.html.

(FEMA, 2008). Federal Emergency Management Agency Map Services Center Flood Insurance Rate Map (FIRM) Number 2100670020D Lexington-Fayette County, effective date 09/17/2008.

(GMWSS, 2009). Georgetown Municipal Water and Sewer Service – About Us. Available at: http://www.gmwss.com/about-us.htm.

(Historic Places Database, 2008) Historic Places in Fayette County Kentucky. Accessed November 2008 at: http://hpdb.org/KY/Fayette.

(KAWC, 2007). Kentucky American Water Company. Central Division Fayette and Surrounding Counties PWS ID:KY0340250, 2007 Annual Water Quality Report, Available at: http://www.amwater.com/files/KY-Central-2007web.pdf.

(KDAQ, 2007). Kentucky Division for Air Quality *Ambient Air Monitoring Report FY 2007.* Accessed December 2008 at: http://www.air.ky.gov/NR/rdonlyres/8DFAF85F-9C91-4CE5-B759-2E267DB1F91E/0/FY2007_AnnualAirMonitoringReport.pdf.

(KDAQ, 2008). Kentucky Annual Ambient Air Monitoring Network Plan for 2008. Accessed December 2008 at: http://www.air.ky.gov/NR/rdonlyres/7492CB66-87F6-4A49-B1F1-DF9799499DCE/0/Network_Surveilance_2008_updated.pdf.

(KDAQ, 2009). Kentucky Division for Air Quality. *Kentucky's Permitting/Regulation Thresholds*. Accessed January 2009 at: http://www.air.ky.gov/NR/rdonlyres/4746FE88-5195-46E3-82ED-30B5445F7206/0/KentuckyPermiting.pdf.

(KDFW, 2008). Kentucky Department of Fish and Wildlife. Species Information for Fayette County. Accessed November 2008 at: http://fw.ky.gov/kfwis/speciesInfo/countyList.asp.

(Kentucky Geological Survey, 2008) Fayette County Karst Areas. Accessed November 2008 at: http://kgsweb.uky.edu/download/gwatlas/gwcounty/fayette/FAYETTEK.pdf

(Kentucky Geological Survey, 2008a) Geology of Kentucky, Strata of Ordovician Age. Accessed November 2008 at: http://www.uky.edu/KGS/geoky/ordovician.htm.

(Kentucky Geological Survey, 2008b) Geology of Kentucky, Bluegrass Region. Accessed November 2008 at: http://www.uky.edu/KGS/geoky/regionbluegrass.htm.

(Kentucky Heritage Council, 2008). Kentucky Heritage Council State Historic Preservation Office Environmental Reviews. Accessed November 2008 at: http://heritage.ky.gov/envreview.

(Kentucky Heritage Council, 2008). The Archeology of Kentucky: An Update Volume One, State Historic Preservation Comprehensive Plan Report No. 3, 604 pp. David Pollack, editor, 2008.

(Kentucky State Nature Preserves Commission, 2008). County Report Endangered, Threatened, and Special concern Plants, Animals, and Natural Communities of Kentucky. Accessed November 2008 at: http://www.naturepreserves.ky.gov/NR/rdonlyres/91E0A271-E42F-45E1-B8D8-741D45366EB2/0/countylist2008.pdf

(Lewis, R. Barry, 1996) Kentucky Archeology, University Press of Kentucky, 289 pp. Lexington, KY, R. Barry Lewis, editor ,1996.

(Natural Resource Conservation Service, 2008). Maurey Series. Accessed November 2008 at: http://www2.ftw.nrcs.usda.gov/osd/dat/M/MAURY.html.

(NETL, 2001). *Life-Cycle Greenhouse Gas Emissions Inventory for Fischer-Tropsch Fuels*, Prepared for the U.S. Department of Energy National Energy Technology Laboratory by Energy and Environmental Solutions, LLC, June 2001.

(NPS, 2008) National Park Service National Register of Historic Places Kentucky – Fayette County. Accessed November 2008 at: http://www.nationalregisterofhistoricplaces.com/KY/Fayette/state.html.

(Royal Spring Water Supply Protection Committee, 2003) Fayette and Scott County Wellhead Protection Plan, June 2003.

(UNFCCC, 2008). *Kyoto Protocol Reference Manual on Accounting of Emissions and Assigned Amount*, United Nations Framework Convention on Climate Change. Climate Change Secretariat (UNFCCC), November, 2008, ISBN 92-9219-055-5. Available at: http://unfccc.int/resource/docs/publications/08_unfccc_kp_ref_manual.pdf.

(USCB, 2008). United States Census Bureau State and County Quick Facts, Lexington-Fayette. Accessed November 2008 at: http://quickfacts.census.gov/qfd/states/21/2146027.html.

(U.S. DOE, 2006). U.S. Department of Energy Strategic Plan. Accessed December 2008 at: http://www.energy.gov/media/2006_DOE_Strategic_Plan.pdf.

(USFS, 2008). United States Forest Service, Eastern Broadleaf Forest (Continental) Province. Accessed November, 2008 at: http://www.fs.fed.us/colormap/ecoreg1_provinces.conf?585,278.

(USFWS, 2008). U.S. Fish and Wildlife Service, Endangered, Threatened, and Candidate Species in Fayette, County, KY. Accessed November 2008 at: http://www.fws.gov/frankfort/docs/FWS%202008%20SPP%20LIST.xls.

(USGS, 2008). United States Geological Survey National Water Information System Surface Water, Cane Run at Berea roads Near Donerail, KY. Accessed November 2008 at: http://waterdata.usgs.gov/ky/nwis/dv/?site_no=03288200&PARAmeter_cd=00060.

(Workforce Kentucky). Workforce Kentucky, Fayette County profile. Accessed January 2009 at: http://www.workforcekentucky.ky.gov/cgi/databrowsing/localAreaProfileQSResults.asp?menuChoice=localAreaPro&state=true&selectedIndex=0&selectedArea=FAYETTE+COUNTY&geogArea=2104000067.

(World Coal Institute, 2006). Coal: Liquid Fuels. October, 2006. Accessed December 2008 at: http://www.worldcoal.org/assets_cm/files/PDF/wci_coal_liquid_fuels.pdf.

This Page Intentionally Left Blank

Appendix A
Consultation Letters

This Page Intentionally Left Blank

RESEARCH AND
DEVELOPMENT SOLUTIONS, LLC
3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353

January 14, 2009

Lee Andrews
Field Supervisor
U.S. Fish & Wildlife Service
Kentucky ES Field Office
330 West Broadway St., Suite 265
Frankfort, Kentucky 40601

Subject: Request for consultation under NEPA on proposed federal project in Fayette County

Dear Mr. Andrews:

The United States Department of Energy (DOE) is considering providing funding for the proposed Early Lead Mini Fischer-Tropsch Refinery (Mini FT Refinery) to be located at the University of Kentucky (UK) Center for Applied Energy Research (CAER). The project would be an addition to existing facilities located at the CAER near Lexington, Kentucky in Fayette County. The facility would be located on land owned by the Commonwealth of Kentucky and would be operated by the CAER.

The proposed project would advance the design and construction of a dedicated research facility at the UK CAER. The facility would carry out research on the Fischer-Tropsch process for converting synthetic gas (syngas), which could be derived from domestic coals, to a liquid fuel. Syngas for the UK CAER project would be produced by blending hydrogen and carbon monoxide. No on-site coal gasification would occur. Research would include experiments on water-gas-shift and Fischer-Tropsch processes as well as on catalyst structure-function properties with the ultimate goal of reducing the costs of the process and helping produce a more environment-friendly liquid fuel. A description of the proposed project and graphics showing its location are enclosed.

As part of DOE's 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 and Wildlife Coordination Act, we would appreciate receiving any information you have on wildlife resources, including threatened and endangered species or critical habitat, in the project area.

Based on the scope of the proposed project, DOE will 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 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.

Thank you for your assistance. Should you require additional information, please call me at (304) 285-4606 email me at Randy.Moore@eg.netl.doe.gov. Please address written correspondence to:

Randy Moore
Research and Development Solutions, LLC
3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353
Phone: 304-599-5941 - Fax: 304-599-8904 - E-mail: RDS@egginc.com

RESEARCH AND
DEVELOPMENT SOLUTIONS, LLC
3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353

January 14, 2009

Mark Dennen
Acting Executive Director and State Historic Preservation Officer
Kentucky Heritage Council/State Historic Preservation Office
300 Washington Street
Frankfort, KY 40601

Subject: Request for consultation under NEPA on proposed federal project in Fayette County

Dear Mr. Dennen:

The United States Department of Energy (DOE) is considering providing funding for the proposed Early Lead Mini Fischer-Tropsch Refinery (Mini FT Refinery) to be located at the University of Kentucky (UK) Center for Applied Energy Research (CAER). The project would be an addition to existing facilities located at the CAER near Lexington, Kentucky in Fayette County. The facility would be located on land owned by the Commonwealth of Kentucky and would be operated by the CAER.

The proposed project would advance the design and construction of a dedicated research facility at the UK CAER. The facility would carry out research on the Fischer-Tropsch process for converting synthetic gas (syngas), which could be derived from domestic coals, to a liquid fuel. Syngas for the UK CAER project would be produced by blending hydrogen and carbon monoxide. No on-site coal gasification would occur. Research would include experiments on water-gas-shift and Fischer-Tropsch processes as well as on catalyst structure-function properties with the ultimate goal of reducing the costs of the process and helping produce a more environment-friendly liquid fuel. A description of the proposed project and graphics showing its location are provided as enclosures.

As part of DOE's 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 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.

Thank you for your assistance. Should you require additional information, please call me at (304) 285-4606 email me at Randy.Moore@eg.netl.doe.gov. Please address written correspondence to:

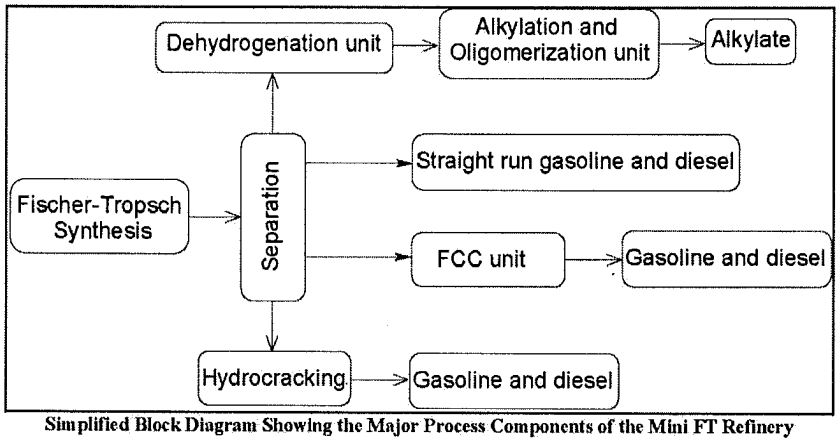
Randy Moore
Research and Development Solutions, LLC
3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353

Phone: 304-599-5941 - Fax: 304-599-8904 - E-mail: RDS@eginc.com

DESIGN AND CONSTRUCTION OF AN EARLY LEAD MINI FISCHER-TROPSCH REFINERY AT THE UK CENTER FOR APPLIED ENERGY RESEARCH
FAYETTE COUNTY KENTUCKY

The Department of Energy (DOE) National Energy Technology Laboratory (NETL) proposes to provide incremental funding to advance the design and eventual construction of an Early Lead Mini Fischer-Tropsch Refinery (Mini FT Refinery) at the University of Kentucky (UK) Center for Applied Energy Research (CAER). The CAER is located in Fayette County, Kentucky, just north of Lexington (see attached map). The Mini FT Refinery would be located in a new, 2700 square foot facility which would be built adjacent to the existing Main Lab building on land owned by the Commonwealth of Kentucky. The new facility would build on work already conducted by the CAER. The facility would be operated by, and is consistent, with the overall research mission of the CAER.

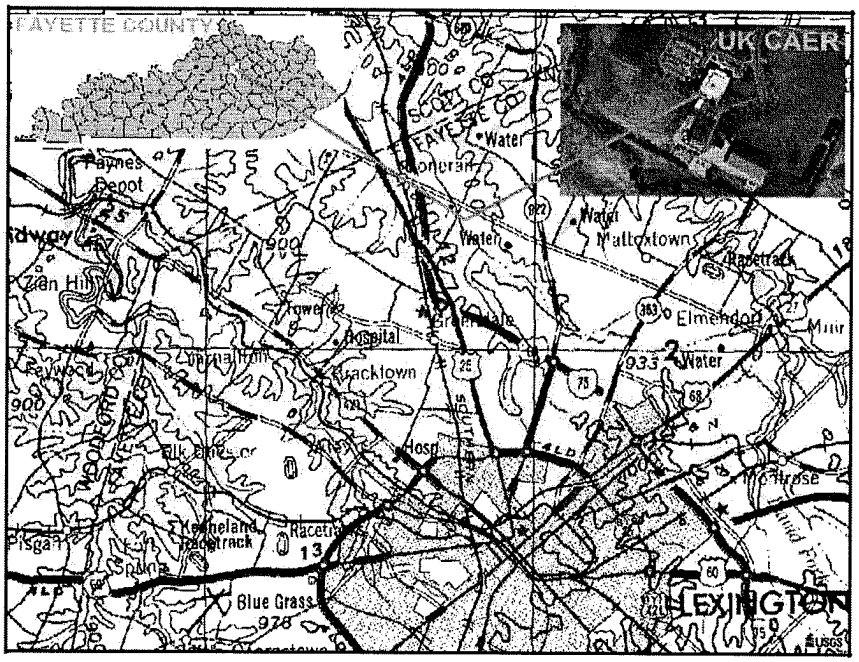
Fischer-Tropsch synthesis uses a catalyzed reaction to convert a mixture of hydrogen and carbon monoxide gases to liquid fuels. The synthetic gas mixture (or syngas) for the Mini FT Refinery would be produced on-site by blending hydrogen (H_2) and carbon monoxide (CO) from on-site supplies of these two gases. The Fischer-Tropch synthesis would occur in a Slurry Bubble Column Reactor (SBCR) containing iron or cobalt catalysts. The SBCR would be small, approximately five inches (12.7 cm) in diameter and approximately twelve and a half feet (3.8 m) high. The expected yield of Fischer-Tropsch liquids is approximately five grams of hydrocarbon per gram of catalyst per hour of operation. The SBCR would be designed to operate continuously producing approximately one barrel of hydrocarbons per day. Because of the research nature of the intended operations, the SBCR would operate about four times per year for a duration of about one month each run. During these runs, the SBCR would run continuously for periods not expected to exceed 20 consecutive days. The remaining time during a one-month test would be used for start-up, shutdown, etc. Other processes, shown in the following diagram, would operate in a batch mode.

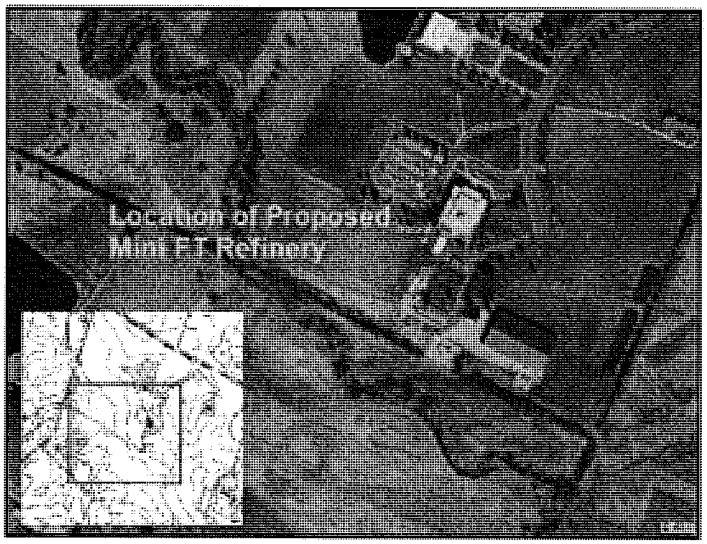


Simplified Block Diagram Showing the Major Process Components of the Mini FT Refinery

The Mini FT Refinery would be a small, research scale facility with the following design capacities:

- Fischer-Tropsch design capacity: 1.0 barrels per day (BPD)
- Fluid Catalytic Cracking design capacity: 0.5 BPD
- Hydro-cracking design capacity:0.2 BPD
- Dehydrogenation design capacity: 0.17 BPD
- Alkylation design capacity: 0.17 BPD


FAYETTE COUNTY
UK CAER
Water
Paynes Depot
Zion Hill
Hospital
Cracklown
Keeneland Racetrack
Blue Grass
Mattoxtown
Elmendorf
LEXINGTON


Location of Proposed
Mini FT Refinery

2009-B-0343

RESEARCH AND
DEVELOPMENT SOLUTIONS, LLC

3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353

KY FIELD OFFICE

RECEIVED

January 14, 2009

Lee Andrews
Field Supervisor
U.S. Fish & Wildlife Service
Kentucky ES Field Office
330 West Broadway St., Suite 265
Frankfort, Kentucky 40601

No significant adverse impacts to wetlands or federally listed endangered or threatened species are anticipated from this proposal.

Field Supervisor Date
U. S. Fish and Wildlife Service
Frankfort, KY 40601

Subject: Request for consultation under NEPA on proposed federal project in Fayette County

Dear Mr. Andrews:

The United States Department of Energy (DOE) is considering providing funding for the proposed Early Lead Mini Fischer-Tropsch Refinery (Mini FT Refinery) to be located at the University of Kentucky (UK) Center for Applied Energy Research (CAER) at 2540 Research Park Drive near Lexington. The project would be an addition to existing facilities located at the CAER near Lexington, Kentucky in Fayette County. The facility would be located on land owned by the Commonwealth of Kentucky and would be operated by the CAER.

The proposed project would advance the design and construction of a dedicated research facility at the UK CAER. The facility would carry out research on the Fischer-Tropsch process for converting synthetic gas (syngas), which could be derived from domestic coals, to a liquid fuel. Syngas for the UK CAER project would be produced by blending hydrogen and carbon monoxide. No on-site coal gasification would occur. Research would include experiments on water-gas-shift and Fischer-Tropsch processes as well as on catalyst structure-function properties with the ultimate goal of reducing the costs of the process and helping produce a more environment-friendly liquid fuel. A description of the proposed project and graphics showing its location are enclosed.

As part of DOE's 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 and Wildlife Coordination Act, we would appreciate receiving any information you have on wildlife resources, including threatened and endangered species or critical habitat, in the project area.

Based on the scope of the proposed project, DOE will 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 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.

Thank you for your assistance. Should you require additional information, please call me at (304) 285-4606 email me at Randy.Moore@eg.netl.doe.gov. Please address written correspondence to:

Randy Moore
Research and Development Solutions, LLC
3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353

Phone: 304-599-5941 Fax: 304-599-8904 E-mail: RDS@eginc.com

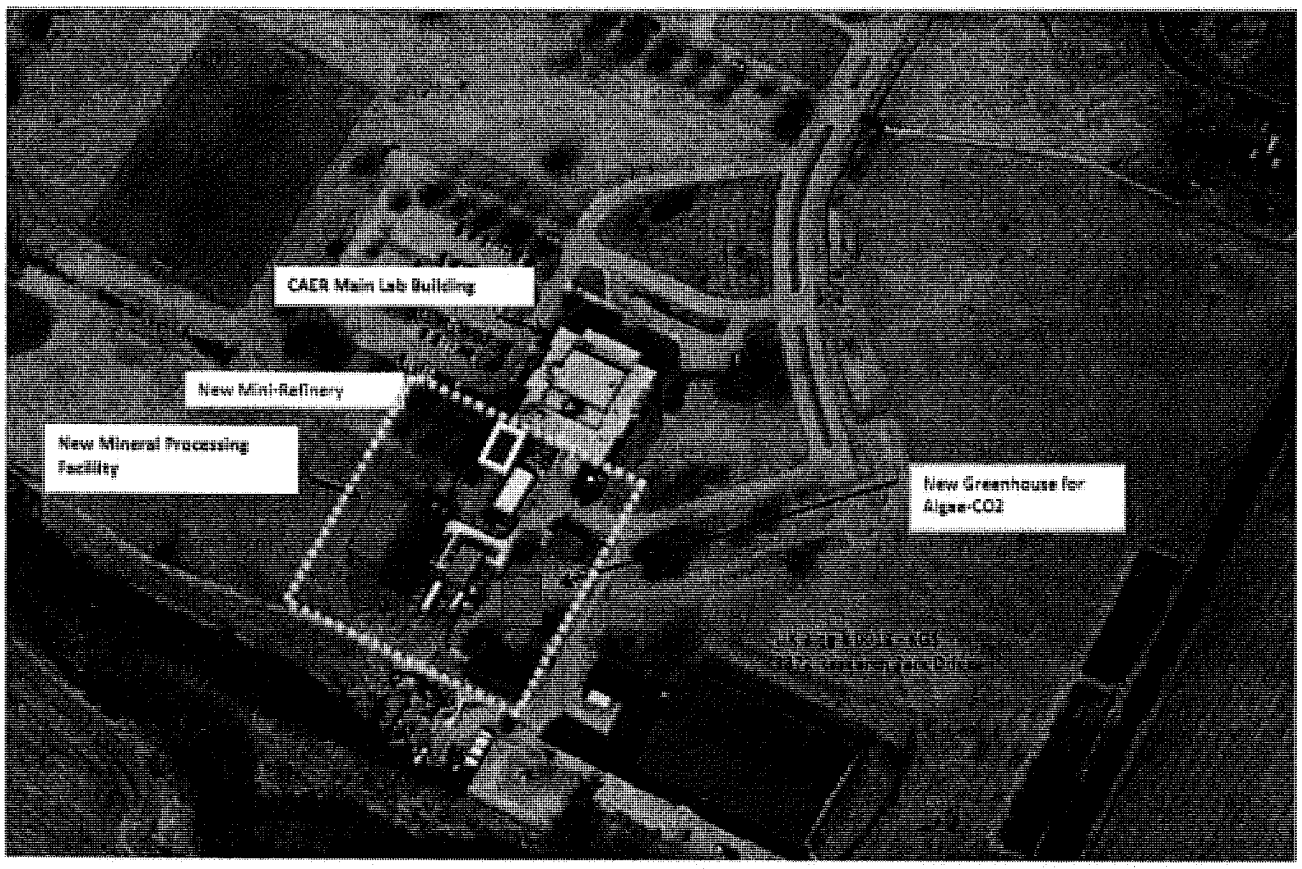
This Page Intentionally Left Blank

Appendix A-1
Supplemental Information
Requested by
Kentucky Heritage Council

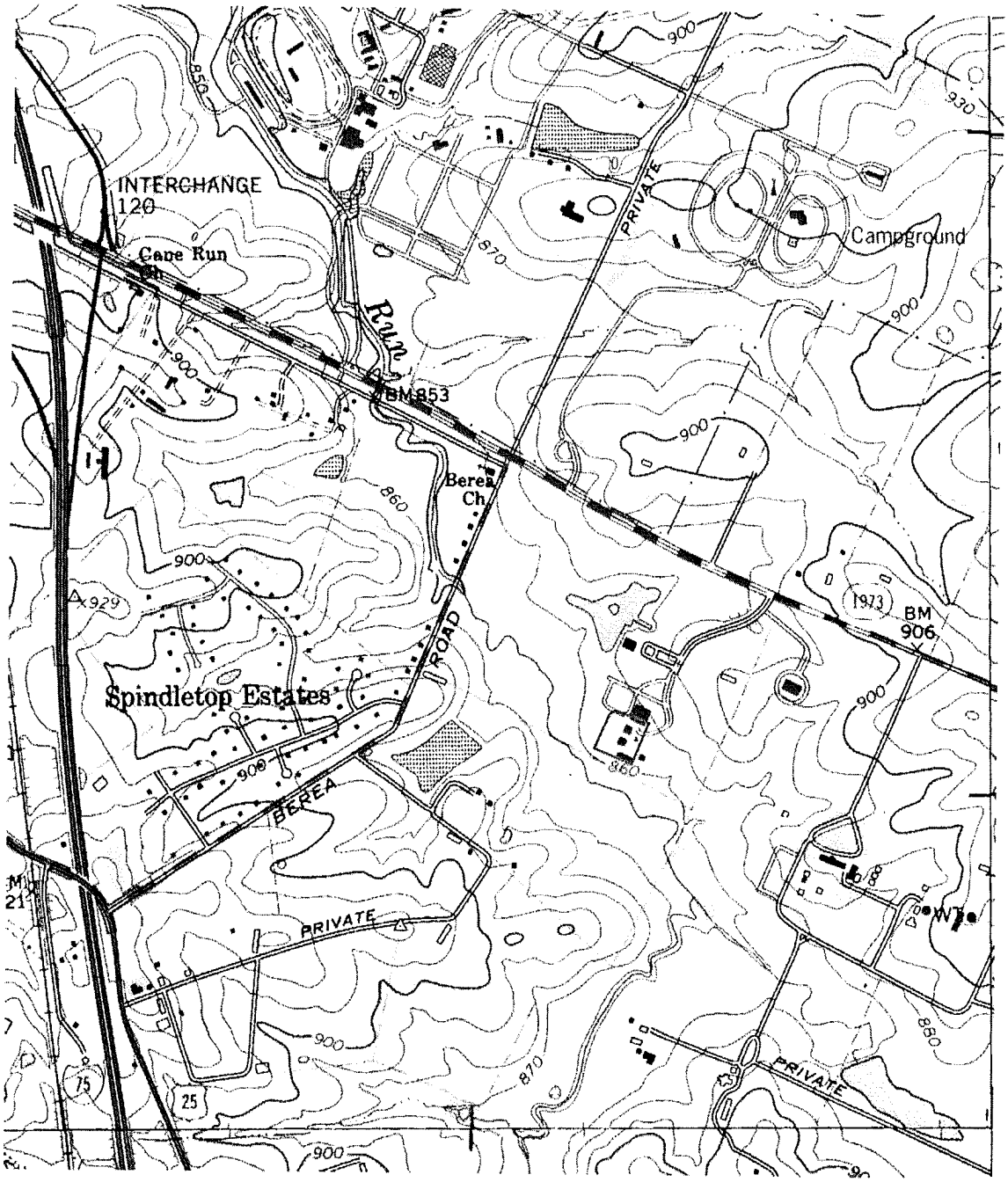
This Page Intentionally Left Blank

The new building being considered under the proposed federal undertaking would be a 45' x 60' structure that would house process equipment and related facilities to produce research quantities (~1 barrel/day) of Fischer-Tropsch (FT) fuels. UK CAER anticipates that the new Mini FT Refinery building would be located adjacent to the SW corner of the existing Main Lab building at 2540 Research Park Drive north of Lexington. This preferred footprint is shown outlined in yellow in the aerial photo below.

UK CAER is also planning to construct additional research facilities on its site (a new mineral processing facility and a greenhouse dedicated to algal research). Although these two new facilities, shown in red below, are not related to the Mini FT Refinery building being considered under the proposed federal undertaking, overall site development/design considerations, including access and utilities, may warrant locating the proposed Mini FT Refinery building elsewhere within the area highlighted is green on the aerial photo below.



The UK CAER facilities are located on the SE ¼ of the SE ¼ of the Georgetown 7 ½ " topographic quadrangle (shown below). The dashed green area shown on the preceding aerial photo, which encloses the area where the smaller 2700 sq. ft. footprint of the proposed Mini FT Refinery could be located, is highlighted in red. Because of scale, the footprint of the 45' x 60' Mini FT Refinery building is not shown below.



STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

MARCHETA SPARROW
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

MARK DENNEN
ACTING EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

March 3, 2009

Mr. Randy Moore
Research and Development Solutions, LLC.
3604 Collins Ferry Road, Suite 200
Morgantown, WV 26505-2353

Re: Refinery at UK Center for Applied Energy Research, Fayette County, Kentucky

Dear Mr. Moore:

This office has received and reviewed the information provided. Our review indicated that the proposed project will not affect any sites eligible for listing in the National Register of Historic Places. In accordance with 36CFR Part 800.4 (d) of the Advisory Council's revised regulations our finding is that there are No Historic Properties Present within the undertaking's area of potential impact. Therefore, we have no further comments and the responsibility to consult with the Kentucky State Historic Preservation Officer under the Section 106 review process for archaeology is fulfilled. Should the project extend outside the indicated boundaries, this office should be contacted as there are archaeological sites recorded very close to the project area.

If you have any questions, please do not hesitate to contact Lori Stahlgren of my staff at (502) 564-7005 ext 151.

Sincerely,

Mark Dennen by cs

Mark Dennen, Acting Executive Director
Kentucky Heritage Council and
State Historic Preservation Officer

LCS/lcs

This Page Intentionally Left Blank

Appendix B
Comments Received
on the
Draft Environmental Assessment

This Page Intentionally Left Blank

ENERGY AND ENVIRONMENT CABINET

Steven L. Beshear
Governor

DEPARTMENT FOR ENVIRONMENTAL PROTECTION
300 FAIR OAKS LANE
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-2150
FAX (502) 564-4245
www.dep.ky.gov

Leonard K. Peters
Secretary

R. Bruce Scott
Commissioner

June 15, 2009

Randy Moore
RDS, LLC
Suite 200
3604 Collins Ferry Road
Morgantown, WV 26505-2353

Re: Design And Construction Of An Early Lead Mini Fischer-Tropsch Refinery At the University Of Kentucky Center For Applied Energy Research Near Lexington, Kentucky (SERO 2009-12)

Dear Mr. Moore,

The cabinet serves as environmental review office for documents prepared under the National Environmental Policy Act (NEPA). Within the Cabinet, the Commissioner's Office in the Department for Environmental Protection coordinates the review for Kentucky state agencies. The document was sent to the Division of Water, Division of Waste Management, Division for Air Quality, Kentucky Heritage Council, Division of Conservation, Department of Natural Resources, Division of Energy Development and Independence, and the Kentucky State Nature Preserves Commission.

The Energy and Environment Cabinet received your letter dated May 20, 2009 requesting our review of the Draft Environmental Assessment (EA) on the project. We have completed our review and the following comments were provided by those state agencies.

Division for Air Quality
As this project is presented, the owner or operator of this company should comply with any applicable Division for Air Quality permitting requirements contained in 401 KAR Chapter 52 Permits, Registrations, and Prohibitory Rules located at http://www.lrc.state.ky.us/kar/TITLE401.HTM and http://www.air.ky.gov/permitting/. For permitting information, please contact the Division for Air Quality Permit Review Branch Manager, at (502) 564-3999.

Kentucky Division for Air Quality Regulation 401 KAR 63:010 Fugitive Emissions states that no person shall cause, suffer, or allow any material to be handled, processed, transported, or stored without taking reasonable precaution to prevent particulate matter from becoming airborne. Additional requirements include the covering of open bodied trucks, operating outside the work area transporting materials likely to become airborne, and that no one shall allow earth or other material being transported by truck or earth moving equipment to be deposited onto a