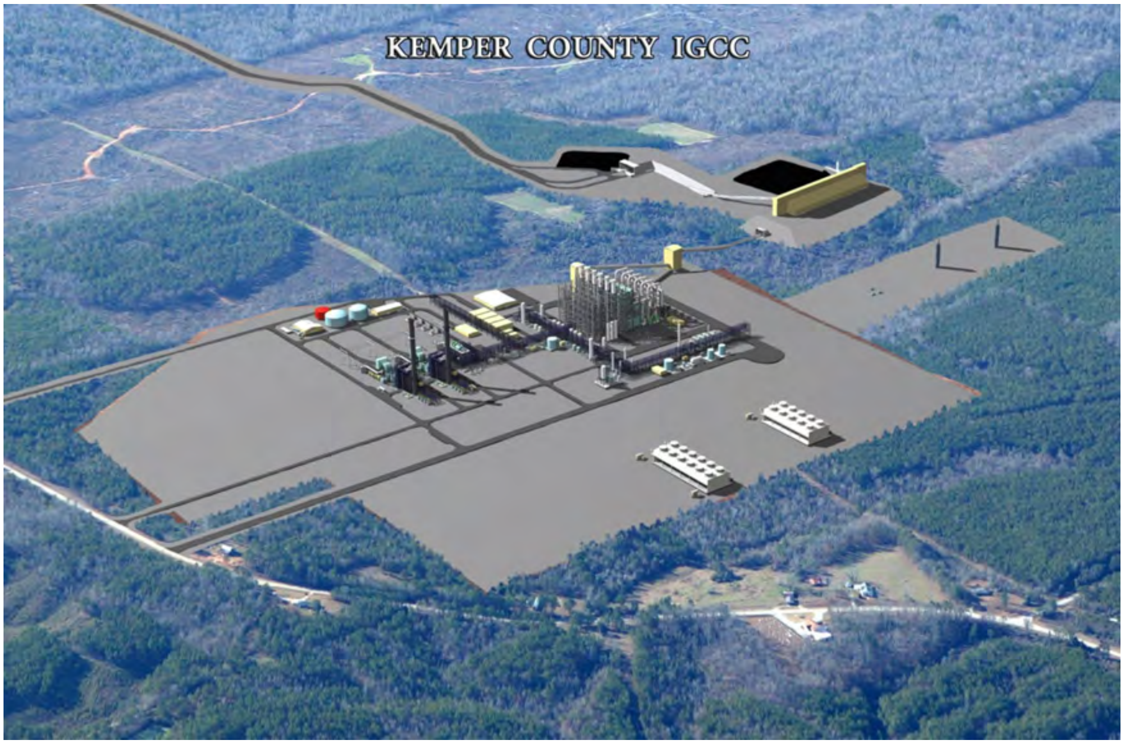
U.S. Department of Energy
in cooperation with
U.S. Army Corps of Engineers

KEMPER COUNTY IGCC PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

DOE/EIS-0409D

VOLUME 2—APPENDICES



November 2009

Office of Fossil Energy
National Energy Technology Laboratory

US Army Corps of Engineers

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VOLUME 2

APPENDICES

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APPENDIX A

AGENCY CORRESPONDENCE AND CONSULTATION LETTERS

NORTH AMERICAN
COAL
CORPORATION
RED HILLS MINE

April 30, 2008

Stan Thieling
Director, Coal Mining Division
Office of Geology
Mississippi Department of Environmental Quality
P.O. Box 2279
Jackson, MS 39225

Subject: Summary of 4/29/08 State and Federal Fish and Wildlife Agency Consultation Meeting on §2713 Fish & Wildlife Plan for Kemper County Project.

Meeting Attendees
North American Coal Corporation: George Hawkey
Barry A Vittor & Associates: Barry Vittor, Terry Whitehurst
Mississippi Power Company: Rick Berry
Southern Company: Dan Warren
U.S. Fish & Wildlife Service: Ray Aycock, Kathy Lunceford, Paul Hartfield, Cary Norquist, Daniel Drennen, Daniel Gregg
Mississippi Department of Wildlife, Fisheries & Parks: Dennis Riecke
Mississippi Department of Environmental Quality: Mike Bograd, Stan Thieling, Charlotte Byrd, Jackie Key

Dear Mr.Thieling:

This letter summarizes and documents the 4/29/08 state and federal fish and wildlife agency and industry consultation meeting held to assist the Mississippi Department of Environmental Quality (MDEQ) in determining the scope and level of detail for collecting site specific fish and wildlife resource information as required by §2713(a)(1) and (2) of the Regulations Governing Surface Coal Mining in Mississippi. The consultation was also helpful in determining the resource information needed for future U.S. Army Corps of Engineers (USACOE) Section 404 permit actions and preparation of an Environmental Impact Statement (EIS) for the project.

Background
In general, North American Coal Corporation (NAC) proposes to conduct terrestrial and aquatic flora and fauna inventories and conduct wetland and stream delineations and characterizations within the proposed 31,000 acre Life of Mine (LOM) project area

1000 McIntire Road, Ackerman, MS 39735-4524 (662) 387-5200

located within Kemper and Lauderdale Counties, Mississippi. NAC has contracted with Barry A. Vittor & Associates, Inc. to conduct the aforementioned inventories and delineations and prepare associated reports for a Mississippi Surface Coal Mining Permit application, USACOE Section 404 Individual Permit or Nationwide Permit 21 Authorization applications and an EIS to be prepared for the project. The goal of the inventories is to provide a description and list of plant and animal species that occur or do not occur within the project area and a characterization of the vegetative communities or habitats that occur within the project area. Study emphasis will be on state and federally protected species and other important fish and wildlife habitat as determined by state and federal fish and wildlife agencies.

Meeting Summary

Following introduction of attendees, Mr. Rick Berry gave an overview of the power generation project and the "first of its kind IGCC clean coal technology" that would be employed. Mr. Berry explained the sources of federal funding, funding conditions and stringent time lines that must be met for the project to remain viable. Mr. Dan Warren next explained the role of the U.S. Department of Energy (USDOE) as the lead federal agency in the NEPA process and the time line in which an EIS will be prepared and the expected 11/09 date of the associated EIS Record of Decision.

I then gave an overview of the mining side of the project explaining the regulatory, permitting, operational and reclamation aspects of the large scale surface coal mining operation that would be installed to provide lignite to the power plant. A variety of slides of the existing Red Hills Mine were presented as examples of what the proposed mining operation would involve.

Kathy Lunceford and other USFWS staff members then provided perspectives on the following species:

Price's potato bean (*Apios priceana*) is the only federally protected species currently known to occur in Kemper County but its known location is not within the project area. The agency requested a very thorough search for this species be conducted during its flowering season within specific habitat types that could likely support this species.

Stream crayfish (*Procamarus lagniappe*) is currently considered a category 2 species associated with the upper and middle Sucarnoochee River system in Mississippi and Alabama which includes watershed within or near the project area. Upon review of the project area map, the Sucarnoochee watershed did not appear to be within the project area. However, crayfish sampled from streams in the project area will be identified following identification criteria for this specific crayfish provided by the agency. The agency will be informed if this species is observed.

A nesting pair of Bald Eagles (*Halieetus leucocephalus*) have been recorded nesting near Lake Okatibbee. The agency did not know if the pair nested in 2008 but requested that information on their use and occurrence (range) in the project area be determined if the pair is present.

While black bears are unlikely to occur, the agency requested sightings or other evidence of black bears (tracks and den trees) be reported.

The agency requested bat caves or structure supporting bat colonies be reported.

The agency indicated existing fisheries information suggests there are no fish species of particular concern to the agency.

Dr. Vittor indicated field crews would be watchful for other federal and state listed species even though these species are not expected to occur in the project area. Dr. Vittor also indicated stream evaluations and characterization would be conducted within the project area providing an inventory of fish and other aquatic species.

While project area wetland, stream and associated riparian habitat were generally discussed during the meeting, attendees agreed these features would be discussed and reviewed in more detail with representatives of the USACOE (Mobile District) at a later planned meeting. USACOE will be directly responsible for overview of wetland and stream delineations and associated review of 404 permit applications submitted in relation to the proposed project.

The meeting adjourned with attendees agreeing the scope and level of detail had been provided and that field inventories could proceed. Dr. Vittor indicated he had the agency information he needed to initiate the inventories and would keep in contact with agency personnel as the field work progressed.

Sincerely,
MISSISSIPPI LIGNITE MINING COMPANY

George Hawkey
Environmental Manager

cc: Barry Vittor (BAV & Associates)
Ray Aycock (USFWS)
Kathy Lunceford (USFWS)
Dennis Riecke (MSDWFP)
Rick Berry (MPC)
Dan Warren (SC)
Cindy House Pearson (USACOE)
Kemper Project (Wildlife/Agency File)

U.S. Department of Energy

National Energy Technology Laboratory

NETL

July 18, 2008

Mr. Joe Carbone
Forest Service
U.S. Department of Agriculture
Ecosystem Management Coordination
Mail Stop 1104
1400 Independence Avenue, SW
Washington, DC 20250

Dear Mr. Joe Carbone:

The U. S. Department of Energy (DOE), National Energy Technology Laboratory (NETL) is beginning the process of preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) for our participation in the Kemper County Integrated Gasification Combined Cycle (IGCC) Project under the Clean Coal Power Initiative (CCPI) Program. NETL intends to publish a Notice of Intent in August to prepare the EIS. Southern Company, through its affiliate Mississippi Power Company, would build, own, and operate the IGCC electric generating facility located in Kemper County Mississippi (see enclosed map). This letter is intended to ascertain whether your agency would be interested in participating in the EIS as a cooperating agency under NEPA.

The proposed IGCC electrical generating facility would be constructed on an undeveloped site located in east-central Mississippi near the town of Liberty, approximately 20 miles north of the city of Meridian (see enclosed map). It is estimated the IGCC facilities would occupy approximately 150 acres of the site. The remainder would remain undeveloped, with the exception of two new transmission lines, a natural gas supply pipeline, a planned for CO2 pipeline and site access and fuel handling infrastructure.

The proposed facilities would demonstrate IGCC technology in a power plant consisting of two lignite coal gasifiers, two gas combustion turbines (CTs), two heat recovery steam generators (HRSG), a single steam turbine, and associated support facilities. Onsite wells would provide approximately 6 million gallons per day of groundwater required for cooling water makeup, steam cycle makeup, and other processes. The IGCC facility would produce synthesis gas from lignite coal and use this gas to drive the two CTs. Hot exhaust gas from the gas turbines generate steam from water in the HRSGs to drive the steam turbine; all three turbines would generate electricity. The gas turbines would be capable of operating on either natural gas or synthesis gas. At full capacity, the two new lignite coal gasifiers are expected to use about 12,000 tons of lignite coal per day to produce synthesis gas. Combined, the three turbines would generate approximately 550 MW of electricity. This combined-cycle approach of using gas turbines and a steam turbine in tandem increases the amount of electricity that can be generated from a given amount of lignite coal.

While the proposed project under the cooperative agreement would consist of the gasifiers, synthesis gas cleanup systems, two CT/HRSGs, a steam turbine, and supporting facilities and infrastructure, the EIS will also address the construction and operation of the neighboring surface lignite coal mine, associated transmission lines (and substations), planned for CO2 capture systems and CO2 pipeline, and a natural gas pipeline, as related actions.

The mine would be operated by North American Coal Corporation and would provide the primary source of fuel for the project. Mining would result in two types of landscape disturbance within the life of mine area. Actual mining - the uncovering and removal of lignite - would disturb approximately 275 acres/year. The mine would use draglines and a truck and shovel operation to remove the overburden, mine the lignite coal, and reclaim the site in accordance with an approved mine plan. Actual mining would disturb uplands, wetlands and require stream diversions. The lignite coal would be transported by truck and /or overland conveyor. Following lignite removal, approximately 275 acres/year of mined land would be restored to approximate the pre-mine land contour and re-vegetated to a land use consistent with an approved mine reclamation plan.

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880   626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236-0940
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Please reply at your earliest convenience to indicate whether your agency, or any of its services, bureaus, or offices, has an interest in becoming a cooperating agency on the EIS. Should you wish to discuss the Project and EIS further, please call me at 412-386-6065 or email at richard.hargis@netl.doe.gov.

Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

Enclosure: Location and Site Map

U.S. Department of Energy

National Energy Technology Laboratory

NETL

July 18, 2008

Mr. Gregory L. Hogue
Regional Environmental Officer
U.S. Department of the Interior
75 Spring Street, SW, Suite 1144
Atlanta, GA 30303

Dear Mr. Gregory L. Hogue:

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Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

Enclosure: Location and Site Map

U.S. Department of Energy

National Energy Technology Laboratory

NETL

July 18, 2008

Mr. Heinz Mueller
Chief of NEPA Program Office
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, GA 30303

Dear Mr. Heinz Mueller:

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Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

Enclosure: Location and Site Map

U.S. Department of Energy

National Energy Technology Laboratory

NETL

July 18, 2008

Mr. Mark Robinson
Director, Office of Energy Projects
Federal Energy Regulatory Commission
888 First Street, NE, Room 6A-01, PJ-1
Washington, DC 20426

Dear Mr. Mark Robinson:

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Sincerely,

Richard A. Hargis, Jr.
NEPA Document Manager

Enclosure: Location and Site Map

U.S. Department of Energy

National Energy Technology Laboratory

NETL

July 18, 2008

Mr. Fred Skaer
Director, Office of Project Development and
Environmental Review
Headquarters, Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

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Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

Enclosure: Location and Site Map

U.S. Department of Energy

NETL

National Energy Technology Laboratory

July 18, 2008

Mr. Ray Aycock
Field Supervisor
Ecological Services Field Office
U.S. Fish & Wildlife Service
6578 Dogwood View Parkway
Jackson, MS 39213

Dear Mr. Ray Aycock:

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NEPA Document Manager

Enclosure: Location and Site Map

U.S. Department of Energy

National Energy Technology Laboratory

NETL

July 18, 2008

Ms. Trudy Fisher
Executive Director, Mississippi Department of
Environmental Quality
P.O. Box 20305
Jackson, MS 39289-1305

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The U. S. Department of Energy (DOE), National Energy Technology Laboratory (NETL) is beginning the process of preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) for our participation in the Kemper County Integrated Gasification Combined Cycle (IGCC) Project under the Clean Coal Power Initiative (CCPI) Program. NETL intends to publish a Notice of Intent in August to prepare the EIS. Southern Company, through its affiliate Mississippi Power Company, would build, own, and operate the IGCC electric generating facility located in Kemper County Mississippi (see enclosed map). This letter is intended to ascertain whether your agency would be interested in participating in the EIS as a cooperating agency under NEPA.

The proposed IGCC electrical generating facility would be constructed on an undeveloped site located in east-central Mississippi near the town of Liberty, approximately 20 miles north of the city of Meridian (see enclosed map). It is estimated the IGCC facilities would occupy approximately 150 acres of the site. The remainder would remain undeveloped, with the exception of two new transmission lines, a natural gas supply pipeline, a planned for CO2 pipeline and site access and fuel handling infrastructure.

The proposed facilities would demonstrate IGCC technology in a power plant consisting of two lignite coal gasifiers, two gas combustion turbines (CTs), two heat recovery steam generators (HRSG), a single steam turbine, and associated support facilities. Onsite wells would provide approximately 6 million gallons per day of groundwater required for cooling water makeup, steam cycle makeup, and other processes. The IGCC facility would produce synthesis gas from lignite coal and use this gas to drive the two CTs. Hot exhaust gas from the gas turbines generate steam from water in the HRSGs to drive the steam turbine; all three turbines would generate electricity. The gas turbines would be capable of operating on either natural gas or synthesis gas. At full capacity, the two new lignite coal gasifiers are expected to use about 12,000 tons of lignite coal per day to produce synthesis gas. Combined, the three turbines would generate approximately 550 MW of electricity. This combined-cycle approach of using gas turbines and a steam turbine in tandem increases the amount of electricity that can be generated from a given amount of lignite coal.

While the proposed project under the cooperative agreement would consist of the gasifiers, synthesis gas cleanup systems, two CT/HRSGs, a steam turbine, and supporting facilities and infrastructure, the EIS will also address the construction and operation of the neighboring surface lignite coal mine, associated transmission lines (and substations), planned for CO2 capture systems and CO2 pipeline, and a natural gas pipeline, as related actions.

The mine would be operated by North American Coal Corporation and would provide the primary source of fuel for the project. Mining would result in two types of landscape disturbance within the life of mine area. Actual mining - the uncovering and removal of lignite - would disturb approximately 275 acres/year. The mine would use draglines and a truck and shovel operation to remove the overburden, mine the lignite coal, and reclaim the site in accordance with an approved mine plan. Actual mining would disturb uplands, wetlands and require stream diversions. The lignite coal would be transported by truck and /or overland conveyor. Following lignite removal, approximately 275 acres/year of mined land would be restored to approximate the pre-mine land contour and re-vegetated to a land use consistent with an approved mine reclamation plan.

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880 | 626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236-0940
REPLY TO: Pittsburgh Office • hargis@netl.doe.gov@netl.doe.gov • Voice (412) 386-6065 • Fax (412) 386-4775 • www.netl.doe.gov

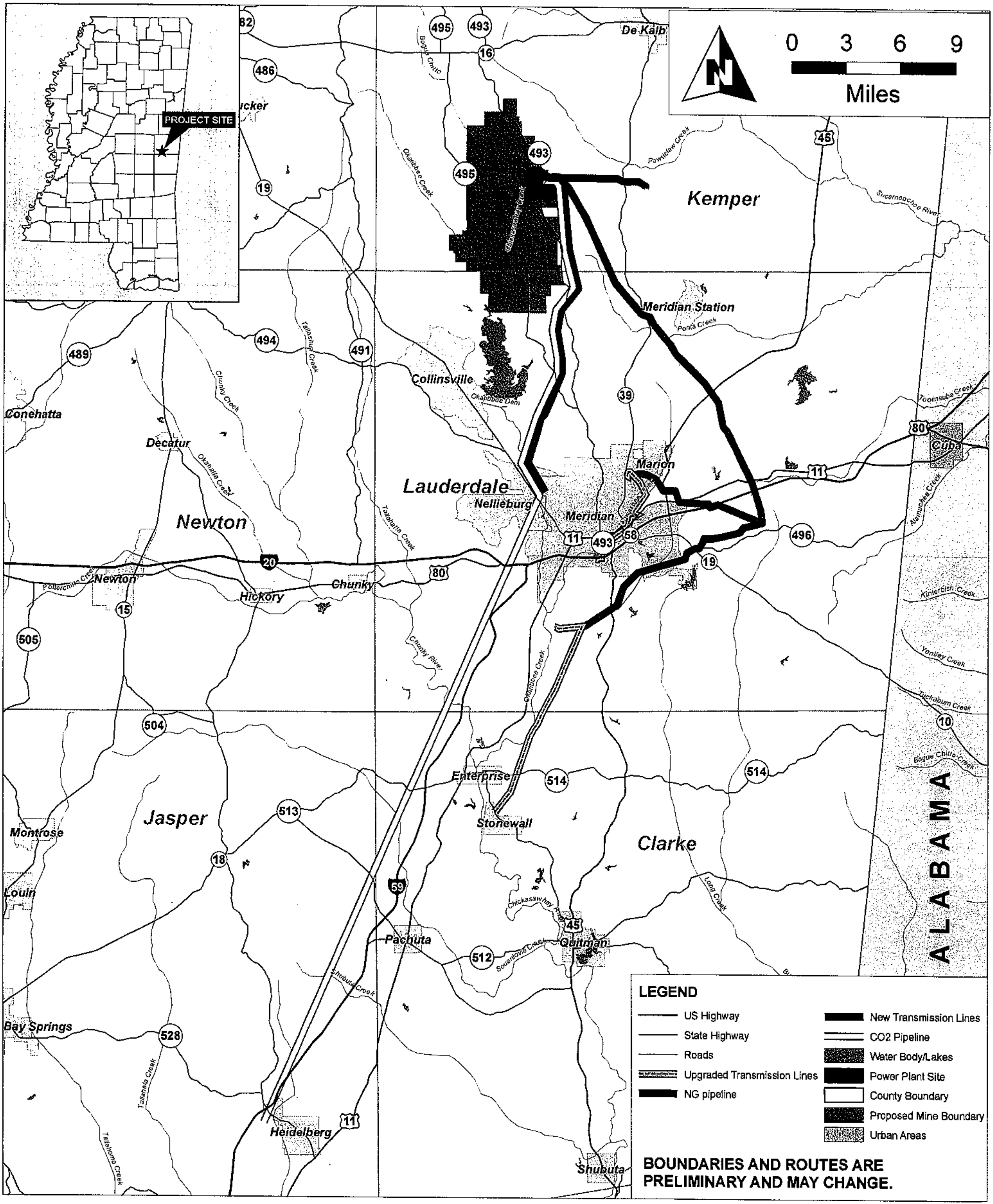
Please reply at your earliest convenience to indicate whether your agency, or any of its services, bureaus, or offices, has an interest in becoming a cooperating agency on the EIS. Should you wish to discuss the Project and EIS further, please call me at 412-386-6065 or email at richard.hargis@netl.doe.gov.

Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

Enclosure: Location and Site Map



PRELIMINARY LOCATION MAP FOR PROPOSED MINE AND PROPOSED KEMPER COUNTY IGCC PROJECT AND SUPPORTING FACILITIES

Sources: US CENSUS, 2000; MARIS, 2006; ECT, 2008.

ECT
Environmental Consulting & Technology, Inc.

United States Department of the Interior

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

August 4, 2008

Mr. Richard Hargis
U.S. Department of Energy
Post Office Box 880
Morgantown, West Virginia 26507-0880

Dear Mr. Hargis:

The U.S. Fish and Wildlife Service (Service) has received your letter dated July 18, 2008, included therein a notification of the preparation of an Environmental Impact Statement for the Kemper County Integrated Gasification Combined Cycle (IGCC) Project under the Clean Coal Power Initiative Program. Our comments are submitted in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e).

Your agency has requested that the Service be a cooperating agency in the National Environmental Policy Act documentation of this project. The Service consents to that request. We also agree to provide fish and wildlife resources information, to review all environmental documents, and to participate in coordination meetings as they relate to the IGCC Project.

Thank you for the opportunity to participate in the planning and development of this project.

Sincerely,

Ray Aycock

Ray Aycock
Field Supervisor

cc: Fish and Wildlife Service, Atlanta, GA
Attn.: Sue Cielinski

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

August 14, 2008

Mr. Richard Hargis
NEPA Document Manager
Department of Energy
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

SUBJECT: Participating Agency Request for the
Environmental Impact Statement
Kemper County IGCC Project

Dear Mr. Hargis:

The U.S. Environmental Protection Agency (EPA) received your letter dated July 18, 2008, inviting EPA to become a participating agency with the Department of Energy (DOE) in the development of the Environmental Impact Statement (EIS) for the proposed Kemper County IGCC project. We accept your invitation to become a participating agency for this project, and will participate in project meetings and activities, subject to our resource limitations.

EPA's participating agency status and level of involvement does not, however, preclude our independent review and comment responsibilities under Section 102(2)(C) of the National Environmental Policy Act and Section 309 of the Clean Air Act, or our authorities under the Clean Water Act. Similarly, our participating agency involvement does not imply that EPA will necessarily concur with all aspects of the EIS.

We appreciate the opportunity to work with the DOE as a participating agency on this important project. Please contact Ramona McConney or Paul Gagliano, our primary agency representatives for this project, at (404) 562-9615 or (404) 562- 9373 if you have additional questions.

Sincerely,

Heinz J. Mueller, Chief
NEPA Program Office
Office of Policy and Management

MISSISSIPPI DIVISION

U.S. Department
of Transportation
**Federal Highway
Administration**

**666 North Street, Suite 105
Jackson, Mississippi 39202-3199**

August 25, 2008

In Reply Refer To: HDA-MS

Mr. Richard Hargis
NEPA Document Manager
National Energy Technology Laboratory
U. S. Department of Energy
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

Dear Mr. Hargis:

Subject: Request to be a Cooperating Agency in EIS Preparation

We are in receipt of your letter dated July 18, 2008 regarding the request for the Federal Highway Administration (FHWA) to be a cooperating agency on the Environmental Impact Statement for the Integrated Gasification Combined Cycle Project in Kemper County Mississippi.

The Mississippi Division FHWA appreciates the opportunity to participate in this effort. However, we want to respectfully decline the request since we have no jurisdiction, review authority or expertise for a project such as this.

Again, we appreciate the opportunity to comment and if you have any questions, please do not hesitate to contact Mr. Dickie Walters on my staff by telephone at (601) 965-4217 or e-mail at Dickie.walters@fhwa.dot.gov.

Sincerely yours,

Andrew H. Hughes
Division Administrator

U.S. Department of Energy

NETL

National Energy Technology Laboratory

September 8, 2008

Mr. Ray Aycock
Ms. Kathy Lunceford
Field Supervisors
Ecological Services Field Office
U.S. Fish and Wildlife Service
6578 Dogwood View Parkway
Jackson, MS 39213

Dear Mr. Ray Aycock and Ms. Kathy Lunceford:

As we agreed in our conference call on September 3, 2008, the involvement of the U.S. Fish and Wildlife Service (Service) in the preparation of the Environmental Impact Statement (EIS) for the Kemper County Integrated Gasification Combined Cycle (IGCC) Project will be on an informal basis, rather than as a formal cooperating agency. This involvement would include providing biological resources information, reviewing draft environmental documents related to biological resource impacts as made available by the U.S. Department of Energy (DOE), and participation in project coordination meetings and conference calls. All of these activities would be dependent upon the staff and resources available to the Service during the course of the EIS preparation by DOE. The Service would not be obligated to assume responsibility for the preparation of environmental analyses or the resolution of significant issues.

In addition to the informal participation in the preparation of the EIS, the Service would provide assistance through informal consultation – and formal consultation, if necessary – under Section 7 of the Endangered Species Act. This assistance would include providing a list of study and survey information and proposed conservation measures to mitigate potential impacts.

I look forward to working with you on this important project and will keep you informed of any planned project coordination meetings and conference calls, as well as any public meetings related to the EIS process. Thank you.

Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
hargis@netl.doe.gov@netl.doe.gov • Voice (412) 386-6065 • Fax (412) 386-4604 • www.netl.doe.gov

U.S. Department of Energy

National Energy Technology Laboratory

NETL

October 3, 2008

Mr. Heinz Mueller
Chief of NEPA Program Office
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, GA 30303

Dear Mr. Mueller:

In response to your letter of August 14, 2008, and as we agreed in our conference call on September 8, 2008, the involvement of the U.S. EPA Region 4 in the preparation of the Environmental Impact Statement (EIS) for the Kemper County Integrated Gasification Combined Cycle (IGCC) Project will be on an informal basis, rather than as a formal cooperating agency. This involvement would include reviewing preliminary draft sections of the EIS as made available by the U.S. Department of Energy (DOE) and participation in project coordination meetings, activities and conference calls. The extent of involvement would be dependent upon the staff and resources available to EPA Region 4 during the course of the EIS preparation by DOE. The EPA Region 4 would not be obligated to assume responsibility for the preparation of environmental analyses or the resolution of significant issues.

DOE understands that the involvement of EPA Region 4 does not preclude EPA's independent review and comment responsibilities under the National Environmental Policy Act and the Clean Air Act or EPA's authorities under the Clean Water Act.

I look forward to working with you on this important project and will keep you informed of any planned project coordination meetings and conference calls, as well as any public meetings related to the EIS process. Thank you.

Sincerely,

Richard A Hargis Jr

Richard A. Hargis, Jr.
NEPA Document Manager

cc:
Ramona McConney, EPA Region 4
Paul Gagliano, EPA Region 4

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880   626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236-0940
REPLY TO: Pittsburgh Office

Mississippi Wildlife Federation
855 S. Pear Orchard Road
Suite 500
Ridgeland, MS 39157

October 22, 2008

Mr. Richard A. Hargis
U.S. Department of Energy
National Energy Technology Laboratory
626 Cochrans Mill Road
Pittsburgh, PA 15236

Re: Kemper County Integrated Gasification Cycle plant

Dear Mr. Hargis:

On behalf of the Mississippi Wildlife Federation I would like to thank you for the opportunity to provide comments on this project. We request that the following questions and concerns be addressed in the EIS for the above mentioned project.

1. What is the total impact to the area in acres? We were given a figure for the footprint of the mine and plant, but this did not include roads, pipelines and rights-of-way or other impacted areas that can greatly expand the affected area.
2. How will rights-of-way be managed? Will they consider impacts to wildlife and how to mitigate those impacts? Will native plantings be used in these areas? What wildlife would benefit from these areas? What efforts will be taken to prevent the spread of exotic species in rights-of-way?
3. How will you maneuver around unwilling sellers, or is it required that all lands within the project area be acquired for the project to move forward? How will surrounding landowners be affected by habitat changes on the mine site?
4. How will ephemeral streams and associated flora and fauna be impacted by the mine? What restoration measures will be taken to restore these functions?
5. How will terrestrial and aquatic micro and macro invertebrates be impacted? What measures will be taken to mitigate these impacts?
6. How do you account for use of the area by migratory birds? What mitigation will be done addressing these species?
7. How much CO_2 will be released and what is the impact to the environment?
8. How efficient is sequestration of CO_2?
9. What is the impact of noise pollution on people and wildlife in the area?
10. What is the impact of light pollution on people and wildlife in the area?
11. What happens to the mercury that is not removed? What is the potential impact?
12. Is a total year comprehensive biological assessment being conducted? If not, why?
13. Will you survey for reptiles, amphibians, invertebrates and fish?

14. Will surveys for amphibians be conducted in winter? (Rare salamanders, state listed species – southern red salamanders and ambystomids are not active during summer, but are active during winter.)
15. Will you survey vernal and autumnal plant communities – i.e. many state listed orchids are vernal spring species and are not detectable during late summer and autumn.
16. Based on recent information, black bears may be using this area. It is known that they often use stream corridors for dispersal and these are otherwise excellent habitat for bears. How will impacts on stream corridors related to black bears be addressed?
17. What surveys will be conducted for bats? Will there be surveys for winter roosts for bats, as well as maternal colonies for rare bats requiring surveys in both winter and spring?
18. How do you plan to measure/monitor impacts to the existing biotic environment throughout the longevity of the mine?
19. Soil disturbance and bare soil are excellent places for the establishment of cogongrass. Due to the location of this project, how will you address this invasive grass? Do you have a budget to address monitoring and control of the economically damaging species?
20. Most species used in reclamation and erosion control are invasive and limiting to native plant diversity. For erosion control and reclamation areas, we would like to see native warm season grasses and other annual and perennial native plants used for these plantings, not Bermuda grass, bahiagrass, Johnson grass or Sericea lespedeza.
21. Lignite is generally associated with iron sulfide and other acidic overburden that when exposed to oxygen and water, become oxidized to form sulfuric acid. In addition, metal toxicities associated with lignite seams in the Wilcox formation will often be high due to the presence of aluminum, manganese, and iron. Liming amounts required to neutralize ph levels of less than 3.0 may often exceed 5 tons per acre and be as high as 20 tons per acre. Thus, soil chemical monitoring should include monitoring of active ph levels, electrical conductivity and extractable ph levels to ascertain the needs for topsoiling and liming over time. The state of Mississippi cannot afford to take on the economic burden of keeping acidic overburden areas treated to ameliorate low ph levels which continues to oxidize to form volatile acids and metal salts. What soil chemistry and physical factors are expected and, how will you monitor, and ameliorate over decades or a century? (It takes about 50 years for pedogenesis to begin forming soil horizons on drastically disturbed mine sites even when they have been reclaimed.)
22. How will ecological and economic evaluations be conducted based on faunal and floral communities and hydrological changes in surface and aquifer water availability?

23. There will be a loss of forested wetlands and bottomland hardwoods. How will you address and mitigate recreational value impacts related to angling, canoeing, hunting and general outdoor recreation?
24. How will you address and mitigate impacts to timber commodity values associated with hardwood forests?
25. How will you address landscape level impacts to rivers and associated riparian habitats in terms of within channel habitat degradation and water quality damage as well as sediment and phytotoxic chemical drainage (acidic chemical drainage associated with lignite seams) into streams, rivers (including the Pascagoula River) eventually marshes and the Gulf of Mexico? How will this affect the hypoxic zone in the Gulf of Mexico? This points to ecological damage as well as economic damage in terms of commercial, subsistence, and recreation fisheries and shellfisheries. How will these ecological and economic impacts be addressed?
26. What impacts will there be downstream from loss of upstream connectivity of tributaries?
27. Are there seasonal differences in stream flows that would direct the progress of work?
28. How many houses and cemeteries would be impacted?
29. Why have these plants been declined in other states?
30. What is the impact to roads by heavier traffic? Who pays the cost of increased maintenance?
31. What is the potential impact to groundwater?
32. What happens if an aquifer is breached?
33. Is there salt that must be disposed of? If so, how will this be accomplished?
34. What are potential markets for recyclables? What happens if those markets fail?
35. What is the predicted truck traffic associated with hauling recyclables?
36. What happens to plant after 30 years?
37. What are potential uses of the ash? Where are those markets?
38. The taxpayer will assume how much of the plant cost? Both federal and state funds?

37. How do you address loss of public lands acquired as mitigation for a previous loss of biological integrity?

Thank you for your consideration of these questions and concerns.

Sincerely,

Cathy Shropshire, PhD
MWF Executive Director

United States Department of the Interior

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

October 23, 2008

Mr. Richard Hargis
National Energy Technology Laboratory
U.S. Department of Energy
Post Office Box 10940
Pittsburg, Pennsylvania 15236

Dear Mr. Hargis:

The U.S. Fish and Wildlife Service (Service) has reviewed the Notice of Intent (NOI) to prepare an Environmental Impact Statement and Notice of Proposed Floodplain and Wetlands Involvement for the Kemper County Integrated Gasification Combined Cycle (IGCC), Kemper County, Mississippi. Our comments are submitted in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e) and the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

Southern Company, an affiliate of Mississippi Power Company, proposes the construction of a demonstration coal-based power plant in the floodplain of Okatibbee Creek, a tributary of the Chickasawhay River. The facility would utilize Clean Coal Power technology designed to achieve high environmental standards as they relate to emissions. The project would include the construction of an electrical generating plant consisting of two lignite coal gasifiers, two gas combustion turbines, two heat recovery steam generators, and a steam turbine on 150 acres of the site. Support facilities would include non-potable water wells, natural gas and CO_2 pipelines, roads, wastewater treatment areas, coal and ash storage and handling areas, and operations structures. In addition, an 11,000-acre surface lignite coal mine would be developed adjacent to the power plant.

The 1,650-acre project site is located near the Town of Liberty, approximately 20 miles north of Meridian. The area is mostly comprised of clay hill uplands with mixed hardwood forests. The site is the headwaters of the Chickasawhay River watershed and contains numerous creeks and meandering drains. These water bodies have narrow floodplains and contain minimal wetlands that are generally undisturbed. Significant portions of the site have been cleared for agriculture or timber management.

In addition to anticipated impacts in Kemper County, corridors for CO_2 and natural gas pipelines and electrical transmission lines would be constructed in Lauderdale, Clarke, and Jasper Counties, Mississippi.

The following federally listed species or their habitats could be found on or near the project site:

Kemper County

The threatened plant **Price's potato bean** (*Apios priceana*) is an herbaceous, twining vine that belongs to the pea family. It is often found in wooded areas that grade into creek and river bottoms.

Surveys need to be conducted when species is in flower or fruit, typically mid-July into October. It is best to confirm flowering/fruiting of the species at a nearby known site prior to initiating surveys.

The **Lagniappe crayfish** (*Procambarus lagniappe)* is found in the Sucarnoochee River watershed. It is a little known species that prefers cool, swift flowing water over a sand substrate. Adults are associated with leaf packs and plant debris that can be found in emergent grasses. This species is designated a Species of Concern, however, its limited distribution and low population numbers make it vulnerable to habitat modification. Although its occurrence has been documented only in the Sucarnoochee watershed, there is potential for habitat within the Chickasawhay watershed. Reassessment of its status may become necessary.

Clarke and Lauderdale Counties

The threatened **yellow-blotched map turtle** (*Graptemys flavimaculata*) is found in the Chickasawhay, Leaf, and Pascagoula Rivers. The yellow-blotched map turtle prefers river stretches with moderate currents, abundant basking sites, and sand bars. Stream modification has significantly contributed to the decline of the species.

The threatened **Gulf sturgeon** (*Acipenser oxyrhynchus desotoi*) is found in the Pearl, Leaf, and Pascagoula Rivers. Gulf sturgeons are primitive, anadromous fish that annually migrate from the Gulf of Mexico into freshwater streams to spawn. Subadults and adults spend eight to nine months each year in rivers. Although Gulf sturgeon activity is not well documented, the species has been found in the upper reaches of the Pearl, Leaf, Strong, Bouie, and Chickasawhay Rivers as far north as the Jackson metropolitan area. Adult and subadult holding areas have been identified in the Pascagoula River. The decline of the Gulf sturgeon is primarily due to limited access to migration routes and historic spawning areas, habitat modification, and water quality degradation.

The **pearl darter** *(Percina aurora)*, a Candidate Species historically found in the Pearl and Pascagoula River systems, is currently found only in the Pascagoula River system. There is potential for re-discovery of the species in certain areas of the Pearl River system. The darter prefers stable gravel riffles or sandstone exposures with large sized gravel or rock. Habitat loss or degradation has been a major contributor to the reduction in pearl darter numbers. Candidates are those species currently under review for possible addition to the federal listed of threatened or endangered species. All efforts should be made to avoid harm or harassment to this species.

Clarke and Jasper Counties

The threatened **gopher tortoise** (*Gopherus polyphemus*) occupies a wide range of upland habitat types. The general physical and biotic features thought to characterize suitable adult tortoise habitat are a presence of well-drained, sandy soils, which allow easy burrowing; an abundance of herbaceous ground cover; and generally open canopy and sparse shrub cover, which allows sunlight to reach the ground floor. The gopher tortoise digs a burrow used as a shelter and nesting area. Groups of these tortoises dig burrows in the same location forming a colony.

Clarke, Jasper, and Lauderdale Counties

The **black pine snake** (*Pituophis melanoleucus* ssp. *lodingi*), a Candidate Species, prefers uplands with well-drained sandy soils in areas of longleaf pine and hardwood tree species. Candidates are those species currently under review for possible addition to the federal listed of threatened or endangered species. All efforts should be made to avoid harm or harassment to this species.

Kemper, Lauderdale, Clarke, and Jasper Counties

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

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

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

Based on the information in the NOI, it is our opinion that the construction of the proposed IGCC project could have direct and indirect impacts on listed species. Loss of numerous miles of riparian habitat could directly affect Price's potato bean and the Lagniappe crayfish. Also, the construction of the coalmine could have impacts on fish and wildlife resources on and off site. Coal surface mining inherently creates concerns regarding air emissions and wastewater discharge. The proposed mine could adversely impact waters associated with the Chickasawhay River and all aquatics found in that watershed.

Further consultation under the ESA will be necessary for the construction of the IGCC project. Also, the Service will make additional comments regarding impacts to wetlands and waters of the United States during the National Environmental Policy Act scoping process.

Thank you for the opportunity to comment on this project. If you have any additional questions, please feel free to contact Kathy Lunceford in this office, telephone: (601) 321-1132.

Sincerely,

Ray Aycock

Ray Aycock
Field Supervisor

U.S. Department of Energy

National Energy Technology Laboratory

November 19, 2008

Damon M. Young, P.G.
Project Manager
US Army Corps of Engineers
Mobile District
USACE-CESAM-RD-I
PO Box 2288
Mobile, AL 36628-0001

Dear Mr. Young:

As we have discussed, the U. S. Department of Energy (DOE) is beginning the process of preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) for our participation in the Kemper County Integrated Gasification Combined Cycle (IGCC) Project under the Clean Coal Power Initiative (CCPI) Program. Southern Company, through its affiliate Mississippi Power Company, would build, own, and operate the IGCC electric generating facility located in Kemper County Mississippi. While the proposed DOE funding for the project would be limited to the gasifiers, synthesis gas cleanup systems, two CT/HRSGs, a steam turbine, and supporting facilities and infrastructure, the EIS will also address the construction and operation of the neighboring surface lignite coal mine, associated transmission lines (and substations), planned for CO2 capture systems and CO2 pipeline, and a natural gas pipeline, as related actions. Since the Army Corps of Engineers will have the responsibility for issuing permits under the Clean Water Act Section 404 (i.e. wetlands permits) for this project and since this project and the associated mine could have secondary and cumulative effects on Okatibbee Lake, this letter is to request that the Army Corps of Engineers, Mobile District, participate in the preparation of the EIS as a formal cooperating agency under NEPA.

If the Corps accepts this request to be a cooperating agency, DOE and the Corps will need to reach an agreement on the expectations, roles, and responsibilities for our respective agencies. Following Council on Environmental Quality guidance, such an agreement would establish the expected time limits, identify milestones, assign responsibilities for analysis and documentation, specify the scope and detail of the cooperating agency's contributions, and establish other appropriate ground-rules addressing issues such as availability of pre-decisional information.

Please let me know if you need any additional information. Thank you.

Sincerely,

Richard A Hargis Jr
Richard A. Hargis, Jr.
NEPA Document Manager

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

November 24, 2008

Inland Branch
Regulatory Division

SUBJECT: Department of the Army Consultation; Notice of Intent to file an Environmental Impact Statement; SAM Number: SAM-2008-1759-DMY

United States Department of Energy
National Energy Technology Laboratory
Attention: Mr. Richard Hargis (922-1W13)
Post Office Box 10940
Pittsburgh, Pennsylvania 15236

Dear Mr. Hargis:

This response is in reference to a recent public scoping meeting we attended on Tuesday, October 14, 2008 regarding the proposed Integrated Gasification Combined Cycle Project (IGCC) that includes the proposed Kemper and Lauderdale County Mine Site located to the north of the U.S. Army Corps of Engineers (USACE), Lake Okatibee Project Site. In September 2008, your agency filed a Notice of Intent to file an Environmental Impact Statement (EIS). The project has been assigned USACE project number SAM-2008-1759-DMY or the proposed Kemper County IGCC Mine Site and Support Facilities which should be referred to in all future correspondence with our office. This office appreciates the opportunity to act as a formal cooperating agency for the EIS upon your written request dated November 19, 2008. This office will respond in writing outlining the recommended roles and responsibilities of the USACE. The project located in multiple Sections, Townships and Ranges of Kemper and Lauderdale Counties, Mississippi.

The USACE has identified several items we would like to see addressed as part of the EIS. First, the USACE has an interest in the secondary and cumulative effects to Lake Okatibee project which lies just to the south of the proposed project. Second, the proposed project may impact jurisdictional "waters of the U.S." as defined by our program. We have also identified several recommendations for the proposed project. The USACE has the following comments, concerns and recommendations partnering to this EIS process:

a. We would like to see the EIS address both direct and indirect effects on all "waters of the U.S." as outlined by the USACE. This includes but is not limited to wetlands and streams as defined by our process;

b. The EIS should address project design and location alternatives to include reasonable and the least environmentally damaging most practicable (LEDPA) alternative regarding effects on "waters of the U.S." in accordance with the enclosed CFR 40 Part 230 Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material;

c. A full wetland and stream functional assessment should be performed on all facilities associated with the project that would impact these resources, including but not limited to the mine site, utility corridors, power plant facility and etc. It is recommended that this be included in the EIS. The EIS should consider a pre and post project functional assessment;

d. It is requested that the EIS make an "analysis recommendation" on the 404(b) (1) Guidelines to include proposed mitigation for un-avoidable impacts to "waters of the U.S." for all portions of the proposed project. Recommendations should be assessed for any impacts associated with proposed impoundments and proposed stream relocations associated with the project;

e. The EIS should address any positive, negative, direct, indirect, secondary environmental, and cumulative impacts associated with the proposed project and all support facilities;

f. The EIS should consider the enclosed Memorandum from Mr. Howard Ladner, USACE Planning Division, dated October 22, 2008 on behalf of the USACE Operations Division.

g. The EIS should consider the comments prepared by Mr. Randall Harvey, USACE Engineering Division, on behalf of the USACE's Operations Division. Mr. Harvey states "the primary purpose of Okatibee Dam is to provide flood damage reduction benefits to downstream communities. As such, the Okatibee Dam and reservoir project was designed based on specific upstream hydrology. The proposed mine project immediately upstream of Okatibee may significantly alter the hydrology of the watershed. The EIS should provide an evaluation of impacts to quantity and timing of flows into Okatibee Lake. The analysis of cumulative effects should quantify the potential for increased flows to the Okatibee Dam and reservoir. Increased flows could be considered a significant adverse impact that would require mitigation. Another purpose of the reservoir is recreation. During periods of drought, the proposed detention facilities could alter flows and reduce the flows into the lake that are necessary to maintain operational pool elevations. The EIS should provide an evaluation of impacts to quantity and timing of flows into Okatibee Lake during drought conditions."

h. It is recommended that the EIS include a construction and operation schedule with the proposed project and support facilities for the IGCC.

We understand that there are multiple applicants for Section 404 permits associated with the proposed project being evaluated in the EIS. Each of these applicants will need to file a Department of the Army (DA) permit application for their individual projects associated with the EIS. As previously discussed, this District intends to utilize the EIS as an evaluation tool for all DA permits for any applicants associated with the proposed project. It is highly recommended that these applicants file their application with this office as soon as possible. At a minimum, the application package shall include a signed joint application notification; a brief scope of work for their involvement in the project; information relating to either an approved or preliminary jurisdictional determination; drawings to include site plans and any typical sections; and any supplemental information that would assist in the determination for a DA permit.

It is also recommended that a Programmatic Agreement (PA) be prepared with all interested parties as it relates to potential cultural resource impacts. At a minimum the PA coordination process and potential signatories should include the DOE, applicant (s), the Mississippi Department of Archives and History (MDAH), and any interested Native American Tribes. This office will assist in the preparation of the programmatic agreement and the tribal consultation process as requested by DOE.

Copies of this letter have been provided to Jack R. Huntley Project Manager Okatibee Lake, Mr. Howard Ladner, Mr. Randall Harvey, the U.S. Environmental Protection Agency Region 4, the U.S. Fish and Wildlife Service, the Mississippi Department of Environmental Quality; and the Mississippi Department of Archives and History. We appreciate the opportunity to serve as a cooperating agency and comment on the proposed project. If you have any questions or comments, please do not hesitate to contact me at telephone number (251) 694-3781 or by email at damon.m.young@usace.army.mil.

Sincerely,

Damon M. Young, P.G.
Project Manager, Inland Branch
Regulatory Division

Enclosures

Copy Furnished

CESAM-OP-OL
Attention: Mr. Jack R. Huntley

CESAM-PD-EI
Attention: Mr. Howard Ladner

CESAM-EN-HW
Attention: Mr. Randall Harvey, Chief

D. YOUNG/3781/awr 11/24/08
RD-I MDM 11/24/08
CHP 11/24
FILE

US Environmental Protection Agency
Region 4
Attention: Mr. Duncan Powell
Regulatory Program Region 4,
61 Forsyth Street, 15th Floor,
Atlanta, Georgia 30303

US Environmental Protection Agency
Region 4
Attention: Ms. Ramona McConney
Regulatory Program Region 4,
61 Forsyth Street, 15th Floor,
Atlanta, Georgia 30303

US Fish and Wildlife Service
Attention: Ms. Kathy Lunceford
6578 Dogwood View Parkway
Jackson, Mississippi 39213

Mississippi Department of Environmental Quality
Water Quality Certification Branch
Environmental Permits Division
Attention: Mrs. Florance Watson, P.E.
Post Office Box 10385
Jackson, Mississippi 39289-0385

Mississippi Department of
Archives and History
Attention: Mr. Jim Woodrick
Review and Compliance Officer
Post Office Box 571
Jackson, Mississippi 39205-0571

CFR 40 Part 230 Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material

Subpart B--Compliance With the Guidelines

Sec. 230.10 Restrictions on discharge.

Note: Because other laws may apply to particular discharges and because the Corps of Engineers or State 404 agency may have additional procedural and substantive requirements, a discharge complying with the requirement of these Guidelines will not automatically receive a permit.

Although all requirements in Sec. 230.10 must be met, the compliance evaluation procedures will vary to reflect the seriousness of the potential for adverse impacts on the aquatic ecosystems posed by specific dredged or fill material discharge activities.

(a) Except as provided under section 404(b)(2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

(1) For the purpose of this requirement, practicable alternatives include, but are not limited to:

(i) Activities which do not involve a discharge of dredged or fill material into the waters of the United States or ocean waters;

(ii) Discharges of dredged or fill material at other locations in waters of the United States or ocean waters;

(2) An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant, which could reasonably be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity may be considered.

(3) Where the activity associated with a discharge which is proposed for a special aquatic site (as defined in subpart E) does not require access or proximity to or sighting within the special aquatic site in question to fulfill its basic purpose (i.e., is not "water dependent"), practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. In addition, where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge, which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise.

(4) For actions subject to NEPA, where the Corps of Engineers is the permitting agency, the analysis of alternatives required for NEPA environmental documents, including supplemental Corps NEPA documents, will in most cases provide the information for the evaluation of alternatives under these Guidelines. On occasion, these

NEPA documents may address a broader range of alternatives than required to be considered under this paragraph or may not have considered the alternatives in sufficient detail to respond to the requirements of these Guidelines. In the latter case, it may be necessary to supplement these NEPA documents with this additional information.

(5) To the extent that practicable alternatives have been identified and evaluated under a Coastal Zone Management program, a section 208 program, or other planning process, such evaluation shall be considered by the permitting authority as part of the consideration of alternatives under the Guidelines. Where such evaluation is less complete than that contemplated under this subsection, it must be supplemented accordingly.

(b) No discharge of dredged or fill material shall be permitted if it:

(1) Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable State water quality standard;

(2) Violates any applicable toxic effluent standard or prohibition under section 307 of the Act;

(3) Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat which is determined by the Secretary of Interior or Commerce, as appropriate, to be a critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply, in lieu of this subparagraph;

(4) Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under title III of the Marine Protection, Research, and Sanctuaries Act of 1972.

(c) Except as provided under section 404(b)(2), no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of the waters of the United States. Findings of significant degradation related to the proposed discharge shall be based upon appropriate factual determinations, evaluations, and tests required by subparts B and G, after consideration of subparts C through F, with special emphasis on the persistence and permanence of the effects outlined in those subparts. Under these Guidelines, effects contributing to significant degradation considered individually or collectively, include:

(1) Significantly adverse effects of the discharge of pollutants on human health or welfare, including but not limited to effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites.

(2) Significantly adverse effects of the discharge of pollutants on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, and spread of pollutants or their byproducts outside of the disposal site through biological, physical, and chemical processes;

(3) Significantly adverse effects of the discharge of pollutants on aquatic ecosystem diversity, productivity, and stability. Such effects may include, but are not limited to, loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients, purify water, or reduce wave energy; or

(4) Significantly adverse effects of discharge of pollutants on recreational, aesthetic, and economic values.

(d) Except as provided under section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. Subpart H identifies such possible steps.

Sec. 230.11 Factual Determinations.

The permitting authority shall determine in writing the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment in light of subparts C through F. Such factual determinations shall be used in Sec. 230.12 in making findings of compliance or non-compliance with the restrictions on discharge in Sec. 230.10. The evaluation and testing procedures described in Sec. 230.60 and Sec. 230.61 of subpart G shall be used as necessary to make, and shall be described in, such determination. The determinations of effects of each proposed discharge shall include the following:

(a) Physical substrate determinations. Determine the nature and degree of effect that the proposed discharge will have, individually and cumulatively, on the characteristics of the substrate at the proposed disposal site. Consideration shall be given to the similarity in particle size, shape, and degree of compaction of the material proposed for discharge and the material constituting the substrate at the disposal site, and any potential changes in substrate elevation and bottom contours, including changes outside of the disposal site which may occur as a result of erosion, slumpage, or other movement of the discharged material. The duration and physical extent of substrate changes shall also be considered. The possible loss of environmental values (Sec. 230.20) and actions to minimize impact (subpart H) shall also be considered in making these determinations. Potential changes in substrate elevation and bottom contours shall be predicted on the basis of the proposed method, volume, location, and rate of discharge, as well as on the individual and combined effects of current patterns, water circulation, wind and wave action, and other physical factors that may affect the movement of the discharged material.

(b) Water circulation, fluctuation, and salinity determinations. Determine the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation. Consideration shall be given to water chemistry, salinity, clarity, color, odor, taste, dissolved gas levels, temperature, nutrients, and eutrophication plus other appropriate characteristics. Consideration shall also be given to the potential diversion or obstruction of flow, alterations of bottom contours, or other significant changes in the hydrologic regime. Additional consideration of the possible loss of environmental values (Secs. 230.23 through 230.25) and actions to minimize impacts (subpart H), shall be used in making these determinations. Potential significant effects on the current patterns, water circulation, normal water fluctuation and salinity shall be evaluated on the basis of the proposed method, volume, location, and rate of discharge.

(c) Suspended particulate/turbidity determinations. Determine the nature and degree of effect that the proposed discharge will have, individually and cumulatively, in terms of potential changes in the kinds and concentrations of suspended particulate/turbidity in the vicinity of the disposal site. Consideration shall be given to the grain size of the material proposed for discharge, the shape and size of the plume of suspended particulates, the duration of the discharge and resulting plume and whether or not the potential changes will cause violations of applicable water quality standards. Consideration should also be given to the possible loss of environmental values (Sec. 230.21) and to actions for minimizing impacts (subpart H). Consideration shall include the proposed method, volume, location, and rate of discharge, as well as the individual and combined effects of current patterns, water circulation and fluctuations, wind and wave action, and other physical factors on the movement of suspended particulates.

(d) Contaminant determinations. Determine the degree to which the material proposed for discharge will introduce, relocate, or increase contaminants. This determination shall consider the material to be discharged, the aquatic environment at the proposed disposal site, and the availability of contaminants.

(e) Aquatic ecosystem and organism determinations. Determine the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms. Consideration shall be given to the effect at the proposed disposal site of potential changes in substrate characteristics and elevation, water or substrate chemistry, nutrients, currents, circulation, fluctuation, and salinity, on the recolonization and existence of indigenous aquatic organisms or communities. Possible loss of environmental values (Sec. 230.31), and actions to minimize impacts (subpart H) shall be examined. Tests as described in Sec. 230.61 (Evaluation and Testing), may be required to provide information on the effect of the discharge material on communities, or populations of organisms expected to be exposed to it.

(f) Proposed disposal site determinations.

(1) Each disposal site shall be specified through the application of these Guidelines. The mixing zone shall be confined to the smallest practicable zone within each specified disposal site that is consistent with the type of dispersion determined to be appropriate by the application of these Guidelines. In a few special cases under unique environmental conditions, where there is adequate justification to show that widespread dispersion by natural means will result in no significantly adverse environmental effects, the discharged material may be intended to be spread naturally in a very thin layer over a large area of the substrate rather than be contained within the disposal site.

(2) The permitting authority and the Regional Administrator shall consider the following factors in determining the acceptability of a proposed mixing zone:

(i) Depth of water at the disposal site;

(ii) Current velocity, direction, and variability at the disposal site;

(iii) Degree of turbulence;

(iv) Stratification attributable to causes such as obstructions, salinity or density profiles at the disposal site;

(v) Discharge vessel speed and direction, if appropriate;

(vi) Rate of discharge;

(vii) Ambient concentration of constituents of interest;

(viii) Dredged material characteristics, particularly concentrations of constituents, amount of material, type of material (sand, silt, clay, etc.) and settling velocities;

(ix) Number of discharge actions per unit of time;

(x) Other factors of the disposal site that affect the rates and patterns of mixing.

(g) Determination of cumulative effects on the aquatic ecosystem.

(1) Cumulative impacts are the changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change, in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems.

(2) Cumulative effects attributable to the discharge of dredged or fill material in waters of the United States should be predicted to the extent reasonable and practical. The permitting authority shall collect information and solicit information from other sources about the cumulative impacts on the aquatic ecosystem. This information shall be documented and considered during the decision-making process concerning the evaluation of individual permit applications, the issuance of a General permit, and monitoring and enforcement of existing permits.

(h) Determination of secondary effects on the aquatic ecosystem.

(1) Secondary effects are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material. Information about secondary effects on aquatic ecosystems shall be considered prior to the time final section 404 action is taken by permitting authorities.

(2) Some examples of secondary effects on an aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with the operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, and leachate and runoff from a sanitary landfill located in waters of the U.S. Activities to be conducted on fast land created by the discharge of dredged or fill material in waters of the United States may have secondary impacts within those waters which should be considered in evaluating the impact of creating those fast lands.

Sec. 230.12 Findings of compliance or non-compliance with the restrictions on discharge.

(a) On the basis of these Guidelines (subparts C through G) the proposed disposal sites for the discharge of dredged or fill material must be:

(1) Specified as complying with the requirements of these Guidelines; or

(2) Specified as complying with the requirements of these Guidelines with the inclusion of appropriate and practicable discharge conditions (see subpart H) to minimize pollution or adverse effects to the affected aquatic ecosystems; or

(3) Specified as failing to comply with the requirements of these Guidelines where:

(i) There is a practicable alternative to the proposed discharge that would have less adverse effect on the aquatic ecosystem, so long as such alternative does not have other significant adverse environmental consequences; or

(ii) The proposed discharge will result in significant degradation of the aquatic ecosystem under Sec. 230.10(b) or (c); or

(iii) The proposed discharge does not include all appropriate and practicable measures to minimize potential harm to the aquatic ecosystem; or

(iv) There does not exist sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with these Guidelines.

(b) Findings under this section shall be set forth in writing by the permitting authority for each proposed discharge and made available to the permit applicant. These findings shall include the factual determinations required by Sec. 230.11, and a brief explanation of any adaptation of these Guidelines to the activity under consideration. In the case of a General permit, such findings shall be prepared at the time of issuance of that permit rather than for each subsequent discharge under the authority of that permit.

Subpart C--Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem

Note: The effects described in this subpart should be considered in making the factual determinations and the findings of compliance or non-compliance in subpart B.

Sec. 230.20 Substrate.

(a) The substrate of the aquatic ecosystem underlies open waters of the United States and constitutes the surface of wetlands. It consists of organic and inorganic solid materials and includes water and other liquids or gases that fill the spaces between solid particles.

(b) Possible loss of environmental characteristics and values: The discharge of dredged or fill material can result in varying degrees of change in the complex physical, chemical, and biological characteristics of the substrate. Discharges which alter substrate elevation or contours can result in changes in water circulation, depth, current pattern, water fluctuation and water temperature. Discharges may adversely affect bottom-dwelling organisms at the site by smothering immobile forms or forcing mobile forms to migrate. Benthic forms present prior to a discharge are unlikely to recolonize on the discharged material if it is very dissimilar from that of the discharge site. Erosion, slumping, or lateral displacement of surrounding bottom of such deposits can adversely affect areas of the substrate outside the perimeters of the disposal site by changing or destroying habitat. The bulk and composition of the discharged material and the location, method, and timing of discharges may all influence the degree of impact on the substrate.

Sec. 230.21 Suspended particulates/turbidity.

(a) Suspended particulates in the aquatic ecosystem consist of fine-grained mineral particles, usually smaller than silt, and organic particles. Suspended particulates may enter water bodies as a result of land runoff, flooding, vegetative and planktonic breakdown, resuspension of bottom sediments, and man's activities including dredging and filling. Particulates may remain suspended in the water column for variable periods of time as a result of such factors as agitation of the water mass, particulate specific gravity, particle shape, and physical and chemical properties of particle surfaces.

(b) Possible loss of environmental characteristics and values: The discharge of dredged or fill material can result in greatly elevated levels of suspended particulates in the water column for varying lengths of time. These new levels may reduce light penetration and lower the rate of photosynthesis and the primary productivity of an aquatic area if they last long enough. Sight-dependent species may suffer reduced feeding ability leading to limited growth and lowered resistance to disease if high levels of suspended particulates persist. The biological and the chemical content of the suspended material may react with the dissolved oxygen in the water, which can result in oxygen depletion. Toxic metals and organics, pathogens, and viruses absorbed or adsorbed to fine-grained particulates in the material may become biologically available to organisms either in the water column or on the substrate. Significant increases in suspended particulate levels create turbid plumes which are highly visible and aesthetically displeasing. The extent and persistence of these adverse impacts caused by discharges depend upon the relative increase in suspended particulates above the amount occurring naturally, the duration of the higher levels, the current patterns, water level, and fluctuations present when such discharges occur, the volume, rate, and duration of the discharge, particulate deposition, and the seasonal timing of the discharge.

Sec. 230.22 Water.

(a) Water is the part of the aquatic ecosystem in which organic and inorganic constituents are dissolved and suspended. It constitutes part of the liquid phase and is contained by the substrate. Water forms part of a dynamic aquatic life-supporting system. Water clarity, nutrients and chemical content, physical and biological content, dissolved gas levels, pH, and temperature contribute to its life-sustaining capabilities.

(b) Possible loss of environmental characteristics and values: The discharge of dredged or fill material can change the chemistry and the physical characteristics of the receiving water at a disposal site through the introduction of chemical constituents in suspended or dissolved form. Changes in the clarity, color, odor, and taste of water and the addition of contaminants can reduce or eliminate the suitability of water bodies for populations of aquatic organisms, and for human consumption, recreation, and aesthetics. The introduction of nutrients or organic material to the water column as a result of the discharge can lead to a high biochemical oxygen demand (BOD), which in turn can lead to reduced dissolved oxygen, thereby potentially affecting the survival of many aquatic organisms. Increases in nutrients can favor one group of organisms such as algae to the detriment of other more desirable types such as submerged aquatic vegetation, potentially causing adverse health effects, objectionable tastes and odors, and other problems.

Sec. 230.23 Current patterns and water circulation.

(a) Current patterns and water circulation are the physical movements of water in the aquatic ecosystem. Currents and circulation respond to natural forces as modified by basin shape and cover, physical and chemical characteristics of water strata and masses, and energy dissipating factors.

(b) Possible loss of environmental characteristics and values: The discharge of dredged or fill material can modify current patterns and water circulation by obstructing flow, changing the direction or velocity of water flow, changing the direction or velocity of water flow and circulation, or otherwise changing the dimensions of a water body. As a result, adverse changes can occur in: Location, structure, and dynamics of aquatic communities; shoreline and substrate erosion and depositon rates; the deposition of suspended particulates; the rate and extent of mixing of dissolved and suspended components of the water body; and water stratification.

Sec. 230.24 Normal water fluctuations.

(a) Normal water fluctuations in a natural aquatic system consist of daily, seasonal, and annual tidal and flood fluctuations in water level. Biological and physical components of such a system are either attuned to or characterized by these periodic water fluctuations.

(b) Possible loss of environmental characteristics and values: The discharge of dredged or fill material can alter the normal water-level fluctuation pattern of an area, resulting in prolonged periods of inundation, exaggerated extremes of high and low water, or a static, non-fluctuating water level. Such water level modifications may change salinity patterns, alter erosion or sedimentation rates, aggravate water temperature extremes, and upset the nutrient and dissolved oxygen balance of the aquatic ecosystem. In addition, these modifications can alter or destroy communities and populations of aquatic animals and vegetation, induce populations of nuisance organisms, modify habitat, reduce food supplies, restrict movement of aquatic fauna, destroy spawning areas, and change adjacent, upstream, and downstream areas.

Sec. 230.25 Salinity gradients.

(a) Salinity gradients form where salt water from the ocean meets and mixes with fresh water from land.

(b) Possible loss of environmental characteristics and values: Obstructions which divert or restrict flow of either fresh or salt water may change existing salinity gradients. For example, partial blocking of the entrance to an estuary or river mouth that significantly restricts the movement of the salt water into and out of that area can effectively lower the volume of salt water available for mixing within that estuary. The downstream migration of the salinity gradient can occur, displacing the maximum sedimentation zone and requiring salinity-dependent aquatic biota to adjust to the new conditions, move to new locations if possible, or perish. In the freshwater zone, discharge operations in the upstream regions can have equally adverse impacts. A significant reduction in the volume of fresh water moving into an estuary below that which is considered normal can affect the location and type of mixing thereby changing the characteristic salinity patterns. The resulting changed circulation pattern can cause the upstream migration of the salinity gradient displacing the maximum sedimentation zone. This migration may affect those organisms that are adapted to freshwater environments. It may also affect municipal water supplies.

Note: Possible actions to minimize adverse impacts regarding site characteristics can be found in subpart H.

Subpart D--Potential Impacts on Biological Characteristics of the Aquatic Ecosystem

Note: The impacts described in this subpart should be considered in making the factual determinations and the findings of compliance or non-compliance in subpart B.

Sec. 230.30 Threatened and endangered species.

(a) An endangered species is a plant or animal in danger of extinction throughout all or a significant portion of its range. A threatened species is one in danger of becoming an endangered species in the foreseeable future throughout all or a significant portion of its range. Listings of threatened and endangered species as well as critical habitats are maintained by some individual States and by the U.S. Fish and Wildlife Service of the Department of the Interior (codified annually at 50 CFR 17.11). The Department of Commerce has authority over some threatened and endangered marine mammals, fish and reptiles.

(b) Possible loss of values: The major potential impacts on threatened or endangered species from the discharge of dredged or fill material include:

(1) Covering or otherwise directly killing species;

(2) The impairment or destruction of habitat to which these species are limited. Elements of the aquatic habitat which are particularly crucial to the continued survival of some threatened or endangered species include adequate good quality water, spawning and maturation areas, nesting areas, protective cover, adequate and reliable food supply, and resting areas for migratory species. Each of these elements can be adversely affected by changes in either the normal water conditions for clarity, chemical content, nutrient balance, dissolved oxygen, pH, temperature, salinity, current patterns, circulation and fluctuation, or the physical removal of habitat; and

(3) Facilitating incompatible activities.

(c) Where consultation with the Secretary of the Interior occurs under section 7 of the Endangered Species Act, the conclusions of the Secretary concerning the impact(s) of the discharge on threatened and endangered species and their habitat shall be considered final.

Sec. 230.31 Fish, crustaceans, mollusks, and other aquatic organisms in the food web.

(a) Aquatic organisms in the food web include, but are not limited to, finfish, crustaceans, mollusks, insects, annelids, planktonic organisms, and the plants and animals on which they feed and depend upon for their needs. All forms and life stages of an organism, throughout its geographic range, are included in this category.

(b) Possible loss of values: The discharge of dredged or fill material can variously affect populations of fish, crustaceans, mollusks and other food web organisms through the release of contaminants which adversely affect adults, juveniles, larvae, or eggs, or result in the establishment or proliferation of an undesirable competitive species of plant or animal at the expense of the desired resident species. Suspended particulates settling on attached or buried eggs can smother the eggs by limiting or sealing off their exposure to oxygenated water. Discharge of dredged and fill material may result in the debilitation or death of sedentary organisms by smothering, exposure to chemical contaminants in dissolved or suspended form, exposure to high levels of suspended particulates, reduction in food supply, or alteration of the substrate upon which they are dependent. Mollusks are particularly sensitive to the discharge of material during periods of reproduction and growth and development due primarily to their limited mobility. They can be rendered unfit for human consumption by tainting, by production and accumulation of toxins, or by ingestion and retention of pathogenic organisms, viruses, heavy metals or persistent synthetic organic chemicals. The discharge of dredged or fill material can redirect, delay, or stop the reproductive and feeding movements of some species of fish and crustacean, thus preventing their aggregation in accustomed places such as spawning or nursery grounds and potentially leading to reduced populations. Reduction of detrital feeding species or other representatives of lower trophic levels can impair the flow of energy from primary consumers to higher trophic levels. The reduction or potential elimination of food chain organism populations decreases the overall productivity and nutrient export capability of the ecosystem.

Sec. 230.32 Other wildlife.

(a) Wildlife associated with aquatic ecosystems are resident and transient mammals, birds, reptiles, and amphibians.

(b) Possible loss of values: The discharge of dredged or fill material can result in the loss or change of breeding and nesting areas, escape cover, travel corridors, and preferred food sources for resident and transient wildlife species associated with the aquatic ecosystem. These adverse impacts upon wildlife habitat may result from changes in water levels, water flow and circulation, salinity, chemical content, and substrate characteristics and elevation. Increased water turbidity can adversely affect wildlife species which rely upon sight to feed, and disrupt the respiration and feeding of certain aquatic wildlife and food chain organisms. The availability of contaminants from the discharge of dredged or fill material may lead to the bioaccumulation of such contaminants in wildlife. Changes in such physical and chemical factors of the environment may favor the introduction of undesirable plant and animal species at the expense of resident species and communities. In some aquatic environments lowering plant and animal species diversity may disrupt the normal functions of the ecosystem and lead to reductions in overall biological productivity.

Note: Possible actions to minimize adverse impacts regarding characteristics of biological components of the aquatic ecosystem can be found in subpart H.

Subpart E--Potential Impacts on Special Aquatic Sites

Note: The impacts described in this subpart should be considered in making the factual determinations and the findings of compliance or non-compliance in subpart B. The definition of special aquatic sites is found in Sec. 230.3(q-1).

Sec. 230.40 Sanctuaries and refuges.

(a) Sanctuaries and refuges consist of areas designated under State and Federal laws or local ordinances to be managed principally for the preservation and use of fish and wildlife resources.

(b) Possible loss of values: Sanctuaries and refuges may be affected by discharges of dredged or fill material which will:

(1) Disrupt the breeding, spawning, migratory movements or other critical life requirements of resident or transient fish and wildlife resources;

(2) Create unplanned, easy and incompatible human access to remote aquatic areas;

(3) Create the need for frequent maintenance activity;

(4) Result in the establishment of undesirable competitive species of plants and animals;

(5) Change the balance of water and land areas needed to provide cover, food, and other fish and wildlife habitat requirements in a way that modifies sanctuary or refuge management practices;

(6) Result in any of the other adverse impacts discussed in subparts C and D as they relate to a particular sanctuary or refuge.

Sec. 230.41 Wetlands.

(a)(1) Wetlands consist of areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

(2) Where wetlands are adjacent to open water, they generally constitute the transition to upland. The margin between wetland and open water can best be established by

specialists familiar with the local environment, particularly where emergent vegetation merges with submerged vegetation over a broad area in such places as the lateral margins of open water, headwaters, rainwater catch basins, and groundwater seeps. The landward margin of wetlands also can best be identified by specialists familiar with the local environment when vegetation from the two regions merges over a broad area.

(3) Wetland vegetation consists of plants that require saturated soils to survive (obligate wetland plants) as well as plants, including certain trees, that gain a competitive advantage over others because they can tolerate prolonged wet soil conditions and their competitors cannot. In addition to plant populations and communities, wetlands are delimited by hydrological and physical characteristics of the environment. These characteristics should be considered when information about them is needed to supplement information available about vegetation, or where wetland vegetation has been removed or is dormant.

(b) Possible loss of values: The discharge of dredged or fill material in wetlands is likely to damage or destroy habitat and adversely affect the biological productivity of wetlands ecosystems by smothering, by dewatering, by permanently flooding, or by altering substrate elevation or periodicity of water movement. The addition of dredged or fill material may destroy wetland vegetation or result in advancement of succession to dry land species. It may reduce or eliminate nutrient exchange by a reduction of the system's productivity, or by altering current patterns and velocities. Disruption or elimination of the wetland system can degrade water quality by obstructing circulation patterns that flush large expanses of wetland systems, by interfering with the filtration function of wetlands, or by changing the aquifer recharge capability of a wetland. Discharges can also change the wetland habitat value for fish and wildlife as discussed in subpart D. When disruptions in flow and circulation patterns occur, apparently minor loss of wetland acreage may result in major losses through secondary impacts. Discharging fill material in wetlands as part of municipal, industrial or recreational development may modify the capacity of wetlands to retain and store floodwaters and to serve as a buffer zone shielding upland areas from wave actions, storm damage and erosion.

Sec. 230.42 Mud flats.

(a) Mud flats are broad flat areas along the sea coast and in coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems. When mud flats are inundated, wind and wave action may re-suspend bottom sediments. Coastal mud flats are exposed at extremely low tides and inundated at high tides with the water table at or near the surface of the substrate. The substrate of mud flats contains organic material and particles smaller in size than sand. They are either un-vegetated or vegetated only by algal mats.

(b) Possible loss of values: The discharge of dredged or fill material can cause changes in water circulation patterns which may permanently flood or dewater the mud flat or disrupt periodic inundation, resulting in an increase in the rate of erosion or accretion. Such changes can deplete or eliminate mud flat biota, foraging areas, and nursery areas. Changes in inundation patterns can affect the chemical and biological exchange and decomposition process occurring on the mud flat and change the deposition of suspended material affecting the productivity of the area. Changes may reduce the mud flat's capacity to dissipate storm surge runoff.

Sec. 230.43 Vegetated shallows.

(a) Vegetated shallows are permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation, such as turtle grass and eelgrass in estuarine or marine systems as well as a number of freshwater species in rivers and lakes.

(b) Possible loss of values: The discharge of dredged or fill material can smother vegetation and benthic organisms. It may also create unsuitable conditions for their continued vigor by:
(1) Changing water circulation patterns;
(2) releasing nutrients that increase undesirable algal populations;
(3) releasing chemicals that adversely affect plants and animals;
(4) increasing turbidity levels, thereby reducing light penetration and hence photosynthesis; and
(5) changing the capacity of a vegetated shallow to stabilize bottom materials and decrease channel shoaling. The discharge of dredged or fill material may reduce the value of vegetated shallows as nesting, spawning, nursery, cover, and forage areas, as well as their value in protecting shorelines from erosion and wave actions. It may also encourage the growth of nuisance vegetation.

Sec. 230.44 Coral reefs.

(a) Coral reefs consist of the skeletal deposit, usually of calcareous or silicaceous materials, produced by the vital activities of anthozoan polyps or other invertebrate organisms present in growing portions of the reef.

(b) Possible loss of values: The discharge of dredged or fill material can adversely affect colonies of reef building organisms by burying them, by releasing contaminants such as hydrocarbons into the water column, by reducing light penetration through the water, and by increasing the level of suspended particulates. Coral organisms are extremely sensitive to even slight reductions in light penetration or increases in suspended particulates. These adverse effects will cause a loss of productive colonies which in turn provide habitat for many species of highly specialized aquatic organisms.

Sec. 230.45 Riffle and pool complexes.

(a) Steep gradient sections of streams are sometimes characterized by riffle and pool complexes. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a coarse substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Pools are characterized by a slower stream velocity, a steaming flow, a smooth surface, and a finer substrate. Riffle and pool complexes are particularly valuable habitat for fish and wildlife.

(b) Possible loss of values: Discharge of dredged or fill material can eliminate riffle and pool areas by displacement, hydrologic modification, or sedimentation. Activities which affect riffle and pool areas and especially riffle/pool ratios, may reduce the aeration and filtration capabilities at the discharge site and downstream, may reduce stream habitat diversity, and may retard repopulation of the disposal site and downstream waters through sedimentation and the creation of unsuitable habitat. The discharge of dredged or fill material which alters stream hydrology may cause scouring or sedimentation of riffles and pools. Sedimentation induced through hydrological modification or as a direct result of the deposition of unconsolidated dredged or fill material may clog riffle and pool areas, destroy habitats, and create anaerobic conditions. Eliminating pools and meanders by the discharge of dredged or fill material can reduce water holding capacity of streams and cause rapid runoff from a watershed. Rapid runoff can deliver large quantities of flood water in a short time to downstream areas resulting in the destruction of natural habitat, high property loss, and the need for further hydraulic modification.

Note: Possible actions to minimize adverse impacts on site or material characteristics can be found in subpart H.

Subpart F--Potential Effects on Human Use Characteristics

Note: The effects described in this subpart should be considered in making the factual determinations and the findings of compliance or non-compliance in subpart B.

Sec. 230.50 Municipal and private water supplies.

(a) Municipal and private water supplies consist of surface water or ground water which is directed to the intake of a municipal or private water supply system.

(b) Possible loss of values: Discharges can affect the quality of water supplies with respect to color, taste, odor, chemical content and suspended particulate concentration, in such a way as to reduce the fitness of the water for consumption. Water can be rendered unpalatable or unhealthy by the addition of suspended particulates, viruses and pathogenic organisms, and dissolved materials. The expense of removing such substances before the water is delivered for consumption can be high. Discharges may also affect the quantity of water available for municipal and private water supplies. In addition, certain commonly used water treatment chemicals have the potential for combining with some suspended or dissolved substances from dredged or fill material to form other products that can have a toxic effect on consumers.

Sec. 230.51 Recreational and commercial fisheries.

(a) Recreational and commercial fisheries consist of harvestable fish, crustaceans, shellfish, and other aquatic organisms used by man.

(b) Possible loss of values: The discharge of dredged or fill materials can affect the suitability of recreational and commercial fishing grounds as habitat for populations of consumable aquatic organisms. Discharges can result in the chemical contamination of recreational or commercial fisheries. They may also interfere with the reproductive success of recreational and commercially important aquatic species through disruption of migration and spawning areas. The introduction of pollutants at critical times in their life cycle may directly reduce populations of commercially important aquatic organisms or indirectly reduce them by reducing organisms upon which they depend for food. Any of these impacts can be of short duration or prolonged, depending upon the physical and chemical impacts of the discharge and the biological availability of contaminants to aquatic organisms.

Sec. 230.52 Water-related recreation.

(a) Water-related recreation encompasses activities undertaken for amusement and relaxation. Activities encompass two broad categories of use: consumptive, e.g., harvesting resources by hunting and fishing; and non-consumptive, e.g. canoeing and sight-seeing.

(b) Possible loss of values: One of the more important direct impacts of dredged or fill disposal is to impair or destroy the resources, which support recreation activities. The disposal of dredged or fill material may adversely modify or destroy water use for recreation by changing turbidity, suspended particulates, temperature, dissolved oxygen, dissolved materials, toxic materials, pathogenic organisms, quality of habitat, and the aesthetic qualities of sight, taste, odor, and color.

Sec. 230.53 Aesthetics.

(a) Aesthetics associated with the aquatic ecosystem consist of the perception of beauty by one or a combination of the senses of sight, hearing, touch, and smell. Aesthetics of aquatic ecosystems apply to the quality of life enjoyed by the general public and property owners.

(b) Possible loss of values: The discharge of dredged or fill material can mar the beauty of natural aquatic ecosystems by degrading water quality, creating distracting disposal sites, inducing inappropriate development, encouraging unplanned and incompatible human access, and by destroying vital elements that contribute to the compositional harmony or unity, visual distinctiveness, or diversity of an area. The discharge of dredged or fill material can adversely affect the particular features, traits, or characteristics of an aquatic area which make it valuable to property owners. Activities which degrade water quality, disrupt natural substrate and vegetational characteristics, deny access to or visibility of the resource, or result in changes in odor, air quality, or noise levels may reduce the value of an aquatic area to private property owners.

Sec. 230.54 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.

(a) These preserves consist of areas designated under Federal and State laws or local ordinances to be managed for their aesthetic, educational, historical, recreational, or scientific value.

(b) Possible loss of values: The discharge of dredged or fill material into such areas may modify the aesthetic, educational, historical, recreational and/or scientific qualities thereby reducing or eliminating the uses for which such sites are set aside and managed.

Note: Possible actions to minimize adverse impacts regarding site or material characteristics can be found in subpart H.

Subpart G--Evaluation and Testing

Sec. 230.60 General evaluation of dredged or fill material.

The purpose of these evaluation procedures and the chemical and biological testing sequence outlined in Sec. 230.61 is to provide information to reach the determinations required by Sec. 230.11. Where the results of prior evaluations, chemical and biological tests, scientific research, and experience can provide information helpful in making a determination, these should be used. Such prior results may make new testing unnecessary. The information used shall be documented. Where the same information applies to more than one determination, it may be documented once and referenced in later determinations.

(a) If the evaluation under paragraph (b) indicates the dredged or fill material is not a carrier of contaminants, then the required determinations pertaining to the presence and effects of contaminants can be made without testing. Dredged or fill material is most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material. Dredged material so composed is generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels. However, when such material is discolored or contains other indications that contaminants may be present, further inquiry should be made.

(b) The extraction site shall be examined in order to assess whether it is sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material is not a carrier of contaminants. Factors to be considered include but are not limited to:

(1) Potential routes of contaminants or contaminated sediments to the extraction site, based on hydrographic or other maps, aerial photography, or other materials that show watercourses, surface relief, proximity to tidal movement, private and public roads, location of buildings, municipal and industrial areas, and agricultural or forest lands.

(2) Pertinent results from tests previously carried out on the material at the extraction

site, or carried out on similar material for other permitted projects in the vicinity. Materials shall be considered similar if the sources of contamination, the physical configuration of the sites and the sediment composition of the materials are comparable, in light of water circulation and stratification, sediment accumulation and general sediment characteristics. Tests from other sites may be relied on only if no changes have occurred at the extraction sites to render the results irrelevant. (3) Any potential for significant introduction of persistent pesticides from land runoff or percolation;

(4) Any records of spills or disposal of petroleum products or substances designated as hazardous under section 311 of the Clean Water Act (See 40 CFR part 116);

(5) Information in Federal, State and local records indicating significant introduction of pollutants from industries, municipalities, or other sources, including types and amounts of waste materials discharged along the potential routes of contaminants to the extraction site; and

(6) Any possibility of the presence of substantial natural deposits of minerals or other substances which could be released to the aquatic environment in harmful quantities by man-induced discharge activities.

(c) To reach the determinations in Sec. 230.11 involving potential effects of the discharge on the characteristics of the disposal site, the narrative guidance in subparts C through F shall be used along with the general evaluation procedure in Sec. 230.60 and, if necessary, the chemical and biological testing sequence in Sec. 230.61. Where the discharge site is adjacent to the extraction site and subject to the same sources of contaminants, and materials at the two sites are substantially similar, the fact that the material to be discharged may be a carrier of contaminants is not likely to result in degradation of the disposal site. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to less contaminated areas, testing will not be required.

(d) Even if the Sec. 230.60(b) evaluation (previous tests, the presence of polluting industries and information about their discharge or runoff into waters of the U.S., bio-inventories, etc.) leads to the conclusion that there is a high probability that the material proposed for discharge is a carrier of contaminants, testing may not be necessary if constraints are available to reduce contamination to acceptable levels within the disposal site and to prevent contaminants from being transported beyond the boundaries of the disposal site, if such constraints are acceptable to the permitting authority and the Regional Administrator, and if the potential discharger is willing and able to implement such constraints. However, even if tests are not performed, the permitting authority must still determine the probable impact of the operation on the receiving aquatic ecosystem. Any decision not to test must be explained in the determinations made under Sec. 230.11.
Sec. 230.61 Chemical, biological, and physical evaluation and testing.

Note: The Agency is today proposing revised testing guidelines. The evaluation and testing procedures in this section are based on the 1975 section 404(b)(1) interim final Guidelines and shall remain in effect until the revised testing guidelines are published as final regulations.

(a) No single test or approach can be applied in all cases to evaluate the effects of proposed discharges of dredged or fill materials. This section provides some guidance in determining which test and/or evaluation procedures are appropriate in a given case. Interim guidance to applicants concerning the applicability of specific approaches or procedures will be furnished by the permitting authority.

(b) Chemical-biological interactive effects. The principal concerns of discharge of dredged or fill material that contain contaminants are the potential effects on the water column and on communities of aquatic organisms.

(1) Evaluation of chemical-biological interactive effects. Dredged or fill material may be excluded from the evaluation procedures specified in paragraphs (b) (2) and (3) of this section if it is determined, on the basis of the evaluation in Sec. 230.60, that the likelihood of contamination by contaminants is acceptably low, unless the permitting authority, after evaluating and considering any comments received from the Regional Administrator, determines that these procedures are necessary. The Regional Administrator may require, on a case-by-case basis, testing approaches and procedures by stating what additional information is needed through further analyses and how the results of the analyses will be of value in evaluating potential environmental effects. If the General Evaluation indicates the presence of a sufficiently large number of chemicals to render impractical the identification of all contaminants by chemical testing, information may be obtained from bioassays in lieu of chemical tests.

(2) Water column effects.

(i) Sediments normally contain constituents that exist in various chemical forms and in various concentrations in several locations within the sediment. An elutriate test may be used to predict the effect on water quality due to release of contaminants from the sediment to the water column. However, in the case of fill material originating on land which may be a carrier of contaminants, a water leachate test is appropriate.

(ii) Major constituents to be analyzed in the elutriate are those deemed critical by the permitting authority, after evaluating and considering any comments received from the Regional Administrator, and considering results of the evaluation in Sec. 230.60. Elutriate concentrations should be compared to concentrations of the same constituents in water from the disposal site. Results should be evaluated in light of the volume and rate of the intended discharge, the type of discharge, the hydrodynamic regime at the disposal site, and other information relevant to the impact on water quality. The permitting authority should consider the mixing zone in evaluating water column effects. The permitting authority may specify bioassays when such procedures will be of value.

(3) Effects on benthos. The permitting authority may use an appropriate benthic bioassay (including bioaccumulation tests) when such procedures will be of value in assessing ecological effects and in establishing discharge conditions.

(c) Procedure for comparison of sites.

(1) When an inventory of the total concentration of contaminants would be of value in comparing sediment at the dredging site with sediment at the disposal site, the permitting authority may require a sediment chemical analysis. Markedly different concentrations of contaminants between the excavation and disposal sites may aid in making an environmental assessment of the proposed disposal operation. Such differences should be

interpreted in terms of the potential for harm as supported by any pertinent scientific literature.

(2) When an analysis of biological community structure will be of value to assess the potential for adverse environmental impact at the proposed disposal site, a comparison of the biological characteristics between the excavation and disposal sites may be required by the permitting authority. Biological indicator species may be useful in evaluating the existing degree of stress at both sites. Sensitive species representing community components colonizing various substrate types within the sites should be identified as possible bioassay organisms if tests for toxicity are required. Community structure studies should be performed only when they will be of value in determining discharge conditions. This is particularly applicable to large quantities of dredged material known to contain adverse quantities of toxic materials. Community studies should include benthic organisms such as microbiota and harvestable shellfish and finfish. Abundance, diversity, and distribution should be documented and correlated with substrate type and other appropriate physical and chemical environmental characteristics.

(d) Physical tests and evaluation. The effect of a discharge of dredged or fill material on physical substrate characteristics at the disposal site, as well as on the water circulation, fluctuation, salinity, and suspended particulates content there, is important in making factual determinations in Sec. 230.11. Where information on such effects is not otherwise available to make these factual determinations, the permitting authority shall require appropriate physical tests and evaluations as are justified and deemed necessary. Such tests may include sieve tests, settleability tests, compaction tests, mixing zone and suspended particulate plume determinations, and site assessments of water flow, circulation, and salinity characteristics.

Subpart H--Actions To Minimize Adverse Effects

Note: There are many actions which can be undertaken in response to Sec. 203.10(d) to minimize the adverse effects of discharges of dredged or fill material. Some of these, grouped by type of activity, are listed in this subpart.

Sec. 230.70 Actions concerning the location of the discharge.

The effects of the discharge can be minimized by the choice of the disposal site. Some of the ways to accomplish this are by:

(a) Locating and confining the discharge to minimize smothering of organisms;

(b) Designing the discharge to avoid a disruption of periodic water inundation patterns;

(c) Selecting a disposal site that has been used previously for dredged material discharge;

(d) Selecting a disposal site at which the substrate is composed of material similar to that being discharged, such as discharging sand on sand or mud on mud;

(e) Selecting the disposal site, the discharge point, and the method of discharge to minimize the extent of any plume;

(f) Designing the discharge of dredged or fill material to minimize or prevent the creation of standing bodies of water in areas of normally fluctuating water levels, and minimize or prevent the drainage of areas subject to such fluctuations.

Sec. 230.71 Actions concerning the material to be discharged.

The effects of a discharge can be minimized by treatment of, or limitations on the material itself, such as:

(a) Disposal of dredged material in such a manner that physiochemical conditions are maintained and the potency and availability of pollutants are reduced.

(b) Limiting the solid, liquid, and gaseous components of material to be discharged at a particular site;

(c) Adding treatment substances to the discharge material;

(d) Utilizing chemical flocculants to enhance the deposition of suspended particulates in diked disposal areas.

Sec. 230.72 Actions controlling the material after discharge.

The effects of the dredged or fill material after discharge may be controlled by:

(a) Selecting discharge methods and disposal sites where the potential for erosion, slumping or leaching of materials into the surrounding aquatic ecosystem will be reduced. These sites or methods include, but are not limited to:
(1) Using containment levees, sediment basins, and cover crops to reduce erosion;
(2) Using lined containment areas to reduce leaching where leaching of chemical constituents from the discharged material is expected to be a problem;

(b) Capping in-place contaminated material with clean material or selectively discharging the most contaminated material first to be capped with the remaining material;

(c) Maintaining and containing discharged material properly to prevent point and nonpoint sources of pollution;

(d) Timing the discharge to minimize impact, for instance during periods of unusual high water flows, wind, wave, and tidal actions.

Sec. 230.73 Actions affecting the method of dispersion.

The effects of a discharge can be minimized by the manner in which it is dispersed, such as:

(a) Where environmentally desirable, distributing the dredged material widely in a thin layer at the disposal site to maintain natural substrate contours and elevation;

(b) Orienting a dredged or fill material mound to minimize undesirable obstruction to the water current or circulation pattern, and utilizing natural bottom contours to minimize the size of the mound;

(c) Using silt screens or other appropriate methods to confine suspended particulate/turbidity to a small area where settling or removal can occur;

(d) Making use of currents and circulation patterns to mix, disperse and dilute the discharge;

(e) Minimizing water column turbidity by using a submerged diffuser system. A similar effect can be accomplished by submerging pipeline discharges or otherwise releasing materials near the bottom;

(f) Selecting sites or managing discharges to confine and minimize the release of suspended particulates to give decreased turbidity levels and to maintain light penetration for organisms;

(g) Setting limitations on the amount of material to be discharged per unit of time or volume of receiving water.

Sec. 230.74 Actions related to technology.

Discharge technology should be adapted to the needs of each site. In determining whether the discharge operation sufficiently minimizes adverse environmental impacts, the applicant should consider:

(a) Using appropriate equipment or machinery, including protective devices, and the use of such equipment or machinery in activities related to the discharge of dredged or fill material;

(b) Employing appropriate maintenance and operation on equipment or machinery, including adequate training, staffing, and working procedures;

(c) Using machinery and techniques that are especially designed to reduce damage to wetlands. This may include machines equipped with devices that scatter rather than mound excavated materials, machines with specially designed wheels or tracks, and the use of mats under heavy machines to reduce wetland surface compaction and rutting;

(d) Designing access roads and channel spanning structures using culverts, open channels, and diversions that will pass both low and high water flows, accommodate fluctuating water levels, and maintain circulation and faunal movement;

(e) Employing appropriate machinery and methods of transport of the material for discharge.

Sec. 230.75 Actions affecting plant and animal populations.

Minimization of adverse effects on populations of plants and animals can be achieved by:

(a) Avoiding changes in water current and circulation patterns which would interfere with the movement of animals;

(b) Selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species which have a competitive edge ecologically over indigenous plants or animals;

(c) Avoiding sites having unique habitat or other value, including habitat of threatened or endangered species;

(d) Using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics. Habitat development and restoration techniques can be used to minimize adverse impacts and to compensate for destroyed habitat. Use techniques that have been demonstrated to be effective in circumstances similar to those under consideration wherever possible. Where proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiate their use on a small scale to allow corrective action if unanticipated adverse impacts occur;

(e) Timing discharge to avoid spawning or migration seasons and other biologically critical time periods;

(f) Avoiding the destruction of remnant natural sites within areas already affected by development.

Sec. 230.76 Actions affecting human use.

Minimization of adverse effects on human use potential may be achieved by:

(a) Selecting discharge sites and following discharge procedures to prevent or minimize any potential damage to the aesthetically pleasing features of the aquatic site (e.g. viewscapes), particularly with respect to water quality;

(b) Selecting disposal sites which are not valuable as natural aquatic areas;

(c) Timing the discharge to avoid the seasons or periods when human recreational activity associated with the aquatic site is most important;

(d) Following discharge procedures which avoid or minimize the disturbance of aesthetic features of an aquatic site or ecosystem;

(e) Selecting sites that will not be detrimental or increase incompatible human activity, or require the need for frequent dredge or fill maintenance activity in remote fish and wildlife areas;

(f) Locating the disposal site outside of the vicinity of a public water supply intake.

Sec. 230.77 Other actions.

(a) In the case of fills, controlling runoff and other discharges from activities to be conducted on the fill;

(b) In the case of dams, designing water releases to accommodate the needs of fish and wildlife;

(c) In dredging projects funded by Federal agencies other than the Corps of Engineers, maintain desired water quality of the return discharge through agreement with the Federal funding authority on scientifically defensible pollutant concentration levels in addition to any applicable water quality standards;

(d) When a significant ecological change in the aquatic environment is proposed by the discharge of dredged or fill material, the permitting authority should consider the ecosystem that will be lost as well as the environmental benefits of the new system.

Subpart I--Planning To Shorten Permit Processing Time

Sec. 230.80 Advanced identification of disposal areas.

(a) Consistent with these Guidelines, EPA and the permitting authority, on their own initiative or at the request of any other party and after consultation with any affected State that is not the permitting authority, may identify sites which will be considered as:

  (1) Possible future disposal sites, including existing disposal sites and non-sensitive areas; or

  (2) Areas generally unsuitable for disposal site specification;

(b) The identification of any area as a possible future disposal site should not be deemed to constitute a permit for the discharge of dredged or fill material within such area or a specification of a disposal site. The identification of areas that generally will not be available for disposal site specification should not be deemed as prohibiting applications for permits to discharge dredged or fill material in such areas. Either type of identification constitutes information to facilitate individual or General permit application and processing.

(c) An appropriate public notice of the proposed identification of such areas shall be issued;

(d) To provide the basis for advanced identification of disposal areas, and areas unsuitable for disposal, EPA and the permitting authority shall consider the likelihood that use of the area in question for dredged or fill material disposal will comply with these Guidelines. To facilitate this analysis, EPA and the permitting authority should review available water resources management data including data available from the public, other Federal and State agencies, and information from approved Coastal Zone Management programs and River Basin Plans;

(e) The permitting authority should maintain a public record of the identified areas and a written statement of the basis for identification.

MEMORANDUM

Date: October 22, 2008

To: CESAM-RD

From: CESAM-PD-EI, Howard Ladner, Biologist

Subject: OP/PD Concerns for Proposed Kemper County Mine Site North of Lake Okatibbee

PD-EI has been requested by OP to review the above proposal. Our review is limited to potential for the proposed action to impact the federal project. Our preliminary review finds that there appears to be no "direct" impact to the federal project. However, there is a potential for significant impacts from secondary and cumulative effects. Specifically, we are concerned with the items listed below. The DOE EIS must address these concerns. All issues found to be significant must be mitigated.

Our issues are as follows:

1. The proposal has the potential to impact area hydrology. EN-HW provided comments on this concern. Further concern exists relative to the potential to lower the groundwater table in the area. This could impact water supply to adjacent federally owned wetlands and the lake itself.
2. Water quality entering and subsequently within the lake could be impacted. The EIS should address potential changes in dissolved oxygen, suspended solids, temperature, pH, contaminates (heavy metals, hydrocarbons, etc.) in the water entering the lake and the lake itself. The EIS should address Lake Okatibbee as a recreational use, flood control and drinking water supply lake. In review of potential effects from contaminates, potential of bioaccumulation of contaminates (especially mercury) in food fishes found within the lake should be considered. The review should also address airborne emissions from the power plant that have the potential to "settle" into the lake and wash in after settling in the surrounding watershed.
3. Typically, you hear nutrification used in a negative context, but a certain nutrient level can be beneficial to a lake's productivity. The EIS should address how land use conversion (from farm land to mine or other use) will affect the quantity and composition of nutrients entering the lake. A reduction of nutrients could have significant effects to the lake's ecosystem and subsequent recreational use.
4. The EIS should address mine reclamation and restoration, specifically related to replacement of lost functions and values of streams and wetlands within this specific watershed.
5. Further, we encourage RD explore all potential options for Sec. 404 mitigation within this specific watershed. The benefits derived from the mitigation should result in benefits to the federal project, and
6. Long term management of sedimentation ponds should be addressed.

Please forward our concerns to the DOE for inclusion into the NEPA process.

Thank You

JOINT APPLICATION AND NOTIFICATION

U.S. DEPARTMENT OF ARMY CORPS OF ENGINEERS
MISSISSIPPI DEPARTMENT OF MARINE RESOURCES
MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY/OFFICE OF POLLUTION CONTROL

This form is to be used for porposed activities in waters of the United States of Mississippi and for the erection of structures on suitable sites for water dependent industry. Note that some items, as indicated, apply only to projects located in the coastal area of Hancock, Harrison, and Jackson Counties.	**1. Date** month day year

2. Applicant (mailing address and telephone)	**Agent name, address and telephone**	**3. Official use only** COE ___________________________ DMR ___________________________ DEQ ___________________________ A95 ___________________________ DATE RECEIVED _________________

4. Project location

Street Address____ City/Community _________________________

Name of Waterway ___________________________________ Latitude __________ Longitude (if known) _________

Geographic location: Section ___________Township _____________ Range _____________ County _____________

5. Project description New work____________ Maintenance work___________

Dredging

_____ Channel length _______________ width _______________ existing depth _________________ proposed depth___________

_____ Canal length _______________ width _______________ existing depth _________________ proposed depth___________

_____ Boat Slip length _______________ width _______________ existing depth _________________ proposed depth___________

_____ Other (explain) length _______________ width _______________ existing depth _________________ proposed depth___________

Cubic yards of material to be removed ______________________ Type of material _____________________________

Location of spoil disposal area ____

Dimensions of spoil area _________________________________ Method of excavation _________________________

How will excavated material be contained? ____

Construction of structures

_____ Bulkhead Total Length ______________ Height above water _______________

_____ Pier length _________________ width ______________________ height _____________________

_____ Boat Ramp length _________________ width ______________________ height _____________________

_____ Boat House length _________________ width ______________________ height _____________________

_____ Structures on designed sites for water dependent industry (Coastal area only). Explain in Item 11 or include as an attachment.

_____ Other (explain) ____

Filling

Dimensions of fill area ____

Cubic yards to fill ____ Type to fill ______________________________

Other regulated activities (i.e. Seismic exploration, burning or clearing of marsh) Explain.

____

____

____

____

6. Additional information relating to the proposed activity

Does project area contain any marsh vegetation? Yes _______ No ________ (If yes, explain) _____________________

Is any portion of the activity for which authorization is sought now complete? Yes ______ No ______

(If yes, explain) ____

Mouth and year activity took place ____

If project is for maintenance work on existing structures or existing channels, describe legal authorization for the existing work. Provide permit number, dates or other form(s) of authorization. ________________________________

Has any agency denied approval for the activity described herein or for any activity that is directly related to the activity described herein? Yes ______ No ______ (If yes, explain) ____

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7. Project schedule

Proposed start date ________________________________ Proposed completion date __________________

Expected completion date (or development timetable) for any projects dependent on the activity described herein.

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8. Estimated cost of the project ____

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9. Describe the purpose of this project. Describe the relationship between this project and any secondary or future development the project is designed to support. ______________________________

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10. Describe the public benefits of the proposed activity and of the projects dependent on the proposed activity. Also describe the extent of public use of the proposed project. _______________________

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11. Remarks

12. Provide the names and addresses of the adjacent property owners. Also identify the property owners on the plan view of the drawing described in Attachment "A". (Attach additional sheets if necessary.)

1) 2)

13. List all approvals or certifications received or applied for from Federal, State and Local agencies for any structures, construction, discharges, deposits or other activities described in this application. Note that the signature in item 14 certifies that application has been made to or that permits are not required, place N/A in the space for Type Approval.

Agency	Type Approval	Application Date	Approval Date
Dept. of Environmental Quality			
Department of Marine Resources			
U.S. Army Corps of Engineers			
City/County ___________________			
Other ________________________			

14. Certification and signatures

Application is hereby made for authorization to conduct the activities described herein. I agree to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable state water quality standards or other environmental protection standards both during construction and after the project is completed. I also agree to provide entry to the project site for inspectors from the environmental protection agencies for the purpose of making preliminary analyses of the site and monitoring permitted works. I certify that I am familiar with and responsible for the information contained in this application, and that to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I am the owner of the property where the proposed project is located or that I have a legal interest in the property and that I have full legal authority to seek this permit.

Signature of Applicant or Agent Date

I8 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willingly falsifies, conceals, or covers up by any trick, scheme or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

15. Mississippi Coastal Program (Coastal area only)

I certify that the proposed project for which authorization is sought complies with the approved Mississippi Coastal Program and will be conducted in a manner consistent with the program.

Signature of Applicant or Agent Date

16. Fees

Payable to State of Mississippi	Please include appropriate fees for all projects proposed in coastal areas of Hancock, Harrison and Jackson counties.
$50.00 Residential	
$500.00 Commercial	
$50.00 Cost of public notice fee	

17. If project is in Hancock, Harrison or Jackson counties, send one completed copy of this application form and appropriate fees listed in Item 16 to:

MS Department of Marine Resources
1141 Bayview Avenue, Suite 101
Biloxi, MS 39530

If project <u>IS NOT</u> in Hancock, Harrison or Jackson Counties, send one completed copy of this application form to each agency listed below:

District Engineer
U.S. Army Engineer
District Mobile
Attn: SAMOP-S
P.O. Box 2288
Mobile, AL 36628

District Engineer
U.S. Army Engineer
District Vicksburg
Attn: LMKOD-FE
P.O. Box 60
Vicksburg, MS 39180

Director
MS Dept. of Environmental Quality
Office of Pollution Control
P.O. Box 10385
Jackson, MS 39289

18. In addition to the completed application form, the following attachments are required:

Attachment "A" Drawings

Provide a vicinity map showing the location of the proposed site along with a written description of how to reach the site from major highways or landmarks. Provide accurate drawings of the project site with proposed activities shown in detail. All drawings must be to scale or with dimensions noted on drawings and must show a plan view and cross section or elevation. Use 8 1/2 x 11" white paper or drawing sheet attached.

Attachment "B" Authorized Agent

If applicant desires to have an agent or consultant act in his behalf for permit coordination, a signed authorization designating said agent must be provided with the application forms. The authorized agent named may sign the application forms and the consistency statement.

Attachment "C" Environmental Assessment

Provide an appropriate report or statement assessing environmental impacts of the proposed activity and the final project dependent on it. The project's effects on the wetlands and the effects on the list dependent on them should be addressed. Also provide a complete description of any measures to be taken to reduce detrimental offsite effects to the coastal wetlands during and after the proposed activity. Alternative analysis, minimization and mitigation information may be required to complete project evaluation.

Attachment "D" Variance or Revisions to Mississippi Coastal Program *(Coastal area only)*

If the applicant is requesting a variance to the guidelines in Section 2, Part III, or a revision to the Coastal Wetlands Use Plan in Section 2, Part IV of the Rules and Regulations, Guidelines and Procedures of the Mississippi Coastal Program, a request and justification must be provided.

Attachment "A" Drawings

Application by:

Sheet _______ of _______

Date __________________

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

December 11, 2008

Mr. Richard A. Hargis
U.S. Department of Energy
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236

RE: **EPA Scoping Comments Regarding
Early Coordination for the
Kemper County IGCC and Lignite Mine
Notice of Intent
Florence County, SC**

Dear Mr. Hargis:

The U.S. Environmental Protection Agency (EPA), pursuant to Section 102(2)(C) of the National Environmental Policy Act (NEPA), and Section 309 of the Clean Air Act, reviewed the subject Notice of Intent (NOI) for the proposed lignite mine and power plant rated for 550 MW. We appreciate your early coordination with us. The purpose of this letter is to convey our comments regarding topics to be addressed in the Draft Environmental Impact Statement (DEIS).

The proposed action for Department of Energy (DOE) is to provide cost-shared funding under CCPI for the proposed project. Project development will include the lignite mine and electrical generating station structure and facilities that include an intake and discharge structures, cooling towers, and roads. The emissions reduction advantages of an Integrated Gasification and Combined Cycle (IGCC) system include less SO_2, NO_x, Hg and particulate emissions than produced by conventional coal-fired power plants.

Evaluation of the impacts during preparation of the DEIS may require various forms of modeling and risk assessment. The Notice of Intent (NOI) identifies the following environmental areas of concern: air quality, water resources, land use, waste, aesthetic impacts, floodplain impacts, wetlands, ecological, safety and health, construction and community impacts, cultural and archaeological resources and cumulative effects.

In addition, alternatives are a particular area of concern in the NEPA process. Technology alternatives, site location alternatives, and their influence on potential impacts should be fully considered and evaluated in the upcoming DEIS.

Our detailed scoping comments are enclosed, and we appreciate the opportunity to provide these comments. Our NEPA review will be coordinated by Ramona McConney (404/562-9615), with technical assistance from representatives in other EPA programs. If you have questions, please coordinate with us at your convenience.

Sincerely,

Heinz J. Mueller, Chief
NEPA Program Office
Office of Policy and Management

Enclosure

Cc: Skip Young, P.G., USACOE Mobile District

EPA Scoping Comments for
Kemper County IGCC and Lignite Mine
Notice of Intent
Florence County, SC

NEPA Process

In addition to the lignite mine and power plant, we consider the interconnection of a transmission line, natural gas supply pipeline, carbon dioxide pipeline, site access and fuel handling infrastructure also parts of the project. The Environmental Impact Statement (EIS) should evaluate the impacts of these actions as direct project impacts, and not as indirect (induced) or cumulative impacts, or as a connected action.

Purpose and Need

The DOE, the Corps of Engineers (COE) and the applicant have distinct perspectives on the purpose and need for the project. The purpose and need for this project should be fully disclosed in the Draft EIS (DEIS), with respect to demonstrating the feasibility of the IGCC technology, projected power generation needs, and determining the least damaging practicable alternative which would minimize environmental impacts.

In addition to the DOE and COE purpose and need statements, we also suggest that the applicant's purpose and need for the proposed project be included in the EIS. This should include the proposed size of the plant (nominally 550 MW) be translated to the number of average homes in the Mississippi area that would be served by the facility. We assume this might be 300-400 homes per MW. In this way, the need for the proposed plant could be evaluated further.

The EPA recommends that all growth rate projection data presented in the DEIS be substantiated in the document, since many interpretations may exist. This data should take industrial, commercial, and institutional users into consideration, as well as residential growth.

Alternatives

We request that a broad range of alternatives be provided, consistent with NEPA. The EIS should evaluate alternative technologies for generating power. Potential rejection of alternative technologies should be documented, with environmental reasons included in the rationale. The No Action Alternative should also be considered.

Alternative sites: While the Kemper County site is the applicant's preferred site for the proposed project, a minimum of three alternative sites should be considered in the EIS, consistent with NEPA. Potential rejection of alternative sites should be documented, with environmental reasons included in the rationale. The EIS should also provide a discussion on the option of expanding an existing generating station site versus construction of a new "greenfield" site. The No Action Alternative should also be considered.

The EIS should identify the potential site locations in MS, and outline the considerations that led to Kemper County being selected. Considerations should include fuel (coal) location, fuel transportation costs, existing fuel transportation corridors, existing land uses, age and integrity of existing power generation plants, and potential increase in power uses, and other environmental and siting factors.

If the Kemper County site goes forward as the preferred alternative in the EIS, the environmental consequences of the proposed project may be buffered (given the size of the overall complex and depending on the configuration of the plant within the complex), but would have cumulative impacts. If an alternative site is selected, the environmental consequences and analyses would change accordingly, depending on the site selected.

Alternative technologies: In addition to the IGCC technology, other power plant designs should be considered and analyzed in the EIS. Various alternative technologies for coal and coal types, as well as conservation measures, should be considered. Rejection of alternatives should be substantiated, including supporting environmental data.

We recommend that the DEIS include a summary section on the conservation methods (or incentives) that the applicant is proposing for use in the service area. Please clarify to what degree conservation would satisfy the need for additional power.

Air Quality

Project Impact Analyses: The DEIS should include the protocol of the assumptions and procedures that were used to address project air quality impacts. The air quality impact assessment should address all applicable project related emissions (*e.g.*, toxics, criteria pollutants, fugitive, etc.). The evaluation criteria should also be provided including but not limited to, the National Ambient Air Quality Standards (NAAQS), Prevention of Significant Deterioration (PSD) increments and other air quality related targets of concern.

Although not developed for the more inclusive NEPA analyses, it is suggested that the modeling methodology and procedures provided as guidance for PSD and SIP modeling be considered for use in developing the modeling protocol for the NEPA impact analyses. The following are some of the references that contain modeling guidance.

- 40 CFR 51, Appendix W; Guideline on Air Quality Models
- New Source Review Workshop Manual, U.S. Environmental Protection Agency, Draft October 1990
- South Carolina DHEC. Air Quality Modeling Guidelines (July 2001)
- Federal Land Managers' Air Quality Related Values Workgroup (FLAG), Phase I Report, December 2000

These documents address regulatory accepted air quality models, assumptions, and procedures that may be appropriate for the NEPA impact modeling assessment. They include, but are not limited to, guidance in the following areas: identifying nearby sources for inclusion in the cumulative modeling inventory, determining controlling operating loads, determining good engineering practice stack height, using representative meteorological data, selecting model input options, and determining appropriate receptor grids.

The NEPA document should contain a discussion of the power plant emission sources, the basis for the project emission estimates (both air toxics and regulated new source review pollutants), and anticipated release information and operating parameters. Mercury is a pollutant of particular concern from coal-based power plants. Information on speciated emissions of mercury (elemental, divalent and particulate forms) from the emissions source should be developed and used in the assessment of mercury deposition impacts.

A discussion of the existing air quality conditions, and the attainment designation status of the area in which the plant will be built, should be included in the document.

A conformity review should be included in the document. Also, all other emissions from the power plant which are not addressed above should be disclosed in the EIS.

PSD Permitting: The proposed project requires a Prevention of Significant Deterioration (PSD) permit from MDEQ, which was issued on October 14, 2008. This PSD permit addresses the types of control methods to be included for each PSD pollutant and estimates pollutant impacts on PSD Class I and II areas. Although the NEPA air quality impact analyses are more inclusive of project related emissions than that required for PSD permitting, it is important that the modeling protocols used for these analyses are consistent and compatible. It is suggested that the PSD air quality impact assessment be either included as an appendix or provided as a reference in the NEPA document.

Ancillary Impacts: Impacts from emissions due to coal transport should be discussed and evaluated in the EIS.

Air Toxics

The requirements of section 112(g) need to be addressed. Section 112(g) requires a case-by-case MACT determination as described in 63.40 – 44. We note that ongoing litigation of the CAMR vacatur could have an impact on the applicability of section 112(g), depending on the outcome of the litigation. Case-by-case MACT determination should address all HAP emissions.

Since Mississippi has responsibility for submitting the State Plan encompassing all subject coal-fired facilities in the State, allocating emissions, and overseeing the monitoring program, the responsible parties will need to coordinate with MDEQ on these issues.

Emissions Inventory: The EIS should include an emissions inventory of air toxics releases associated with the proposed plant. For information on the types of pollutants commonly associated with coal-fired power plants, refer to the primary emissions inventory for Hazardous Air Pollutants (HAPs) regulated under the Clean Air Act, (EPA's National Emissions Inventory or NEI), and EPA's Toxics Release Inventory (TRI).

Since the emissions inventory will provide the basis for the ensuing air quality modeling and risk analyses, analysts should be careful to develop a "modeling inventory" that includes the key information needed to meet air emission fate and transport modeling data quality objectives.

Information on accessing available emissions inventories and developing an emissions inventory suitable for modeling for risk assessment purposes is provided in EPA's Air Toxics Risk Assessment (ATRA) reference library; links are listed at the end of this air toxics section.

Risk Analysis: Once the air toxics emissions inventory has been developed, an air toxics risk analysis should be performed and the results included in the EIS. This analysis of air toxics risk will enhance the EIS by clarifying which pollutants may pose exposures of potential concern to both human health and ecological receptors near the proposed facility.

For example, the analysis should evaluate the potential for mercury emissions to deposit onto the local landscape, accumulate in biota, and move up the food chain. In particular, inclusion of mercury fate and transport modeling, (for elemental, divalent and particulate forms), will enhance the EIS by accounting for potential impacts to watersheds, people who fish those watersheds, and enhance any associated total maximum daily load (TMDL) assessments for impaired waterbodies.

The ATRA Reference Library provides an overview of air toxics risk assessment for human and ecological receptors, including an overview (and references for) the various parts of the process, including development of an emissions inventory, fate and transport modeling, toxicity assessment, and risk characterization. The reference library also provides a basic overview of risk management and communication. The documents can be found at: http://www.epa.gov/ttn/fera/risk_atra_main.html.

ATRA Volume 1 provides a general overview of the various topics; Volume 2 provides a suggested approach to performing risk assessment at the facility-specific level. In addition, the EPA Office of Air and Radiation recommended toxicity values for screening level human health risk assessments can be found at: http//:www.epa.gov/ttn/atw/toxicsource/summary.html

General information on air toxics fate, exposure, and risk analysis can be found at: www.epa.gov/ttn/fera.

Climate Change

In response to the April 2007 Supreme Court decision, EPA is preparing national and regional guidance for reviewing climate change issues in documents subject to EPA review.

Depending on the power plant design and fuel source selected, climate change could be a significant issue for the proposed power plant. As part of documenting (qualifying and quantifying) all air emissions of the proposed power plant, we recommend that greenhouse gas (GHG) contributions be included, especially carbon dioxide (CO_2). At this time, we also recommend that climate change be generally addressed in the EIS.

Once EPA's guidance is finalized, we may wish to further discuss EIS documentation of the impacts of climate change and possible offsets for those impacts, as well as other aspects that may be associated with the guidance.

Noise

EPA recommends that the noise levels from three project sources be documented in the EIS: noise from the plant, coal delivery trucks, and construction.

Regarding coal delivery noise, we understand that truck delivery is planned. For such an incoming linear source, the project area will need to be defined. We suggest some reasonable radius from the plant might be appropriate to limit the noise study. Noise modeling or monitoring of noise at the nearest residences should be provided. The number of affected residences (and their estimated residents) should also be enumerated. If more than one route is available, delivery could be varied in order to distribute the noise impacts if both routes are populated.

The appropriate noise metric would likely be the equivalent level (Leq) metric to obtain a peak 1-hr average level ($Leq_{(1)}$). The day-night level (DNL) metric would be required if trucks run day and night and are frequent (a useful reference on metrics is the 1974 EPA "levels" document available online at: www.nonoise.org/library/levels/levels.htm).

FHWA noise abatement criteria for highway noise might be useful thresholds to determine if noise impacts are significant at inhabited buildings (67 Leq for residences and 72 Leq for businesses). Single-event noise levels at roadway intersections should also be documented (including their frequency) as well as basic truck noise levels within 50 ft (these may be available from existing literature). It should be noted that project noise could be avoided without mitigation if an alternate technology is used that does not require coal delivery (or could be reduced if less frequent delivery is required).

Documentation of plant noise should include modeling for noise levels at the site boundary or fence line, and at the nearest residences. The number of nearby residences (and their estimated residents) should be enumerated. Disclosure of the distances to these sites should be included as well as a discussion of the topography of the buffer area on plant property (landscape, trees, swales, etc.) between the plant and the fence line and nearest residences. The appropriate noise metric should be the DNL metric since the plant would operate day and night.

We also recommend that follow-up noise monitoring be provided after prospective plant operation to verify the modeling and provide the baseline for any noise abatement action. Such noise attenuation could be achieved at the source (plant shielding or use of alternate technology) or by providing additional buffer interference (vegetation, berms, etc.).

Finally, construction noise should be documented. We suggest the EIS evaluate noise from basic construction equipment (bulldozers, graders, trucks, pile drivers, etc.) at a distance of 50 ft (available data from existing literature). Mitigation of stationary sources such as pumps includes "hush houses" to shield noise.

All construction equipment should also be equipped with factory mufflers and engine housings to minimize construction noise. To help assess the magnitude of construction noise, the timeframe for plant construction should be estimated (years/months). For worker safety, all OSHA regulations relating to noise should be followed.

Waters of the United States (Waters)

Project impacts to wetlands, streams and other Waters should be avoided and minimized during project site selection and operation, consistent with the 404(b)(1) Guidelines of the Clean Water Act. Any wetlands proposed for filling should be quantified and qualified in terms of acreages and the type/quality of the Waters affected. Permanent (direct, indirect, and cumulative) and temporary (construction) impacts should be discussed.

Unavoidable impacts to Waters should be appropriately compensated through coordination with the U.S. Army Corps of Engineers (COE), U.S. Fish and Wildlife Service (FWS) and EPA. A draft wetland mitigation plan with applicant commitments should be discussed in the EIS, and finalized during the 404 permitting process.

A table showing the linear feet of ephemeral, intermittent, and perennial streams, acres of lakes and wetlands for existing and final site conditions for each evaluated configuration should be provided in the EIS, to demonstrate the mitigation steps of avoidance and minimization required by NEPA and CWA Part 404(b)(1) regulations.

The final component of the NEPA and CWA required mitigation is the compensatory mitigation that should comply with the new Mitigation Rule, 33 CFR Parts 325 and 332, and 40 CFR Part 230.

Groundwater Quality

The EIS should discuss drinking water sources in the area, the presence or absence of sole source aquifers, water quantity issues, and any other potential impacts to groundwater which might occur as the result of this project.

Surface Water Quality

Impingement (juvenile and adult fishes) and entrainment (fish eggs and larvae) studies are required for surface water intakes for cooling water. The initial and make-up volumes of such water intake should be disclosed (and compared to the mean annual average flow of the receiving stream) and acknowledged as consumptive use. As consumptive use, the EIS should also verify that there will be no thermal discharge. Any thermal impacts to existing onsite waterbodies should be discussed in the DEIS.

The EIS should address whether the receiving waterbody is on the state's most recent 303(d) list and identify the pollutant of concern. Also, the EIS should address the extent to which the proposed new point source discharges will not cause or contribute to further impairment. See 40 Code of Federal Regulation Section 122.4(i).

Surface water quality data in the EIS should show the State's existing designated uses, the narrative and numeric criteria to support those uses, and the existing use requirements in the antidegradation policy, and project impacts on these parameters. Change is in quantity, whether velocity, volume, or timing that may change the balance of flora and fauna in the waters of the United States would be changing the water quality of the nation's waters. The EIS should demonstrate how these will be affected by the various alternative site selections and configurations for the preferred alternative site.

Floodplains

Erosion and accretion is one of the subject areas of concern. Mitigation and avoidance of impacts should be detailed in the DEIS.

Wetlands

The DEIS should clarify plans for addressing impacts to wetlands, as well as the planned schedule for the 401/404 permitting process. Wetlands are a subset of waters of the United States, and are included with the water quality standards.

NPDES Permitting

Modeling information regarding the proposed thermal discharge should be included in the EIS along with any potential impacts on the receiving waterbody from other process wastewater streams (i.e., ash pond, metal cleaning wastes, cooling tower blowdown, coal pile runoff, etc). Also, a discussion of stormwater during construction and during operation should be included.

The EIS should describe potential impacts on the receiving waterbody(ies) from coal mining, infrastructure, construction, and maintenance of the power plant being affected from stormwater.

Hazardous Waste

Details regarding onsite generation, storage, transport and disposition of hazardous waste should be disclosed in the EIS. Coordination with the MDEQ or EPA is advised regarding hazardous waste issues. If any hazardous waste is discovered on the selected construction site, this issue should be reported to appropriate agencies and appropriately addressed prior to site clearing and plant construction.

Environmental Justice (EJ)

Impacts to area residents including EJ populations should be considered during the site selection process and during project operation, in order to avoid/minimize disproportionate environmental, social, and economic impacts. Census data from the year 2000 should be used to conduct the EJ analysis that compares the block groups within the project area to neighboring block groups, counties, and the state. Analyses should be mindful of possible EJ concentrations (pockets) within block groups that may be affected by power plant emissions and other impacts. Given the large proposed site, potential cumulative effects should be evaluated in terms of impacts to the residents.

Bioaccumulation

The EIS should clarify whether mercury contamination from plant effluent may contribute to bioaccumulation of mercury in fish tissue, and whether water bodies in the project area are included on the impaired waters list. The DEIS should explain how mitigation will be addressed, and how mercury deposition issues would impact the permitting process for the facility. Local air deposition of mercury should be discussed, along with plans for mitigation.

Endangered Species

EPA will defer to the U.S. Fish and Wildlife Service (FWS) regarding potential project impacts to federally-protected species. The EIS should clarify whether there any threatened or endangered species is nesting on the proposed site. In addition, impacts and mitigation for conservation areas or environmentally sensitive areas within the project area should be addressed in the EIS.

Construction Impacts

In addition to operational impacts, construction impacts should also be disclosed and minimized. These include air emissions, noise, soil erosion and other impacts during construction. The expected construction time should also be disclosed in the EIS to help assess the magnitude of construction impacts. Efforts should be made to minimize construction impacts in terms of fuel choice and engine tuning of equipment, site selection for staging areas, working hours during the day, limiting open burning, use of shielding (hush-houses) for stationary equipment, fugitive dust control, and other areas.

Indirect (Induced) Impacts

Indirect impacts are those impacts that would not occur but for the proposed project. These impacts should be listed and discussed, including those facilities that would be induced to locate in the project area due the availability of additional power from the proposed power plant (e.g., new commercial, industrial and residential development using generated power, as well as coal-related facilities that support and supply the plant). Indirect impacts would also be associated with any infrastructure improvements, such as highways and utilities needed for new development induced by the power plant.

Cumulative Impacts

Cumulative impacts should be disclosed in the EIS. The basis for defining the project area should be included (for example: a project area based on a physical feature (e.g., watershed), or reasonable radial distance from the plant.

The cumulative impacts analysis should document those ongoing and proposed projects in foreseeable future within the project area that would impact the same resources as the plant. Past projects and their impacts are also important but these would likely already be incorporated in the EIS baseline or "Affected Environment."

Emphasis should be placed on projects with impacts similar to those predicted for the proposed power plant that would cumulatively affect the same resources in the project area. Mercury deposition is a particular concern.

Common resources affected by the proposal together with other projects might be surface water bodies, groundwater aquifers, air sheds, noise receptors, land use, etc. Project documentation might be a listing of projects with their main associated impacts. This can be a qualitative listing but preferably also somewhat quantitative to extent data available and accessible (*i.e.,* if not proprietary mercury deposition and bioaccumlation as a specific topic under cumulative impacts).

A project area should be defined with a rationale provided (*e.g.,* based on a physical feature (*e.g.,* watershed) or a reasonable radius from the plant). The size and configuration of the project area will likely differ for each area of concern. Guidance on defining a project area and other aspects of the cumulative impacts analysis is provided by the Council on Environmental Quality (CEQ) at: http://www.nepa.gov/nepa/nepanet.htm

Historic Preservation

The NEPA document should reflect the coordination with the State Historic Preservation Officers (SHPO) on a cultural resources survey. The NEPA document should discuss procedures for events such as unearthing archaeological sites during prospective construction. Typical procedures include work cessation in the area until SHPO approval of continued construction.

Our copy

NETL
NATIONAL ENERGY TECHNOLOGY LABORATORY
A U.S. Department of Energy National Laboratory
Albany, OR • Morgantown, WV • Pittsburgh, PA

JUL 30 2009

United States Department of the Army
U.S. Army Engineer District, Mobile
Attention: COL Byron G. Jorns, District Commander
P. O. Box 2288
Mobile, Alabama 36628-0001

Re: Letter of Understanding (LOU): Inter-Agency Cooperation on the Kemper County IGCC Project Environmental Impact Statement (EIS); SAM Number: SAM-2008-1759-DMY

Dear Sir:

This LOU is a follow-up to a letter dated November 19, 2008, inviting the U.S. Army Corps of Engineers (Corps) to participate as a formally cooperating agency in the NEPA compliance process for the proposed Kemper County Integrated Gasification Combined Cycle (IGCC) Power Plant Project. The proposed action for DOE with respect to the project is to provide a total of $294 million in cost-shared funding under the Clean Coal Power Initiative (CCPI) Program. In addition, DOE may also provide a loan guarantee pursuant to the Energy Policy Act of 2005. DOE considers the associated linear facilities and a proposed, lignite mine near the plan to be connected actions. The proposed mine would be at a site to the north of, and up-stream of, the Corps' Lake Okatibbee. This project is located in multiple sections, townships and ranges of Kemper and Lauderdale Counties, in Mississippi. In September 2008, DOE published a Notice of Intent to prepare an EIS to satisfy its responsibilities under NEPA with respect to the proposed action.

The Corps' proposed action with respect to the project is to decide whether to issue Clean Water Act permits for the IGCC plant, associated linear facilities and mine. The mine site and power plant project have already been assigned Corps' project number SAM-2008-1759-DMY, which will be referred to in all future correspondence between DOE and the Corps. Future permit applications will be assigned project numbers accordingly.

DOE is the lead Federal agency for preparation of the EIS. The Corps is a formal cooperating agency in the preparation of the EIS and will work to adopt the EIS to support its decision on the permitting process. It is understood that as a cooperating agency, the Corps will assist in the proceedings of the EIS in accordance with the Council of Environmental Quality regulations and guidance. Furthermore, it is understood that as a cooperating agency the Corps will be treated in some respects as though it were DOE staff, including having conversations and exchanging information that may not be put into the record, just as the DOE staff shares pre-decisional analysis and information internally. To allow a cooperating agency to intervene in a proceeding or task would make it a party that would be privy to decisional

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
carl.bauer@netl.doe.gov • Voice (412) 386-6122 • Fax (412) 386-6127 • www.netl.doe.gov

information not available to other parties. Therefore, DOE and the Corps have agreed to the following:

Responsibilities:

a. It is understood by the Corps that the current state of the environment is the baseline condition against which all alternatives in the environmental documents will be compared. This includes but is not limited to all "waters of the U.S." and Okatibbee Lake;

b. DOE, as a lead agency, will prepare a preliminary draft of each environmental document (i.e., Draft EIS, Final EIS);

c. DOE will provide the Corps with a preliminary draft of each environmental document so that the Corps may participate in document development at the drafting stage;

d. DOE will expedite transmittal of documents through the use of ftp sites, email, express mail, or fax, to the greatest extent possible;

e. The Corps will return review comments on drafts of all documents prepared by the DOE within three weeks or within another time frame agreed upon;

f. The Corps will provide a review of the analysis provided on impacts to "waters of the U.S." including Lake Okatibbee, and text that addresses these impacts for use in each environmental document;

g. The Corps will assist DOE in reviewing the responses to comments received on each environmental document, specifically with respect to comments on impacts to wetlands and Lake Okatibbee;

h. Excluding DOE's Record of Decision, for each environmental document published by the DOE, the Corps will provide a letter stating either its concurrence approving publication or its reason for declining to concur in the publication. The Corps will utilize information contained within the Final EIS to formulate a Record of Decision for the Corps' actions relating to "waters of the U.S.", including Lake Okatibbee;

i. DOE will take responsibility to schedule the key steps in the EIS process; this schedule may be revised from time to time to meet various project and administrative needs;

j. The Corps may attend public hearings held by DOE to obtain public comments on the Draft EIS; DOE will control and moderate the hearings;

k. DOE will be responsible for satisfying Section 106 of the Historic Preservation Act. The Corps will support DOE on any cultural resource issues including preparation of a programmatic agreement if necessary to satisfy Section 106 of the National Historic Preservation Act and will be a signatory on any documentation for which the Corps may at some future date assume either a regulatory role or the lead federal agency role;

l. DOE will be responsible for satisfying Section 7 of the Endangered Species Act (ESA). The Corps will rely upon DOE's analysis for satisfying its ESA responsibility in the permitting process; and

m. The Corps will provide technical assistance to support DOE in consulting with Native American Tribes regarding their concerns with potential environmental impacts of the project. DOE will maintain the sole responsibility under the NEPA for all consultation with regard to Native American Tribes.

Communication:

n. DOE and the Corps staff are free to communicate with each other on any issue related to the EIS process and overall project;

o. All predecisional communications between DOE and the Corps, written and verbal, will be kept confidential, to the extent permitted by law. Since EPA Region 4 and the U.S. Fish and Wildlife Service have agreed to participate as informal cooperating agencies, DOE intends to coordinate preparation of certain sections of the environmental documents with these two agencies. Except for communications with these two agencies and with project proponents and others for the purpose of assuring the accuracy of documents, DOE staff and Corps staff will refrain from communicating with persons, groups, or other agencies who are interested in the project, regarding the content of preliminary documents. Any official communication either through official correspondence, email, memos, etc. between the Corps staff and the DOE staff concerning "waters of the U.S.", including Okatibbee Lake, must be included in the record, either: 1) in writing and filed in the record; or 2) at a publicly-noticed meeting where other parties may attend and participate;

p. DOE will provide the Corps with any formal letters sent by DOE to the applicants related to the environmental processes, agency and public comments received during the comment periods for the environmental documents, and any other formal correspondence by DOE that is relevant to the Corps. Likewise, the Corps will do the same for the DOE.

Staff Coordination:

q. Mr. Richard A. Hargis Jr. will be the lead contact for the DOE and can be reached by telephone at (412) 386-6065 or email at Richard.Hargis@netl.doe.gov.

r. Mr. Damon M. Young will be the lead project contact for the Corps and can be reached by telephone at (251) 694-3781 or email at Damon.M.Young@usace.army.mil.

s. Mrs. Cindy J. House-Pearson will be the co-lead / alternate contact for the Corp and can be reached by telephone at (205) 290-9096 or email at Cindy.J.House-Pearson@usace.army.mil.

Termination:

t. This agreement takes effect upon the signature of agency officials for the Corps and DOE and shall remain in effect until the final DOE Record of Decision is issued. This LOU may be extended or amended upon written request of either party to the LOU and the subsequent written concurrence of the other. Either party to the LOU may terminate it with written notice to the other;

u. If DOE or the Corps cannot participate in this process for any reason, the agreement shall be terminated following the above guidelines.

Participation in Similar Activities

v. This instrument in no way restricts the Corps as the cooperating agency from participating in similar activities with other public or private agencies, organizations and individuals as they relate to either the EIS process or a Department of the Army (DA) permit process.

Non-fund Obligating Document

w. Nothing in this agreement shall require the Corps or DOE to obligate or transfer any funds as a result of this process.

x. Copies of this letter have been provided to the U.S. Environmental Protection Agency Region 4 and the U.S. Fish and Wildlife Service.

DOE looks forward to the Corps' involvement as a cooperating agency. If you have any questions or comments, please do not hesitate to contact me at telephone number (412) 386-6122 or Mr. Richard Hargis at (412) 386-6065.

Sincerely,

Carl O. Bauer

Carl O. Bauer, Director
National Energy Technology Laboratory

Concurrence:

Upon signature by an authorized official of each agency, this document will establish the agreement between the DOE and the Corps on the terms and conditions of the cooperating agency relationship for the Kemper County IGCC Project Environmental Impact Statement.

Byron G. Jorns
District Commander
US Army Engineer District, Mobile
Corps of Engineers

Date: AUG 7 2009

Carl O. Bauer

Carl O. Bauer
Director
National Energy Technology Laboratory
US Department of Energy

Date: JUL 30 2009

cc:

US Department of the Army
Corps of Engineers – Mobile
Attention: Damon M. "Skip" Young
Project Manager, Inland Branch
Regulatory Division
109 St. Joseph Street
Mobile, Al 36608

US Department of Energy
Attention: Ms. Diane R. Madden
Project Manager
Major Projects Division
626 Cochrans Mill Road
Pittsburgh, PA 15236

US Department of Energy
Attention: Mr. Richard A. Hargis
NEPA Document Manager
626 Cochrans Mill Road
Pittsburgh, PA 15236

US Environmental Protection Agency
Region 4
Attention: Mr. Duncan Powell
Regulatory Program Region 4
61 Forsyth Street, 15th Floor
Atlanta, GA 30303

US Environmental Protection Agency
Region 4
Attention: Ms. Ramona McConney
Regulatory Program Region 4
61 Forsyth Street, 15th Floor
Atlanta, GA 30303

US Fish and Wildlife Service
Attention: Ms. Kathy Lunceford
6578 Dogwood View Parkway
Jackson, MS 39213

NETL
NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA
U.S. DEPARTMENT OF ENERGY

September 22, 2009

Ms. Kathy Lunceford, Field Supervisor
Ecological Services Field Office
U.S. Fish and Wildlife Service
6578 Dogwood View Parkway
Jackson, MS 39213

Dear Ms. Kathy Lunceford:

As we discussed in our conference call on September 14, 2009, the U.S. Department of Energy (DOE) anticipates that the Draft Environmental Impact Statement (EIS) for the Kemper County Integrated Gasification Combined Cycle (IGCC) Project will be distributed by the end of October of this year. This Draft EIS will address the scoping comments received from your office regarding potential impacts to biological resources in a letter dated October 23, 2008. As you requested in our conference call, the information contained in the EIS will address the methodology used in the surveys for threatened and endangered species.

Informal consultation under Section 7 of the Endangered Species Act was initiated in September of 2008 with conference calls and correspondence. This informal consultation included a tour of the project site and agency meeting that you attended on October 14, 2008. In addition, prior to the initiation of DOE's informal consultation, I understand that you participated in a state and Federal fish and wildlife agency and industry consultation meeting held on April 29, 2008, to assist the Mississippi Department of Environmental Quality in determining the scope and level of detail for collecting biological resource information as required by state regulations.

Based on the information available to date which will be presented in the Draft EIS, DOE has made a preliminary determination that the proposed project may affect, but would not adversely affect, threatened or endangered species or critical habitat. I understand that the U.S. Fish and Wildlife Service may request additional information and/or surveys after reviewing the information in the Draft EIS. After your office provides comments on the Draft EIS, DOE will continue with informal consultation until either DOE determines that formal consultation is required or DOE makes a final determination, with USFWS concurrence, of "may affect but not likely to adversely affect" threatened or endangered species or critical habitat.

We appreciate the assistance provided by USFWS in the preparation of the Draft EIS and look forward to working with you on this important project. Thank you.

Sincerely,

Richard Hargis

Richard Hargis
NEPA Document Manager

Copy to:
Mr. Ray Aycock, USFWS
Mr. Damon M. Young, Army Corps of Engineers

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

October 13, 2009

Inland Branch
Regulatory Division

SUBJECT: Department of the Army Consultation; Draft Environmental Impact Statement Release for Availability; SAM Number: SAM-2008-1759-DMY and SAM-2009-1149-DMY.

United States Department of Energy
National Energy Technology Laboratory
Attention: Mr. Richard A. Hargis Jr. (922-1W13)
Post Office Box 10940
Pittsburgh, Pennsylvania 15236

Dear Mr. Hargis:

This response is in reference to the Draft Environmental Impact Statement (DEIS) in which the U.S. Army Corps of Engineers (Corps) is a cooperating agency regarding the proposed Integrated Gasification Combined Cycle Project (IGCC) that includes the proposed Kemper and Lauderdale County Mine Site located to the north of the U.S. Army Corps of Engineers (Corps), Lake Okatibbee Project Site. In September 2008, your agency filed a Notice of Intent to file an EIS. The project has been assigned USACE project number SAM-2008-1759-DMY for North American Coal and SAM-2009-1149-DMY for Mississippi Power Company which should be referred to in all future correspondence with our office. This project is located in multiple Sections, Townships and Ranges of Kemper and Lauderdale Counties, Mississippi.

The Corps has conducted an initial review of the supplemental documentation including the preliminary wetland assessment, stream assessment and proposed mitigation plan dated October 2009 in accordance with Section 404 of the Clean Water Act and information relating to the DEIS. The Corps has agreed for the release of the DEIS for availability and public comment. The Corps has not finalized its review of the supplemental documentation and will continue to evaluate comments provided by the public and any federal, state, and local agencies. A final decision on behalf of the Corps will be provided upon completion of our regulatory review process in accordance with 33 CFR 325.

Copies of this letter have been provided to the U.S. Environmental Protection Agency Region 4, the U.S. Fish and Wildlife Service, the Mississippi Department of Environmental Quality; and the Mississippi Department of Archives and History. If you have any questions or comments, please do not hesitate to contact me at telephone number (251) 694-3781 or by email at damon.m.young@usace.army.mil.

Sincerely,

Damon M. Young

Damon M. Young, P.G.
Project Manager, Coastal Branch
Regulatory Division

Copy Furnished:

US Environmental Protection Agency
Region 4
Attention: Mr. Duncan Powell
Regulatory Program Region 4,
61 Forsyth Street, 15th Floor,
Atlanta, Georgia 30303

US Environmental Protection Agency
Region 4
Attention: Ms. Ramona McConney
Regulatory Program Region 4,
61 Forsyth Street, 15th Floor,
Atlanta, Georgia 30303

US Fish and Wildlife Service
Attention: Ms. Kathy Lunceford
6578 Dogwood View Parkway
Jackson, Mississippi 39213

Mississippi Department of Environmental Quality
Water Quality Certification Branch
Environmental Permits Division
Attention: Mr. Harry Wilson, P.E.
Post Office Box 10385
Jackson, Mississippi 39289-0385

Mississippi Department of
Archives and History
Attention: Mr. Jim Woodrick
Review and Compliance Officer
Post Office Box 571
Jackson, Mississippi 39205-0571

APPENDIX B

DRAFT COMPENSATORY STREAM MITIGATION STANDARD OPERATING PROCEDURES AND GUIDELINES

Department of the Army
Mobile District Corps of Engineers

COMPENSATORY STREAM MITIGATION STANDARD OPERATION PROCEDURES AND GUIDELINES

Table of Contents

STREAM MITIGATION STANDARD OPERATION PROCEDURES AND GUIDELINES

1.0 INTRODUCTION:

The purpose of this document is to provide natural resource agencies, parties involved in stream compensatory mitigation, and the public with a set of standardized procedures and requirements for addressing stream mitigation in the Mobile District. The manual may be divided into two sections; the first section is the main body comprised of the Standard Operating Procedure (SOP) for rapidly assessing the compensatory mitigation required for permitted stream activities within the Mobile District, as well as evaluating the number of "credits" obtainable through implementation of various stream mitigation practices. The SOP describes a process to: 1) determine and assess the stream impacts; 2) determine the compensation requirement; and, 3) determine what types of and the amount of the various compensation practices that will satisfy the compensation requirement. The second section of the manual includes, in the form of supporting appendices, guidance for formulating stream mitigation plan requirements, stream mitigation monitoring requirements, and stream mitigation success criteria applicable to all forms of stream mitigation within the Mobile District, as well as a credit release schedule for stream mitigation banks. This guidance may be used for all projects required to provide stream mitigation by the Mobile District Regulatory Program.

The Mobile District encourages the use of natural stream channel design concepts for all in-stream mitigation projects. This approach incorporates the use of stable, preferably non-impacted reference quality stream reaches for designing the appropriate pattern, profile, and dimension for stream mitigation projects. The concept of using reference sites is also encouraged when designing stream riparian buffer mitigation projects. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan.** Final stream restoration plans will be completed and presented to the Corps for review. The final plans will incorporate appropriate stream restoration techniques based on a reference stream and will be designed as required by the natural channel design methods.

These standard operating procedures and guidelines are not intended to take the place of project specific review and discussion between the resource agencies and the applicant, which may result in adjustments to compensation requirements or credits obtained through application of this process. These requirements do not negate nor diminish an applicant's responsibility to comply with all other laws and regulations. Applicants should defer to 33 CFR 332, Compensatory Mitigation For Losses of Aquatic Resources, for guidance on mitigation requirements not specifically addressed in this SOP. These Guidelines can be applied to stream compensation projects performed on-site, off-site, for a stream mitigation bank, or for an in-lieu fee fund project, thereby, ensuring a standard application for evaluating and crediting all stream compensation projects. These Guidelines are intended to be used on intermittent or perennial streams within the Mobile District.

2.0 REGULATORY AUTHORITIES AND GUIDELINES

Section 10 of the River and Harbor Act of 1899: In accordance with Section 10 of the River and Harbor Act, the Corps of Engineers is responsible for regulating all work in navigable waters of the United States.

Section 404 of the Clean Water Act: In accordance with Section 404 of the Clean Water Act (CWA) as amended in 1977, the Corps of Engineers is responsible for regulating the discharge of dredged or fill material in waters of the United States, including wetlands. The purpose of the CWA is to restore and maintain the physical, chemical, and biological integrity of the nation's waters. Section 404(b)(1) ("The Guidelines") of the CWA provides the substantive environmental criteria by which all proposed discharges of dredged or fill material are evaluated (49CFR230.10). The Section 404 (b)(1) Guidelines requires application of a sequence of mitigation -- avoidance, minimization and compensation. Section 230.10 (d) of the 404(b)(1) Guidelines states that "... no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem." In other words, mitigation consists of the set of modifications necessary to avoid adverse impacts altogether, minimize the adverse impacts that are unavoidable and compensate for the unavoidable adverse impacts. Compensatory mitigation is required for unavoidable adverse impacts, which remain after all appropriate and practicable avoidance and minimization has been achieved. The 404(b)(1) Guidelines identify a number of "Special Aquatic Sites," including riffle pool complexes, which require a higher level of regulatory review and protection. This stream guidance document addresses only compensatory mitigation and should only be used after adequate avoidance and minimization of impacts associated with the proposed project has occurred.

2008 Mitigation Rule, 33 C.F.R. 332 - Compensatory Mitigation for Impacts to Aquatic Resources. This guidance requires compensatory mitigation to replace aquatic resource functions unavoidably lost or adversely affected by authorized activities. The Mitigation Rule provides important guidance on compensatory mitigation including requiring increased use of functional assessment tools, improved performance standards, and a stronger emphasis on monitoring with the purpose of improving the success of compensatory mitigation projects.

Regulatory Guidance Letter (RGL) 05-05 – Ordinary High Water Mark Identification. This document provided guidance for identifying ordinary high water mark. RGL 05-05 applies to jurisdictional determinations for non-tidal waters under Section 404 of the Clean Water Act and under Sections 9 and 10 of the Rivers and Harbors Act.

Regulatory Guidance Letter (RGL) 08-03 – Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Creation, Restoration, and/or Enhancement of Aquatic Resources. This document provides guidance on minimum monitoring requirements for compensatory mitigation projects, including the required content for monitoring reports.

3.0 ORGANIZATION OF THE STANDARD OPERATING PROCEDURE (SOP)

The Stream SOP, used to calculate credits required from an impact site and credits generated from a compensatory mitigation site, is divided into three evaluation sections, summarized below. The sections represent the basic types of stream analyses that are performed, including characterizing and assessing stream impacts, determining compensation requirements, and determining compensation credits for in-stream and riparian buffer mitigation actions. The worksheets, found in Appendix A contain the factors discussed below for Adverse Impacts, In-Stream Work, and Riparian Buffer Restoration. These SOP worksheets are to be completed when calculating the number of compensatory credits needed due to an impact and the number generated by stream mitigation and riparian buffer mitigation.

Section 4.0 - The "Adverse (Stream) Impact" section describes a method to rapidly characterize existing condition and proposed impacts to streams and calculates the compensation required. It is accompanied by a worksheet in Appendix A which is to be completed for projects that impact streams.

Sections 5.0 – The "In-stream Work" section describes a method for rapidly assessing and characterizing in-stream restoration and enhancement actions and calculates the compensation generated from these actions. It is accompanied by a worksheet in Appendix A for projects that propose in-stream work.

Section 6.0 – Riparian buffer restoration, enhancement, and preservation describes a method for rapidly assessing and characterizing riparian buffer mitigation actions and calculates the compensation generated from these actions. It is accompanied by a worksheet in Appendix A that must be completed for each stream mitigation project.

4.0 ADVERSE (STREAM) IMPACT

Streams are complex ecosystems with morphological, biological and chemical characteristics that are dependent on appropriate geomorphic dimension, pattern, and profile as well as habitat and watershed integrity. They are not simply stormwater conveyances.

The following factors will determine the amount of mitigation credits required:

4.1 Stream Types:

Perennial Stream - A perennial stream has flowing water year-round during a typical year. The water table is located above the streambed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow. Perennial streams support a diverse aquatic community of organisms year round and are typically the streams that support major fisheries.

Intermittent Stream – An intermittent stream has flowing water during certain times of the year, when ground water provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources. For the purpose of mitigation, intermittent streams will be treated as 1st order streams.

Ephemeral Stream – An ephemeral stream has flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage. Impacts to ephemeral streams will be addressed as wetland impacts.

4.2 Priority Area:

Priority area is a factor used to determine the importance of the water body proposed to be impacted or used for mitigation. Priority areas are influenced by the quality of the aquatic habitat potentially subject to be impacted or used for mitigation. The priority area factor will influence the amount of stream credits generated. The priority areas are divided into three categories:

Primary: These areas are important to the biodiversity of stream ecosystems and/or larger watersheds and provide high levels of unique stream functions. Presence and performance of these functions is typically due to the absence of widespread (i.e., cumulative) stressors in and around the stream system. Impacts to these areas should be rigorously avoided or minimized. If, after thorough agency review, impacts are deemed unavoidable, compensation for impacts in these areas should emphasize replacement in the same immediate 8-digit watershed. Designated primary priority areas include:

- Waters with Federal or State listed species,
- National Estuarine Research Reserves,
- River sections in approved greenway corridors,
- Wild and Scenic Rivers,
- Outstanding National Resource Waters,
- Outstanding State Waters,
- Essential Fish Habitat
- Anadromous fish spawning habitat
- Waters with Federal Species of Management Concern or State listed rare or uncommon species
- Designated shellfish grounds

Secondary: These areas are important to the biodiversity of stream ecosystems and/or larger watersheds and provide moderate levels of stream functions. Presence and performance of these functions has been hampered by the presence of cumulative stressors (i.e., agricultural, urban, suburban land uses) in and around the stream system. Secondary priority areas include stream reaches (i.e., a stream section containing a complete riffle and pool complex, or a suitable length of stream usually no less than 300 feet) which are:

- Designated secondary trout streams (Put and Take Fishery),
- Waters adjacent to Federal or State protected areas or Corps' approved mitigation banks,
- Waters on the 303(d) list,
- Designated State Heritage Trust Preserves,
- Within 0.5 mile upstream or downstream of primary priority reaches (as outlined above),
- Within high growth areas that aren't ranked as primary priority systems,
- Within 0.5 miles of a drinking water withdrawal site

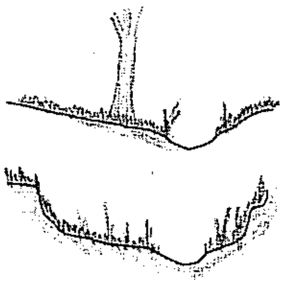
Tertiary: These areas include all other freshwater or tidally influenced lotic systems not ranked as primary or secondary priority.

4.3 Existing Condition - Channel Condition Parameter:

Typically, stream channels respond to disturbances or changes in flow regime and sediment loads by degrading to a lower elevation and eventually re-stabilizing at that lower elevation. This sequential readjustment of the channel to changing flows is the basic premise of the stream channel evolutionary process. The differing stages of this evolutionary process can be directly correlated with the current state of stream stability. The purpose of evaluating **Channel Condition** is to determine the current condition of the channel cross-section, as it relates to this geomorphologic evolutionary process, and to assess the current state of stream stability. These geomorphologic processes apply to the majority of stream systems and assessment reaches due to the constant response of streams to watershed changes in flow and sediment loads.

A channel's physical condition can be determined by visually assessing certain geomorphological indicators. These indicators include channel incision, access to original or recently created floodplains, channel widening, channel depositional features, rooting depth compared to streambed elevation, streambank vegetative protection, and streambank erosion. Each of the Channel Condition categories describes a particular combination of the state of these geomorphological indicators which generally correspond to a stream channel stability condition at some stage in the evolution process.

Existing channel condition is an assessment of the stream cross-section, along any given stream reach. The existing/current channel condition of each reach is assessed using the following five categories. However, in cases where the stream lies between category descriptions, the most characteristic condition should be selected. The Evaluator needs to identify the prevailing channel condition or problem (erosion, deposition, disconnection to the floodplain).



A. Optimal

These channels show very little incision and little or no evidence of active erosion or unprotected banks. 80-100% of both banks are stable. Vegetative surface protection may be prominent on 80-100% of the banks or natural rock stability is present along the majority of the banks.

AND/OR

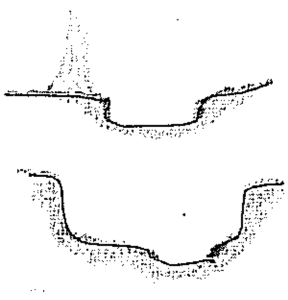
Stable point bars and bankfull benches are present (when appropriate for the stream type). These channels are stable and have access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars should be few. If transient sediment deposition is present, it covers less than 10% of the stream bottom.

B. Suboptimal

These channels are slightly incised and contain few areas of active erosion or unprotected banks. The majority of both banks are stable (60-80%). Vegetative surface protection may be prominent along 60-80% of the banks or natural rock stability present along the majority of both banks.

AND/OR

Depositional features (point bars, mid-channel bars, transverse bars, and bankfull benches) are likely present (when appropriate for the stream type) and most are contributing to stability. The bankfull and low flow channels (when appropriate for the stream type) are well defined. This stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. If transient sediment is present, it affects or buries 10-40% of the stream bottom.



C. Marginal

These channels are often incised, but to a lesser degree than the ***Severe*** and ***Poor*** channel conditions. The banks are more stable than the stream cross sections in the ***Severe*** or ***Poor*** condition due to lower bank slopes. Erosional scars may be present on 40-60% of both banks. Vegetative surface protection may be present on 40-60% of the banks. The streambanks may consist of some vertical or undercut banks. While portions of the bankfull channel may still widen, other portions have begun to narrow in an attempt to obtain stable dimensions.

AND/OR

Between 40-60% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition. Sediment depositional features may be temporary and transient in nature, and may contribute to channel instability; however, depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), that contribute to stability, may be forming or present in the appropriate stream types.

AND/OR

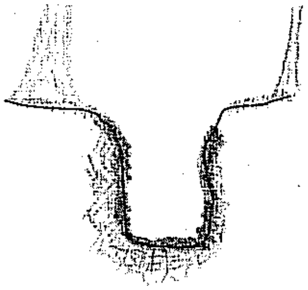
Channels that have experienced historic incision but may be relatively stable (banks and channel) at their existing elevation. These channels may have a V-shape and no connection to their floodplain. Vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. Marginal V-shaped channels have depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), which contribute to stability.

D. Poor

These channels are overwidened and are incised. These channels are vertically and/or laterally unstable. They are more likely to widen rather than incise further. The majority of both banks are near vertical with shallow to moderate root depths. Erosional scars may be present on 60-80% of the banks. Vegetative surface protection may be present on 20-40% of both banks, and is insufficient to prevent significant erosion from continuing.

AND/OR

Between 60-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition. Sediment depositional features are temporary and transient in nature, and are likely contributing to channel instability. Depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), which contribute to stability are absent.



E. Severe

These channels are deeply incised (or excavated) with vertical and/or lateral instability and will likely continue to incise and widen. Incision is severe enough that flow is contained within the banks during heavy rainfall events (i.e. the stream does not have access to its floodplain). The streambed elevation may be below the average rooting depth within the banks and the majority of both banks may be vertical or undercut. Vegetative surface protection may be present on less than 20% of the banks and is not preventing erosion from continuing.

Obvious bank sloughing may be present. Erosional scars or raw banks may be present on 80-100% of the banks.

AND/OR

These channels are aggrading and have an excessive sediment supply that is filling the channel with alluvium, impeding its flow. Greater than 80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition that is likely contributing to channel instability. Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a *Severe* Parameter Condition.

4.4 Impact Duration: Duration is the amount of time adverse impacts are expected to persist. Impacts which do not persist are assumed to have less effect on the aquatic ecosystem than those that persist for longer time periods.

Temporary means impacts will occur within a period of less than 6 months and recovery of system integrity will follow cessation of the permitted activity.

Recurrent means repeated impacts of short duration (such as within-channel 24-hour stormwater detention).

Permanent means project impacts will be permanent or will occur during spawning or growth periods for Federal and/or State protected species.

4.5 Dominant Impact Parameter

This indicator considers direct impacts to the stream channel from anthropogenic sources for which a Corps permit is required. . The reach may or may not have been altered throughout its entire length.

Examples of channel alterations evaluated by this indicator that disrupt the natural conditions of the stream include, but are not limited to the following:

1. Straightening of channel or other channelization
2. Stream crossings (bridges and bottomless culverts)
3. Riprap along streambank or in streambed
4. Concrete, gabions, or concrete blocks along streambank
5. Manmade embankments on streambanks, including spoil piles
6. Constrictions to stream channel or immediate flood prone area
7. Livestock impacted channels (i.e., hoof tread, livestock in stream)

The presence of a structure does not necessarily result in a reduced score. For instance, a bridge that completely spans the floodplain would not be considered an alteration. Also, the Evaluator is cautioned not to make assumptions about past alterations. Incision can be mistaken for channelization.

Armor means to riprap, bulkhead, or use other rigid methods to contain stream channels.

Below Grade (embedded) Culvert means to route a stream through pipes, box culverts, or other enclosed structures (<= 100 LF of stream to be impacted per crossing). The below grade culverts should be designed to pass bankfull flow, and greater than bankfull flow to be passed through other culverts within the floodplain. The culvert bottom including head-walls and toe-walls would be designed to be embedded to a depth of no less than 12 inches below ground line. If rock runs throughout the culvert area, a bottomless culvert should be used. Improperly designed culverts will be evaluated under Dominant Impact Factor for piping. Culverts should be designed to allow fish passage and allow other natural stream processes to occur unimpeded.

Clearing means clearing of streambank vegetation or other activities that reduce or eliminate the quality and functions of vegetation within riparian habitat without disturbing the existing topography or soil. Mitigation for these impacts may be required if the impact occurs as a result of; or in association with, an activity requiring a permit, and because degradation of riparian vegetation may affect the water quality and biota of the adjacent stream.

Detention means to temporarily slow flows in a channel when bankfull is reached. Areas that are temporarily flooded due to detention structures must be designed to pass flows below bankfull stage.

Fill means permanent fill of a stream channel due to construction of dams or weirs, relocation of a stream channel (even if a new stream channel is constructed), or other fill activities.

Impound means to convert a stream to a lentic state with a dam or other detention/control structure that is not designed to pass normal flows below bankfull stage. Impacts to the stream channel where the structure is located is considered fill, as defined above.

Morphologic change means to channelize, dredge, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.

Pipe means to route a stream for more than 100' through pipes, box culverts, or other enclosed structures.

Utility crossings mean pipeline/utility line installation methods that require disturbance of the streambed.

4.6 Scaling Factor: The Scaling factor assumes that the greater the linear distance affected by the impact the greater the impact. Therefore, the scaling factor assesses the relative effects of impacts based upon the length of stream impacted by a project, as authorized under Section 404 of the Clean Water Act, and for which mitigation will be required.

5.0 IN-STREAM WORK - MITIGATION CREDITS:

5.1. In-Stream Net Benefit: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, and maintenance of the chemical, biological, and physical integrity of the Nation's waters. Three stream mitigation categories are evaluated for Net Benefit – stream relocation, stream channel restoration, and stream channel enhancement.

All restored or enhanced channels must be protected by at least a minimum width buffer of native vegetation **on both sides** of the stream. Credit for installation of structures described below will be based on 3X the length of the appropriate size structure (e.g., 600' for a 200' tree revetment). Credit for removal of structures described below will be based on the documented length of reach that the structure impacts under current flow conditions.

5.1.1 Stream Relocation

Stream relocation is moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed on the stream's former location. (Note: relocation of a stream is considered fill under these guidelines when the relocation is conducted to allow development of the area where the stream previously was located; impacts associated with stream relocation in these situations must be fully mitigated). Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions; maintain the capacity to transport bedload sediment; and have at least a minimum width buffer of natural vegetation on both sides of the stream to receive mitigation credit; this buffer also will generate riparian preservation or restoration mitigation credit.

5.1.2 Restoration

Restoration is the process of converting an unstable, altered, or degraded stream corridor, including flood-prone areas, to a natural stable condition (i.e., neither aggrading nor degrading) considering recent and future watershed conditions. This process is be based on a reference condition/reach for the same stream valley type or other analog or analytical methods, and includes restoring the appropriate geomorphic dimension (cross-section), pattern (sinuosity), and profile (channel slope). This process supports reestablishing the streams biological and chemical integrity, including transport of the water and sediment produced by its watershed in order to achieve dynamic equilibrium.

An analysis of the existing geomorphological parameters of the compensation stream is compared to those in a stable reference stream. Natural stream channel design methods and calculations are then applied to develop a stable stream dimension, pattern, and profile that maintains itself within the natural variability of the design parameters. Restoration activities utilizing the natural stream channel design approach typically address the following:

1. Deficiencies in sinuosity, radius of curvature, belt width, meander length
2. Deficiencies in spacing, lengths, and depths for riffles, runs, pools, & glides
3. Restore appropriate critical shear stress
4. Deficiencies in slopes for channel, riffles, runs, pools, & glides
5. Deficiencies in width-depth ratio and cross-sectional area

Situations that readily lend themselves to inclusion in the Restoration Category include Priority 1, 2, or 3 relocations and restorations as described in *A Geomorphological Approach to Restoration of Incised Rivers*, Rosgen 1997[1]. The following provides a summary of these management activities:

- **Priority 1 Restoration[1]**
  Priority 1 Restoration is defined as stream channel restoration that involves the re-establishment of a channel on the original floodplain, using a relic channel or constructing a new channel. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. The existing, incised channel is either backfilled or made into discontinuous oxbow lakes level with the new floodplain elevation. (Rosgen, 1997)

- **Priority 2 Restoration[1]**
  Priority 2 Restoration is defined as stream channel restoration that involves re-establishment of a new floodplain at the existing level or higher but not at the original level. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. (Rosgen, 1997)

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[1] Rosgen, David. 1997. *A Geomorphological Approach to Restoration of Incised Rivers*. Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. 11pp.

- **Priority 3 Restoration**[1]

Priority 3 Restoration is defined as stream channel restoration to a channel without an active floodplain but with a flood prone area (Rosgen, 1997). However, the channel restoration must involve establishing proper dimension, pattern, and profile.

Some sites may present difficulties in reestablishing a sinuous pattern when they are laterally contained or have limitations in available belt width. This is often caused by utilities, infrastructure, and other floodplain encroachments. Such physical constraints often favor the creation of a step/pool bed morphology with less sinuosity (associated with Priority 3) over a riffle/pool bed morphology with greater sinuosity (associated with Priorities 1 & 2). It is necessary to consider the available belt width and the slope of the proposed stream when designing the appropriate stream type that is suitable for that situation. Information should be provided showing that the appropriate dimension, pattern, and profile are being restored for the proposed stream type in that particular situation. The compensation plan narrative needs to describe, and the plan design sheets need to clearly demarcate, the stream channel length (in linear feet) and stream reaches to be restored, as defined above.

Restoration mitigation credits cannot be generated for stream channel or stream bank restoration if the mitigation segment is within 300 feet upstream of a dam or a channelized/piped section.

Restoration Restrictions:

1. **No enhance ment activities can be coupled with restoration on the same linear foot of stream channel.**

2. **The difference between projects that are credited as Restoration and projects that are credited as Enhancement, is whether or not changes are necessary to address the current channel's dimension, pattern, and profile, as described for each of the Priorities, to produce a stable channel. All three geomorphic categories (i.e., pattern, profile, and dimension) are required to be addressed, with noted pattern limitations for Priority 3, in order to receive Restoration credit. Enhancement credit is given in all other situations when only two geomorphic variables are addressed to produce a stable channel.**

5.1.3 Enhancement

Enhancement Activities include physical alterations to the channel that do not constitute Restoration but that directly augment channel stability, enhance streambanks, streambed, and in-stream habitat, water quality, and stream ecology in accordance with a reference condition,or analytical methodology. These activities may include physical in-stream and/or streambank activities, but in total restore only one or two of the geomorphic variables: dimension, pattern and profile. There are 6 activities included in the Enhancement category: 1) Instream Structures (cross vanes, j hooks, fish passage structures etc.), 2) Habitat Structures, 3) Bankfull Bench Creation, 4) Laying Back Banks, 5) Bioremediation Techniques, and 6) Stream Bank Planting.

Instream Structures

This activity includes structures that are specifically designed and result in grade control and/or bank stabilization. Accepted structures include, but are not limited to, cross-vanes, j-hook vanes, native material revetments, rock weirs, rock vortex weirs, log-vanes, constructed riffles, and step-pools. These structures may be created out of appropriate sized rock or logs, boulders or cobbles based on the size of the stream and the flow regime. Structures not listed will be considered on case-by-case basis. Normally, a pool is constructed in combination with these structures, however, if one is not constructed this does not alter the credit provided.

The compensation plan needs to state, and clearly demarcate, the length (in linear feet) of stream channel and reaches of stream channel expected to benefit from and be influenced by the structures. An alternative strategy is that the benefit can be estimated to be 3 times the length of the structure.

Habitat Structures

This activity includes structures designed specifically for habitat creation. Although, Instream Structures typically provide habitat, they are constructed for channel stability and will not receive credit for Habitat Structures. Habitat Structures do not typically contribute to channel stability. Accepted structures include, but are not limited to, submerged shelters, fish boards or bank cover, floating log structures, root wads, and half-log cover. Riffle and pool complexes and over hanging vegetation do not qualify for credit in this activity. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where habitat structures are proposed.

Bankfull Bench Creation

This activity involves the creation of a bankfull bench along one or both of the stream banks. This activity may result in less than the proper entrenchment ratio but does result in a stable channel. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where bankfull benches are proposed.

Lay Back Bank

This activity involves the manual manipulation of the bank slope but does not create a bankfull bench or floodplain. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where laying back the banks is proposed.

Bioremediation Techniques

This activity primarily relates to the use of coir logs or similar materials for bank stabilization. Techniques and materials in this category include, but are not limited to, live fascines, branch packing, brush mattresses, coir logs, and natural fiber rolls. More than one of these materials or techniques may be warranted over the same stream length. In this case, no additional credit will be applied for that length. In other words, the compensation plan should include all bioremediation techniques required over a particular length. Techniques and materials other than those listed will be considered on a case-by-case basis for approval by the agencies. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where bioremediation techniques are proposed.

Streambank Planting

This activity includes the installation of plants other than seed along the immediate stream bank area. This is primarily done for streambank stabilization. This activity includes live stakes, dormant post/stakes, branch layering, and the installation of plants. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where streambank plantings are proposed.

Enhancement Restrictions:

1. **Activities cannot be credited as both Restoration and Enhancement activities.**
2. **A structure cannot be credited as both an Instream Structure and a Habitat Structure.**
3. **Mechanical bank work cannot be credited as both Bankfull Bench and Laying Back the Banks.**
4. **Biore mediation Techniques do not include Erosion Control matting.**

5.2 Streambank Stability: The streambank stability/Bank erosion potential addresses the existence of the potential for soil detachment from the upper and lower stream banks and its movement into the streams. Some bank erosion is normal in a healthy stream. Excessive bank erosion occurs where riparian zones are degraded; the stream is unstable due to changes in hydrology, sediment load, or loss of access to the floodplain, and when the stream banks are high and steep.

Low Bank Erosion Potential: where the banks are low and at the appropriate elevation to allow the stream appropriate access to the floodplain, and the banks are protected by roots and vegetation that extend to the base-flow elevation. Greater than 33 percent of the surface areas of outside stream bends are protected by roots and/or vegetation.

Moderately Bank Erosion Potential: where the banks are low and at the appropriate elevation to allow the stream appropriate access to the floodplain, and the banks are protected by roots and vegetation that extend to the base-flow elevation. Less than 33 percent of the surface areas of outside stream bends are protected by roots and/or vegetation.

High Bank Erosion Potential: where the banks are high and steep, stream no longer has access to the floodplain, and the banks are no longer protected by roots and vegetation. There is evidence of significant bank erosion with less than 5 percent of the surface areas of outside stream bends are protected by roots and/or vegetation.

Streambank stability can be assessed using the Bank Erosion Hazard Index (BEHI) (Fig. 1). Low, moderate and high bank erosion potential can be correlated with the BEHI.

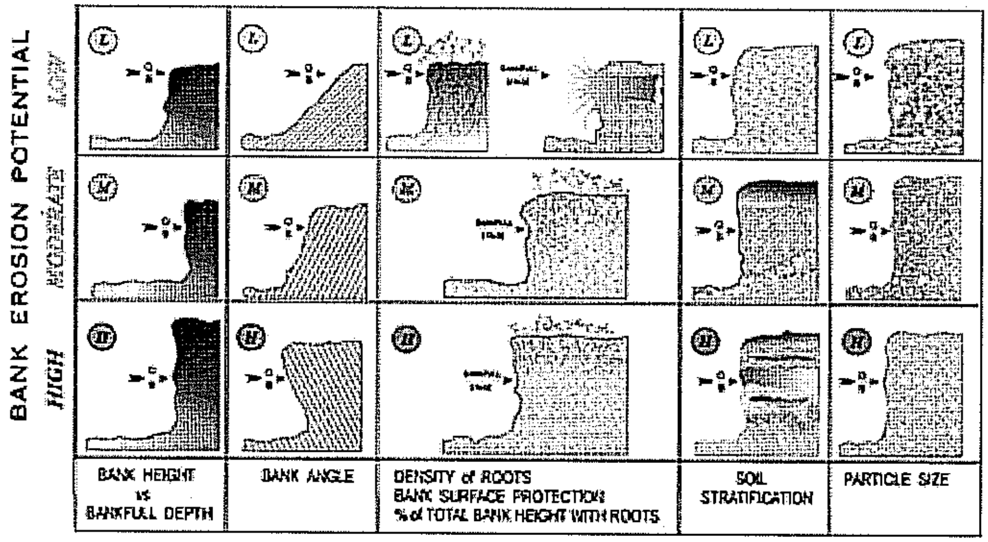


Figure 1. Illustrated examples of the five Bank Erosion Hazard Index (BEHI) criteria

5.3 Instream Habitat: The In-Stream Habitat assessment considers the habitat suitability for effective colonization or use by fish, amphibians, and/or macroinvertebrates. This assessment does not consider the abundance or types of organisms present, nor does it consider the water chemistry and/or quality of the stream. Other factors beyond those measured (i.e. watershed conditions), also affect the presence and diversity of aquatic organisms. Therefore, this assessment seeks to evaluate the suitability of physical elements within the stream reach which support aquatic organisms.

This habitat assessment includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, persistent leaf packs, and undercut banks; available as refugia, feeding, or sites for spawning, and nursery functions of aquatic macrofauna. A wide variety and/or abundance of instream habitat features provide macroinvertebrates and fish with a large number of niches, thus increasing species diversity. As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases. Riffles and runs are critical for maintaining a variety and abundance of benthic organisms and serve as spawning and feeding refugia for certain fish. The extent and quality of the riffle is an important factor in the support of a healthy biological condition. Riffles and runs offer habitat diversity through a variety of particle sizes. Snags and submerged logs are also productive habitat structures for macroinvertebrate colonization and fish refugia.

The assessment does not establish a percent slope for distinguishing between high and low gradient streams. Therefore, the Evaluator has to know whether a high or low gradient stream is being assessed. Generally speaking, low gradient streams occur in the Coastal Plain, wetland / marsh conditions, or wet meadows, and do not contain riffles. High gradient streams generally have alternating riffles and pools, with gravel or cobble present in the riffles. Typically, most streams north of the Fall Line are high gradient, with the exception of streams in the Coastal Plain and low gradient streams flowing through wetlands or wet meadows throughout the state. Headwater stream channels have intermittent hydrologic regimes and may not have the diversity of habitat features found in higher order stream channels. Hyporheic zone flow (subsurface region of streams where the mixture of surface water and groundwater can be found) may comprise all of the flow in intermittent streams during dry times of the year. A high gradient stream should not be scored lower because there is not submerged aquatic vegetation. Likewise, a low gradient stream should not be scored lower because it does not contain riffles.

High Gradient Streams

Physical elements of high gradient stream systems that enhance a stream's ability to support aquatic organisms and are indicative of habitat diversity include the following:

1. A varied mixture of substrate sizes (i.e., sand, gravel, cobbles, and boulders).
2. Low amount of highly mobile substrate material – While most streambed substrate mobilizes under a particular discharge, substrate that remains immobile during the more consistent and frequent discharges provides stable habitat that fish and macroinvertebrates can utilize throughout differing stages of their lifecycles.
3. Low Embeddedness of substrate material – Embeddedness is the extent to which rocks (gravel, cobble, and boulders) and snags are covered by silt, sand, or mud on the stream bottom. As rocks and snags become embedded, there is less area available for colonization for macroinvertebrates and less fish habitat. Generally, the less embedded each particle is, the more surface area available to macroinvertebrates and fish. Additionally, less embeddedness indicates less large-scale sediment movement and deposition. (Observations of embeddedness are taken in the upstream and central portions of riffles and cobble substrate areas.)
4. A varied combination of water velocities and depths (riffles and pools) - More combinations of velocity and depth patterns provide increased habitat diversity.
5. The presence of woody and leafy debris (fallen trees, logs, branches, leaf packs, etc.), root mats, large rocks, and undercut banks (below bankfull).
6. The provision of shade protection by overhanging vegetation.
7. The Hyporheic zone is wet within 12" of ground surface.

Low Gradient Streams

Physical elements of low gradient stream systems that enhance a stream's ability to support aquatic organisms and are indicative of habitat diversity include the following:

1. A varied mixture of substrate materials (i.e., sand and gravel) in pools – Varied substrate materials support a higher diversity of organisms than mud or bedrock.
2. Submerged aquatic vegetation in pools – Will also support a higher diversity of organisms.
3. The presence of woody and leafy debris (fallen trees, logs, branches, leaf packs, etc.), root mats, and undercut banks (below bankfull).
4. The provision of shade protection by overhanging vegetation.
5. The Hyporheic zone is wet within 12" of ground surface.

A diverse and abundant assemblage of these features promotes the potential for colonization by diverse and abundant epifaunal and fish communities. This assessment measures the availability of physical habitat diversity within a stream. Each cover type must be present in appreciable amounts and with high likelihood of having a long-term presence to score. This should be assessed within a representative subsection of the stream reach that is equivalent to 5 times the active channel width.

Logs/large woody debris: Fallen trees or parts of trees that provide structure and attachment for aquatic macroinvertebrates and hiding places for fish.

Deep Pools: Areas characterized by a smooth undisturbed surface, generally slow current, and deep enough to provide protective cover for fish (75-100 percent deeper than prevailing stream depth).

Overhanging vegetation: Trees, shrubs, vines, or perennial herbaceous vegetation that hang immediately over the stream surface, providing shade and cover.

Boulders: Boulders more than 10 inches in diameter or large slabs more than 10 inches in length.

Undercut banks: Eroded areas extending horizontally beneath the surface of the bank forming underwater pockets used by fish for hiding and protection.

Thick root mats: Dense mats of roots (generally from trees) at or beneath the water surface forming structure for invertebrate attachment and fish cover.

Dense macrophyte beds: Beds of emergent or submerged aquatic vegetation thick enough to provide invertebrate attachment and fish cover.

Riffles: Area characterized by broken water surface, rocky or firm substrate, moderately swift current, and relatively shallow depth (usually less than 18 inches).

5.3.1 In-Stream Habitat Categories

The reach is assessed for the condition of **In-Stream Habitat** using the following four Categories. The Evaluator selects the category most representative of the stream reach.

A. Optimal

Greater than 5 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in greater than 50% of the reach. Substrate is favorable for colonization by a diverse and abundant epifaunal community, and there are many suitable areas for epifaunal colonization and/or fish cover.

B. Suboptimal

5 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in 30-50% of the reach. Conditions are mostly desirable, and are generally suitable for full colonization by a moderately diverse and abundant epifaunal community.

C. Marginal

4 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in 10-30% of the reach. Conditions are generally suitable for partial colonization by epifaunal and/or fish communities.

D. Poor

3 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in less than 10% of the reach. Conditions are generally unsuitable for colonization by epifaunal and/or fish communities.

5.4 <u>Timing of Mitigation</u>: Mitigation must be initiated prior to or concurrent with the start of the authorized project impacts to wetlands. Any required riparian buffer tree planting must occur within the first growing season of the project. No credits are generated for this factor if the mitigation action in a reach is primarily riparian buffer preservation.

Non-Banks:

***Before*:**	All mitigation is completed before the impacts occur.
***During*:**	A majority of the mitigation is completed concurrent with the impacts
***After*:**	A majority of the mitigation will be completed after the impacts occur.

Banks: Release of credits will be determined by the MBRT on a case-by-case basis.

6.0. RIPARIAN WORK - MITIGATION CREDITS:

All stream mitigation projects require protected riparian buffers. Riparian buffer mitigation must provide high quality wetland and upland habitats based upon measurable ecological success parameters. Similar to in-stream projects, applicants are encouraged to utilize reference quality wetland and upland systems for developing their ecological success criteria. Applicants are encouraged to use the success criteria developed by the Mobile District for wetland habitats which may be adjusted for regional differences as supported by data collected from similar high quality wetland habitats in the same watershed.

Activities that constitute stream preservation, restoration and enhancement may include, but are not limited to, stream channel restoration; stream bank stabilization, and natural riparian buffer restoration, enhancement, or preservation. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan and must meet the requirements contained in 33 CFR Part 332.3(h) on preservation.** Deviation from these percentages may be approved on a case-by-case basis by the Corps in consultation with other resource and regulatory agencies.

6.1 Riparian Buffer Restoration, Enhancement, and Preservation Mitigation:

The minimum buffer width (MBW) for which mitigation credit will be earned is 50 feet on one side of the stream, measured from the top of the stream bank (i.e., the bankfull stage), perpendicular to the channel. Narrower buffer widths may be allowed on a case-by-case basis for small urban streams due to physical space constraints often encountered in urban environments. Intermittent streams may only claim credit for a maximum of a 2X the minimum buffer width. If topography within a proposed stream buffer has more than a 2% slope, 2 additional feet of buffer are required for every additional percent of slope (e.g., minimum buffer width with a +10% slope is 70'). Buffer slope will be determined in 50'-increments beginning at the stream bank. No additional buffer width will be required for negative slopes. For the reach being buffered, degree of slope will be determined at 100' intervals and averaged to obtain a mean degree of slope for calculating minimum buffer width. This mean degree of slope will be used to calculate the minimum buffer width for the entire segment of stream being buffered.

6.2. Riparian Buffer Net Benefit:

Riparian Buffer Restoration means implementing rehabilitation practices within a stream riparian buffer zone to have a measurable effect on stream ecological function and water quality. Buffer restoration requires the restoration of both vegetation and hydrology to that of a reference high quality upland and/or wetlands system within the same watershed. Restoration programs should strive to mimic the hydrology, and vegetation species composition, structure, and density of an in-kind reference system.

Riparian Buffer Enhancement means implementing rehabilitation practices within a stream riparian buffer zone to have a measurable effect on stream water quality and/or ecological function. Buffer enhancement requires improving the existing upland and/or wetlands habitat either by improving the hydrology or vegetation to mimic that of a reference system within the same watershed. Enhancement programs should strive to mimic the vegetation species composition, structure, and density of an in-kind reference system.

Riparian Buffer Preservation means the conservation, in its naturally occurring or present condition, of a high quality riparian buffer to prevent its destruction, degradation, or alteration in any manner not authorized by the governing authority. For the purposes of these guidelines, an area will be considered as riparian buffer preservation if less than 10% of the area would require planting of deep-rooted vegetation to restore stream bank stability and improve wildlife habitat. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan.**

Tables 1 below provide appropriate Net Benefit values for the riparian restoration, enhancement and preservation mitigation worksheet. Note that on the worksheet in Appendix A that buffers on each bank generate independent mitigation credit.

Table 1. Riparian Buffer Restoration, Enhancement and Preservation

	% Buffer that Needs Vegetation Planted	Buffer Restoration	Buffer Enhancement -		Buffer Preservation - Planting (0 – 10%)
			Planting (51 - 100%)	Planting (11% - 50%)	
Buffer Width (on one side of the stream)	4X min. width	1.6	1.2	0.8	0.4
	3X min. width	1.2	0.9	0.6	0.3
	**2X min. width	0.8	0.6	0.4	0.2
	*Minimum width (50 ft)	0.4	0.3	0.2	0.1

No mitigation credit will be given for riparian buffers on impacted streams where no in-stream work is proposed.

* Smaller buffers width may be allowed on a case-by-case basis for small urban streams.

** Intermittent streams are limited to a maximum 2X minimum buffer width (maximum 100 feet on each side).

Fencing in Actively-Grazed Riparian Buffers: Cattle are not allowed to access riparian buffers within compensatory mitigation sites. Land management actions typically include restoring vegetation and fencing livestock from pastures, where livestock grazing activities are impacting water quality and/or stream ecological function by causing streambank degradation, sedimentation, and water quality problems. Livestock exclusion is normally accomplished by fencing stream corridors and can include the construction of stream crossings with controlled access and with stable and protected stream banks. No more than one livestock crossing is allowed per 1,000 linear feet of stream mitigation. The width of the livestock crossing and any length of affected stream below will be deducted from the total length of the stream mitigation segment. After cattle have been removed, impacted riparian buffers must be restored or enhanced and may not be used for preservation purposes only.

6.2 System Protection Credit: Bonus mitigation credit may be generated if proposed riparian mitigation activities include minimum width buffers on both sides of a stream reach and legal protection of a fully buffered stream channel. (**Condition:** Mitigation plan provides for restoration or preservation of minimum width buffers, as defined in these guidelines, on both streambanks of the reach).

6.4 **Mitigation Factor:** It is recommended that stream mitigation be conducted on free flowing streams. However, if a proposed stream mitigation segment is located within 1 mile of the upstream end of an existing or proposed man made lake, and flows into the lake,, then mitigation credits for this segment of stream will be reduced by 50%. **Use mitigation factor of 0.5 for the above mitigation sites. Use mitigation factor of 1.0 for all other mitigation.**

7.0 DEFINITIONS:

Bankfull Discharge (effective discharge) The bankfull discharge stage is the incipient point at which water begins to overflow the bed and bank channel and onto a floodplain. Bankfull may not be at the top of the stream bank in incised or entrenched streams. On average, bankfull discharge events occur approximately once every 1.5 years. The bankfull discharge is the most important stream process in defining channel form and is the flow that is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and doing work that results in the average morphologic characteristics of channels.

Bankfull Width- is the width of the stream channel at bankfull discharge, as measured in a riffle section.

Bank Height Ratio- is the maximum depth of the stream from top of the lowest bank to the thalweg divided by the maximum depth from bankfull to thalweg. It along with entrenchment ratio is a means to measure vertical stability of a stream.

Channel Dimension- is the stream's cross-sectional area (calculated as bankfull width multiplied by mean depth at bankfull). Changes in bankfull channel dimensions correspond to changes in the magnitude and frequency of bankfull discharge that are associated with water diversions, reservoir regulation, vegetation conversion, development, overgrazing, and other watershed changes. Stream width is a function of occurrence and magnitude of discharge, sediment transport (including sediment size and type), and the streambed and bank materials.

Channel Features- natural streams have sequences of riffles and pools or steps and pools that maintain channel slope and stability and provide diverse aquatic habitat. A riffle is a bed feature where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. Pools are located on the outside bends of meanders between riffles. The pool has a flat slope and is much deeper than the average channel depth. Step/pool sequences are found in high gradient streams. Steps are vertical drops often formed by large boulders or downed trees. Deep pools are found at the bottom of each step.

Channel Pattern- refers to the plan view of the channel as seen from above. Streams are rarely straight; they tend to follow a sinuous path across a floodplain. Sinuosity of a stream is defined as the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, stream flow, and the bed and bank materials. In general, sinuosity increases as valley gradient increases. Stream pattern is defined by measuring meander wavelength, radius of curvature, amplitude, and belt width.

Channel Profile- of a stream refers to its longitudinal slope which typically decreases downstream and is inversely related to slope. It is a reflection of irregular profile based upon bed material, riffle/pool spacing, and other variables. At the watershed scale, channel slope generally decreases in the downstream direction with commensurate increases in stream flow and decreases in sediment size. Channel slope is inversely related to sinuosity, so steep streams have low sinuosity and flat streams have high sinuosity.

Entrenchment Ratio- is an index value that describes the degree of vertical containment of a river channel. It is calculated as the width of the flood-prone area (elevation at twice bankfull max depth above thalweg) divided by width of bankfull channel.

Ephemeral Streams - streams that have flowing water only during and for a short duration after, precipitation events in a typical year. Ephemeral streambeds are located above the groundwater table year-round and typically do not have bed and bank features. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for these streams which typically occur as vegetated wetland swales.

Flood-prone Area- the width of the flood prone area is measured in the field at an elevation twice-maximum depth at bankfull, measured in the thalweg. Maximum depth is the difference between the bankfull stage and thalweg elevations in a riffle section.

High Gradient Streams –streams with moderate-high gradient landscapes; substrates primarily composed of coarse sediments [gravel (2mm) or larger] or frequent coarse particulate aggregations; riffle/run prevalent.

Intermittent Streams - streams that have flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Low Gradient Streams - streams with low-moderate gradient landscapes; substrates of fine sediment particles or infrequent aggregations of coarse sediment particles [gravel (2mm) or larger]; glide/pool prevalent.

Mean Depth at Bankfull-is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.

Meander Width Ratio- is defined as the meander belt width divided by bankfull width.

Natural Stream Channel Design- is the concept of determining appropriate stream channel design utilizing stable reference stream reaches that represent the best conditions attainable within a particular stream class within a watershed.

Priority 1 Restoration - is defined as stream channel restoration that involves the re-establishment of a channel on the original floodplain, using either a relic channel or construction of a new channel. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. The existing, incised channel is either backfilled or made into discontinuous oxbow lakes level with the new floodplain elevation.

Priority 2 Restoration - is defined as stream channel restoration that involves re-establishment of a new floodplain at the existing level or higher but not at the original level. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream.

Priority 3 Restoration - is defined as stream channel restoration to a channel without an active floodplain but with a floodprone area. However, the restoration of the channel must involve establishing proper dimension, pattern, and profile. Some sites may present difficulties in reestablishing a sinuous pattern when they are laterally contained or have limitations in available belt width. This is often caused by utilities, infrastructure, and other floodplain encroachments. Such physical constraints often favor the creation of a step/pool bed morphology with less sinuosity (associated with Priority 3) over a riffle/pool bed morphology with greater sinuosity (associated with Priorities 1 & 2).

Reference Reach/Condition - Reference reaches are unimpaired stream reaches located as close as possible to the impacted reach, within the same watershed or stream whenever possible. These relatively unimpaired stream systems provide reference metrics of physical (bed features, channel forms, dimension, pattern, and profile), biological, and chemical parameters that have demonstrated to be persistent even after periodic disturbances such as flooding events.

Sinuosity: the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, stream flow, and the bed and bank materials. In general, sinuosity increases as valley gradient increases.

Slope- slope of water surface averaged for 20-30 channel widths.

Stable Stream- a naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not cumulatively aggrade or degrade. Naturally stable streams must be able to transport the water, organic matter, and sediment load supplied by the watershed. Stable streams are not fixed and migrate across the landscape slowly over geologic time while maintaining their form and function. In general, stream stability can be assumed if the stream maintains a stable pattern, profile, and dimension after two bankfull events which typically occur at a 1.5 year interval.

Stream Reach - stream reach is the length of a stream section containing a complete riffle and pool complex. If none noted, a suitable length is usually no less than 300 feet long

Stream Re-establishment – is the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of creating natural/historic functions to former stream. Re-establishment results in rebuilding a former stream.

Stream Restoration or Rehabilitation - is the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of restoring natural/historic functions of degraded streams. Rehabilitation results in a gain in stream functions. This can he accomplished by converting an unstable, altered, or degraded stream channel / stream corridor, including adjacent riparian zone and flood-prone areas to its natural or referenced, stable conditions considering recent and future watershed conditions. Stream channel restoration methods should be based on measurements taken in a reference reach and may include restoration of the stream's geomorphic dimension, pattern and profile and/or biological and chemical integrity, including transport of water and sediment produced by the streams' watershed to achieve dynamic equilibrium. (Dimension includes a stream's width, mean depth, width/depth ratio, maximum depth, flood prone area width, and entrenchment ratio. Pattern refers to a stream's sinuosity, meander wavelength, belt width, meander width ratio, and radius of curvature. Profile includes the mean water surface slope, pool/pool spacing, pool slope, & riffle slope.)

Stream Stabilization - the manipulation of the physical characteristics of stream to reduce the erosion potential of the stream. Stabilization techniques which include "soft" methods or natural materials (such as tree revetments, root wads, log crib structures, rock vanes, vegetated crib walls and sloping of streambanks) may be considered part of a restoration design. However, stream stabilization techniques that consist primarily of "hard" engineering, such as concrete lined channels, rip rap, or gabions, while providing bank stabilization, will usually not be considered restoration or enhancement in most cases.

Stream Enhancement – is the manipulation of the physical, chemical, or biological characteristics of a (undisturbed but degraded) stream or stream buffer to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is undertaken for a purpose such as water quality improvement and/or ecological functions (flood water retention or wildlife habitat). This can be accomplished by implementing certain stream rehabilitation practices. These practices are typically conducted on the stream bank or in the flood prone area but may also include the placement of in-stream habitat structures; however, they should only be attempted on a stream reach that is not experiencing severe aggradation or degradation. Care must be taken to ensure that the placement of in-stream structures will not affect the overall dimension, pattern, or profile of a stable stream.

Stream Preservation - The protection of ecologically important aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms. Preservation will include protection of riparian areas adjacent to stream channels or other aquatic resources as necessary to ensure protection and/or enhancement of the aquatic ecosystem.

Stream Restoration - Converting an unstable, altered, or degraded stream corridor, including adjacent riparian zone (buffers) and flood-prone areas, to its natural stable condition considering recent and future watershed conditions. This process should be based on a reference condition/reach for the valley type and includes restoring the appropriate geomorphic dimension (cross-section), pattern (sinuosity), and profile (channel slopes), as well as reestablishing the biological and chemical integrity, including transport of the water and sediment produced by the **stream's watershed in order to achieve dynamic equilibrium.**

Stream Relocation- Is moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed on the stream's former location. (Note: relocation of a stream is considered fill under these guidelines when the relocation is conducted to allow development of the area where the stream previously was located; impacts associated with stream relocation in these situations must be fully mitigated). <u>Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions; maintain the capacity to transport bedload sediment; and have at least a minimum width buffer of natural vegetation on both sides of the stream to receive mitigation credit</u>; this buffer also will generate riparian preservation or restoration mitigation credit.

Width/Depth Ratio- is an index value that indicates the shape of the channel cross-section. It is the ratio of the bankfull width divided by the mean depth at bankfull.

APPENDIX A
ADVERSE IMPACT
FACTORS FOR RIVERINE SYSTEMS WORKSHEET

<table>
<tr><td>Stream Type Impacted</td><td colspan="3">Intermittent
0.1</td><td colspan="3">1st or 2nd Order Perennial Stream
0.8</td><td colspan="3">>2nd Order Perennial Stream
0.4</td></tr>
<tr><td>Priority Area</td><td colspan="3">Tertiary
0.1</td><td colspan="3">Secondary
0.4</td><td colspan="3">Primary
0.8</td></tr>
<tr><td>Existing Condition</td><td colspan="3">Impaired
0.1</td><td colspan="3">Somewhat Impaired
0.8</td><td colspan="3">Fully Functional
1.6</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary
0.05</td><td colspan="3">Recurrent
0.1</td><td colspan="3">Permanent
0.3</td></tr>
<tr><td>Dominant Impact</td><td>Shade/ Clear
0.05</td><td>Utility Crossing
0.15</td><td>Below Grade Culvert
0.3</td><td>Armor
0.5</td><td>Detention /Weir
0.75</td><td>Morphologic Change
1.5</td><td>Impoundment (dam)
2.0</td><td>Pipe >100'
2.2</td><td>Fill
2.5</td></tr>
<tr><td>Cumulative Impact Factor</td><td><100'
0</td><td>100'-200'
0.05</td><td>201-500'
0.1</td><td>501-1000'
0.2</td><td colspan="5">>1000 linear feet (LF)
0.1 for each 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1)</td></tr>
</table>

Factor	Dominant Impact Type 1	Dominant Impact Type 2	Dominant Impact Type 3	Dominant Impact Type 4	Dominant Impact Type 5
Stream Type Impacted					
Priority Area					
Existing Condition					
Duration					
Dominant Impact					
Cumulative Impacts Factor					
Sum of Factors	M =				
Linear Feet of Stream Impacted in Reach	LF=				
M X LF					

Total Mitigation Credits Required = (M X LF) = ______________

IN-STREAM WORK
STREAM CHANNEL /STREAMBANK RESTORATION AND RELOCATION WORKSHEET

Stream Type	Intermittent 0.05	1st or 2nd Order Perennial Stream 0.4	>2nd order Perennial Stream (Bankfull width)			
			>15’ 0.4	15’-30’ 0.6	30’-50’ 0.8	>50’ 1.0
Priority Area	Tertiary 0.05	Secondary 0.2	Primary 0.4			
Existing Condition	Impaired 0.4	Somewhat Impaired 0.05				
Net Benefit	Stream Relocation 0.1	Stream Channel Restoration/Stream Bank Stabilization				
		Moderate 1.0	Good 2.0	Excellent 3.5		
Streambank Stability	Stable Banks 0.4	Moderately Stable Banks 0.2				
Instream Habitat	>5 cover types 0.35	5 cover types 0.25	4 cover types 0.15	3 Cover types 0.1		
Timing of Mitigation	Before 0.15	During 0.05	After 0			

Factors	Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type						
Priority Area						
Existing Condition						
Net Benefit						
Bank Stability						
Instream Habitat						
Timing of Mitigation						
Sum Factors (M)=						
Stream length in Reach (do not count each bank separately) (LF)=						
Credits (C) = M X LF						
Mitigation Factor Use (MF) = 0.5 or 1.0						
Total Credits Generated C X MF =						

Total Channel Restoration/Relocation Credits Generated = ____________

RIPARIAN BUFFER RESTORATION AND PRESERVATION WORKSHEET

Stream Type	Intermittent 0.05	>2nd Order Perennial Stream 0.2	1st or 2nd Order Perennial 0.4
Priority Area	Tertiary 0.05	Secondary 0.2	Primary 0.4
Net Benefit (for each side of stream	Riparian Restoration, Enhancement, and Preservation Factors (select values from Table 1) (MBW = Minimum Buffer Width = 50' + 2' / 1% slope)		
System Protection Credit	Condition : MBW restored or protected on both streambanks To calculate:(Net Benefit Stream Side A + Net Benefit Stream Side B) / 2		
Timing of Mitigation	Before 0.15	During 0.05	After 0

Factors		Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type							
Priority Area							
Net Benefit	Stream Side A						
	Stream Side B						
System Protection Credit Condition Met (Buffer on both sides)							
Timing of Mitigation (None for primarily riparian preservation)	Stream Side A						
	Stream Side B						
Sum Factors (M)=							
Linear Feet of Stream Buffer (LF)= (don't count each bank separately)							
Credits (C) =M X LF							
Mitigation Factor Use (MF) = 0.5 or 1.0							
Total Credits Generated C X MF =							

Total Riparian Restoration Credits Generated = ____________________

Appendix B: Stream Mitigation Plan Requirements

Stream Conceptual Mitigation Plan

The Mobile District encourages the use of natural stream channel design concepts for all in-stream mitigation projects. This approach incorporates the use of stable, preferably non-impacted reference quality stream reaches for designing the appropriate pattern, profile, and dimension for stream mitigation projects. The concept of using reference sites is also encouraged when designing stream riparian buffer mitigation projects. Stream mitigation projects can be very complex depending on the level of manipulation required to achieve the target stream. It requires an understanding of upstream land use changes, both at the local and watershed level, since these changes are usually the cause of the disequilibrium regarding upstream delivery of water flow and sediment that influences the final stream restoration design necessary to achieve a stable stream restoration project. The Mobile District encourages the use of the Rosgen stream classification and stream stability concepts to allow for a consistent framework for organizing information and communications. This method allows for consistent discussion regarding data requirements including the current stream stability parameters based upon stream dimension metrics such as width/depth ratio, bank height ratio, and entrenchment ratio, as well as pattern and profile metrics including slope, bed features, sinuosity, meander width ratio, and radius of curvature. ***The Corps will determine, on a case-by-case basis***, the net benefit of mitigation actions that do not involve direct manipulation of the entire length of stream. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan.** Stream mitigation within 300 feet of a culvert, dam, or other man-made impact to waters of the United States generally will generate only minimal restoration or preservation credit due to impacts associated with these structures.

All of the restoration and enhancement measures should be designed with the goal of improving the entire stream system within a target reach using approved reference stream systems to properly determine appropriate stable stream pattern, profile, and dimension, stable stream bank design, and target species composition and diversity within the adjacent riparian buffer ecosystem. The level of detail required in a mitigation plan will be commensurate with the complexity of the mitigation project. All compensatory mitigation sites must be deed protected using either a conservation easement or restrictive covenant. The conservation easement or restrictive covenant must be approved by the Corps prior to being properly recorded with the appropriate local entity and be in compliance with Mobile District's requirements. They should be conforming to the most recent example edition located on the Mobile District web page at http://www.sam.usace.army.mil/RD/reg/.

In order to develop a conceptual stream mitigation plan, it is necessary to first research the stream's watershed and its history to determine the cause and extent of its deficiencies. The following questions should be answered to help identify and document the specific deficiencies to be addressed within a stream reach.

1. What is the stream name?
2. What is the reach length to be evaluated? Provide a USGS topographic map with the location of the stream reach clearly identified.
3. What is the stream order?
4. What is the approximate drainage area?

5. Describe the existing watershed and the estimated proposed land use for that watershed (i.e.: percent residential, percent forested, percent commercial, percent cleared/logged, percent industrial, percent agricultural, other).
6. Describe the existing riparian buffer (i.e.: mature forested, herbaceous and shrub layers present in understory, utility easements present, understory maintained, lawns, impervious surfaces, active row crops, etc.). Provide the estimated percentage of the total riparian area comprised of each cover type.
7. What is the estimated bankfull width?
8. What is the estimated bank height?
9. Is the channel high gradient or low gradient?
10. Does the channel appear to have natural sinuosity or does it appear that the channel patterns have been altered?
11. Does the channel appear to be aggrading, degrading, or stable?
12. Describe the sediment supply (i.e. extreme, very high, high, etc.)
13. Are the streambanks eroding? Over what percentage of the reach?
14. Are head-cuts present within the reach?
15. Provide a general narrative overview of the existing stream pattern, profile, or dimension alterations and the proposed necessary restoration or enhancement measures to be taken to address those deficiencies.
16. What are the goals and objectives of the mitigation, and how will the mitigation plan meet those goals and objectives?
17. The Stream Impact Assessment Form can be used to further document the existing condition of the mitigation site.

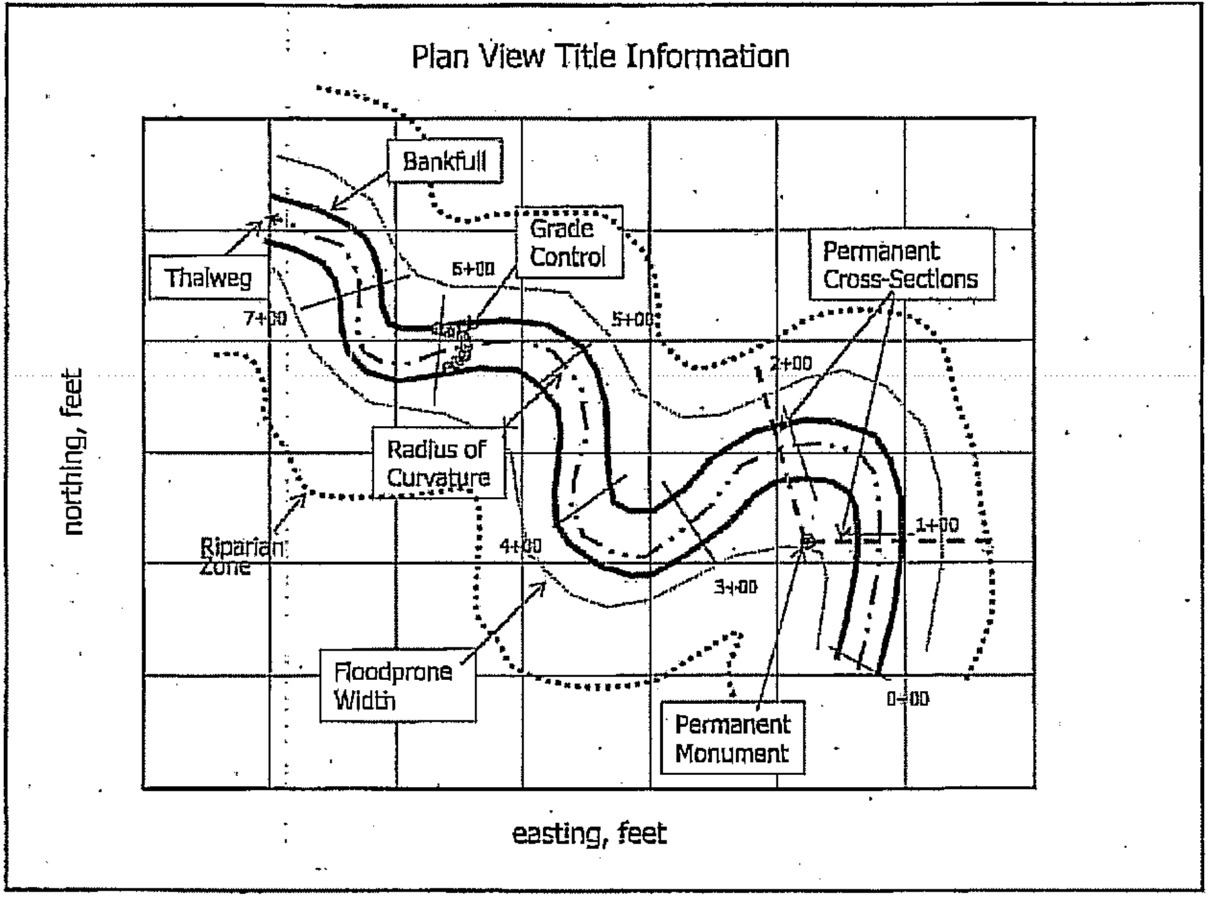
DATA SUMMARY SHEET

	EXISTING	PROPOSED	REFERENCE	AS BUILT*
Stream Name				
Stream Width				
Drainage Area				
Rosgen Stream Type				
Channel Slope				
Length of Valley				
Length of Channel Thalweg				
Sinuosity				
Meander Wavelength				
Meander Belt Width				
Radius of Curvature				
Meander Width Ratio				
Radius of Curvature Ratio				
Bankfull Width				
Bankfull Area				
Mean Depth @ BKF				
Max Depth @ BKF				
Entrenchment Ratio				
Width to Depth Ratio				
Bank Height Ratio				
Max Depth Ratio				

Sediment Type				
Flood prone width				
Flood prone area				

- *A current Summary Sheet Data worksheet must be completed and provided for each requested credit release associated with in-stream work.

Typical Plan View



Appendix C: Stream Mitigation Success Criteria

1. Introduction

There is no simple recipe approach to address how to achieve a successful stream channel restoration project. River corridors are dynamic and influenced by a diverse array of environmental processes. These physical and ecological processes are related to regional variability in hydrologic regimes, hydraulics, geology, geomorphic channel processes, connectivity to riparian zones, climates, and ever changing surrounding development influences. There are too many variables that must be addressed for a one-size fits all approach to stream channel restoration. Because of the dynamic nature in how stream systems adapt to these changing influences, the same stream restoration design plan is rarely applicable to different streams.

2. Natural Stream Channel Design

One method for addressing the wide range of variability associated with properly designing a stream channel restoration project, and the method endorsed by the Mobile District, is the concept and use of natural stream channel design for stream restoration projects. This approach incorporates the use of stable "reference reach" streams when designing appropriate pattern, profile, and dimension characteristics for a stream restoration project. Reference reaches are streams of the same order and position within the watershed that exhibit the least altered stable stream pattern, profile, and dimension. Reference reaches do not have to be perfect streams, most represent the least altered stable stream available for a watershed. While the reference reach can provide reference stream metrics for the stable stream at that one moment, it is also important to understand upstream land use changes, both at the local or watershed level, that cause disequilibrium regarding upstream delivery of water flow and sediment that influences the final stream restoration design necessary to achieve a stable stream restoration project.

3. Discussing Your Stream Channel Restoration Project

When initially presenting an instream channel restoration project, applicants should be prepared to discuss the current stream condition/type using the Rosgen stream classification system as well as the current stage in the Stream Channel Evolution Model. To provide a consistent and standardized framework for communicating stream information, this discussion should center on the current dimension (vertical stability) metrics including width depth ratio, bank height ratio, entrenchment ratio, as well as pattern and profile (lateral stability) metrics including slope, bed features, sinuosity, meander width ratio, and radius of curvature. Data sheets should be provided for all stream channel restoration projects that will require in-stream work. The level of information collected should be commensurate with the level of instream work being proposed. Final stream design data sheets should include stream measurement data for the currently impacted stream, the reference reach, and the target stream design.

4. Wetland Riparian Buffers

All streams proposed as mitigation must be protected with riparian buffers. The minimum riparian buffer that can be placed on a stream is 50 feet. Riparian buffer restoration and enhancement actions and target ecological performance standards should be based upon success criteria developed for each wetland type by the Mobile District and found on the Regional Internet Banking Information Tracking System (RIBITS) on the Mobile District Regulatory Division website.

5. Upland Riparian Buffers

For upland riparian buffers on streams, riparian buffer restoration and enhancement actions and target ecological performance standards should be based upon target species composition, diversity, and structure, gathered from high quality reference upland riparian buffers in the same watershed.

Stream Mitigation Success Criteria

1. In-stream Mitigation

- Establishment/acceptance of Reference stream reach for target stream pattern, profile, and dimension.
- Identification of stream gage station data regional curve data for region if available.

Restoration of a stream channel to a stable pattern, profile, and dimension based upon reference stream parameters.

- Maintaining stable stream parameters for two bankfull events. Bankfull events typically occur on a 1.5 year basis. The second bankfull event should be no sooner than 1.5 years after the first event to demonstrate long-term stability of the restored stream channel.

1.1 Stream Channel Monitoring

Monitoring should include annual inspections of each individual stream reach and documenting stream stability parameters for pattern, profile, and dimension as well as deviations from stable stream conditions. Prior to requesting a credit release, stream measurement data sheets should be provided for each stream reach to demonstrate stable stream conditions. Selected cross-sectional areas should be representative of typical pattern, profile, and dimension for the entire stream reach. Additional measurements may be required for individual stream reaches deviating from target stable stream conditions..

2. Riparian Buffer Mitigation

2.1 Wetlands. Restore wetlands using success criteria and credit release schedule developed by Mobile District and listed on Regional Internet Banking Information Tracking System site on Mobile District Regulatory Division web site.

2.2. Uplands. Establishment/acceptance of Reference Forest Ecosystem (RFE).

Restoration of an upland habitat to mimic species composition and diversity of RFE. Initial planting density should be approximately twice the final target density.

Appendix D: Stream Mitigation Monitoring Requirements

Monitoring should be in compliance with Regulatory Guidance Letter 08-03, Mitigation Monitoring Requirements. Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include contingency actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period. Monitoring is a required component of all mitigation plans and should at a minimum, address all success criteria paragraphs. The following monitoring requirements are to be applied to all stream mitigation sites as well as all reference sites.

- **Monitoring (Physical Monitoring):**
  - -- **Riparian buffer preservation:** After initial collection of baseline information on vegetation, document any changes in the preserved buffer annually for at least 5 years or the life of the mitigation project. Minimal baseline information to be collected should include vegetation present, species composition, density, and structure including average species height and average species diameter at breast height (dbh). The site should be continually monitored for the presence of exotic species and appropriate actions taken when necessary.

  - -- **Riparian buffer restoration and enhancement:** Collection of baseline information on vegetation in the buffer before mitigation is implemented and annually for atleast 5 years or the life of the mitigation project. Minimal information to be collected annually should include vegetation present, species composition, density, and structure including average species height and diameter (dbh). In addition, similar data for planted and naturally recruiting trees and vegetation should be monitored annually, at least for 5 years or the life of the mitigation project, until target success criteria are achieved.

  - -- **Stream channel restoration/stream bank stabilization and stream relocation:** Collection of initial baseline data on physical parameters in streams before mitigation is implemented and monitoring of these physical parameters annually, for at least 5 years or the life of the mitigation project, and after mitigation is completed. Physical parameters to be measured include stream pattern, profile, and dimension metrics at sites above, within, and below the restored reach, water temperature, DO, turbidity, pH, stream substrate characteristics, erosion patterns, and biological parameters that may include density and diversity of reptiles, amphibians, fish, freshwater mussels, or other macroinvertebrates and other fauna at sites within the stream.

Determinations of success will be proposed by the mitigation sponsor and confirmed by COE and review agencies. Monitoring will include items 1, 2 and 3 and may include item 4 (see Table 2) based on the project review.

Contingency Plans/Remedial Actions: In the event the mitigation fails to achieve interim or final success criteria as specified in the mitigation plan, sponsor shall develop necessary contingency plans and implement appropriate remedial actins for that phase. In the event the sponsor fails to implement necessary remedial actions or demonstrate meaningful progress towards achieving the target success criteria within an appropriate amount of time determined by the Corps, the Corps will notify sponsor and the appropriate authorizing agencies and require appropriate corrective actions that may include providing alternative compensation by purchasing mitigation credits from an approved mitigation bank.. The Corps reserves the right to take enforcement actions on all permit non-compliance issues.

Table 2. General criteria used to evaluate the success or failure of activities at mitigation sites and required remedial actions to be implemented should monitoring indicate failure of component.

Mitigation Component (Item)	**Success (Required on action)**	**Failure**	**Action**
1. Photo Reference of Sample Sites Longitudinal photos Lateral photos	No substantial instream aggradation, degradation or bank erosion.	Substantial aggradation degradation or bank erosion.	When substantial aggradation, degradation or bank erosion occurs, adaptive management actions will be planned, approved, and implemented.
2. Riparian Vegetation and Hydrology Riparian Buffer: Sample plots Tree counts Monitoring wells	Within the riparian buffer, achievement of target hydrology, tree and plant species diversity, composition, and structure as required by Mobile District wetland habitat success criteria or should mimic approved reference reach target habitats in species composition, density, and structure.	Failure to achieve target hydrology, and/or tree and plant species diversity, composition, and structure as required by Mobile District wetland habitat success criteria or approved reference site	Target species will be re-seeded and or fertilized; live stakes and bare rooted trees will be planted to achieve desired densities. Adaptive management actions will be planned, approved, and implemented.
3. Channel Stability Pattern, Profile, and Dimension, Pebble count	Stable stream with pattern, profile and dimension of similar reference reach type. No evidence of instability (down-cutting, deposition, bank erosion, increase in sands or finer substrate material).	Substantial evidence of instability, not achieving target stream design goals.	When Substantial evidence of instability occurs, remedial actions will be planned, approved, and implemented.
4. Biological Indicators Invertebrate populations Fish populations	Relative to baseline data, stream habitats and aquatic population measurements remain the same or improve, and target species composition indicates a positive trend in composition, density, and diversity.	Population measurements and target species composition indicate a negative trend.	Reasons for failure will be evaluated and remedial action plans developed, approved, and implemented.

Appendix E: Example Credit Release Schedule for Mitigation Banks

The first credit release for each habitat type, regardless of the scientific based success criteria, will include proof of subjugation of any liens or encumbrances on the property to the conservation easement. For the second credit release, if the long-term management will be coordinated by a long-term management board instead of a separate entity such as a land trust, the board members must be named by agency/profession and name. The long-term land management board must be composed of private and conservation interests and approved by the Interagency Review Team (IRT).

Stream Restoration (In-Stream and Riparian Restoration) – Credit Release Schedule (IRT standards)
Credit releases below apply to stream buffer restoration and channel restoration as noted below.

Stream A

20% Initial release (all buffer/channel stream credits) for conservation easement, financial assurance and approval of detailed stream channel restoration data collection/design plans.

10% Upon completion of site preparation and hydrology work related to stream areas (buffer and channel) (see explanation below).). To assess in-channel hydrology, stream gages should be installed and correlated with bankfull indicators to show baseline and post mitigation changes. For buffer areas, groundwater monitoring wells should be arrayed to document the timing, duration and frequency of riparian inundation and/or saturation.

- Removal of exotics (<1% and no seed producing species present), invasives, or inappropriate species.
- Upon completion of initial physical, hydrological, and biological improvements made pursuant to the stream restoration plan. Improvements include: grading, construction of bankfull benches, placement and construction of in-stream structures, riparian enhancement, and vegetative plantings as needed.
- TFT established, accepted, and documented.
- Approval of Land Trust Board and Long-term Land Management Board by MBRT

20% Following first successful bankfull event.

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation, and narrative descriptions.
- Target species planted to achieve overall composition of 10-15 species per acre, with no greater than 25% coverage of a single species.
- Minimum of 400 trees per acre, post-planting.

30% Following second successful bankfull event.

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation and narrative descriptions. Note: Second bankfull event should have a return interval approximately 1.5 years from date of first bankfull event.
- Visual evidence of species (and individual seedling) placement in relation to appropriate topographic/hydrologic habitat.
- Plantings show positive growth of root collar, diameter, and/or height.

10% After fifth (5th) year of successful bank stability and riparian monitoring.

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation and narrative descriptions.
- Post-planting of shrubs and herbaceous layer and channel restoration success.
- A minimum of three years positive growth of planted tree species is required before shrubs and herbs are planted and/or naturally regenerate.
- Visual evidence of appropriate shrubs and herbs planted sparingly or naturally recruited, in small groupings across site.
- Establish non-wasting escrow account with proof of appropriate funds in place.

10% Final credit release upon completion of monitoring (approximately year 10),

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation and narrative descriptions. Riparian area success as defined in the mitigation plan.
- A minimum of nine years positive growth of planted tree species.
- Minimum of 10 target tree species and coverage of 200-300 stems per acre, with all plantings showing positive growth of root collar, diameter, and height with a minimum of 10 trees per acre of each target species.
- Average height of planted canopy a minimum 7'-10' (excluding fast growing species such as *Platanus* and *Populus*).
- 50% of shrub species from Table 2, 20-60% cover.
- 50% of herbaceous species from Table 3, appropriate cover as related to TFT.
- <1% cover by exotics.

APPENDIX C

KEMPER COUNTY IGCC PROJECT AIR EMISSIONS DATA

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REVISED
Sept. 15, 2009

Table 3-1 - Facility-Wide Annual Potential Emissions (TPY)
Mississippi Power Company - IGCC Plant

								HAPs	
Emission Source	**NO_X**	**SO_2**	**CO**	**PM/PM_{10}**	**VOC**	**Lead**	**H_2SO_4 Mist**	**Total Combined**	**Maximum Indivdual HAP (COS)**
IGCC Stacks (#1 and #2)	1839.6	114.8	1112.5	455.5	181.3	<0.1	15.8	9.18	Neg.
Material Handling	NA	NA	NA	33.2	NA	NA	NA	NA	NA
Wet Gas Sulfuric Acid (WSA) Process	72.3	198.9	Neg.	Neg.	Neg.	Neg.	21.9	Neg.	Neg.
AGR Process Vents (MP 1 & 2, LP 1 & 2)	NA	NA	--*	NA	NA	NA	NA	8.6	8.6
Flares (Continuous Operation)	132.9	318.1	106.4	1.3	1.0	<0.1	24.4	0.29	Neg.
Flares (during Gasifier Startups)	2.1	7.5	7.5	<0.1	<0.1	<0.1	0.6	<0.01	Neg.
Gasifier Startup Stacks	28.8	30.3	0.6	<0.1	<0.1	<0.1	2.3	<0.01	Neg.
Auxiliary Boiler	13.8	0.1	8.4	2.1	1.1	<0.1	<0.1	0.39	Neg.
Gasification Cooling Tower	NA	NA	NA	13.2	NA	NA	NA	NA	NA
Combined Cycle Cooling Tower	NA	NA	NA	16.4	NA	NA	NA	NA	NA
Emergency Fire Pumps	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	Neg.
Facility-WideTotal	**2089.6**	**669.7**	**1235.4**	**521.8**	**183.4**	**Neg.**	**64.9**	**18.5**	**8.6**

* TPY to be determined based on total hours described in Section 3.1.9 of the PSD application.

REVISED
Sept. 15, 2009

Table 3-2 - Criteria Pollutant Emission Rates per IGCC Stack - Syngas
Mississippi Power Company - IGCC Plant

Unit Load (%)	Ambient Temperature (°F)	NO_X			SO_2			CO			PM/PM_{10}(3)			VOC			Lead			H_2SO_4 Mist		
		lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)
100(1)	10	0.061	210	919.8	0.0040	13.1	57.4	0.031	105	459.9	0.015	52	227.8	0.005	17.1	74.9	Neg.	<0.1	<0.1	0.00051	1.8	7.9
	65	0.06	202	884.8	0.0040	12.9	56.5	0.029	97	424.9	0.015	50	219.0	0.0048	15.8	69.2	Neg.	<0.1	<0.1	0.00052	1.7	7.4
	95	0.06	203	889.1	0.0040	12.9	56.5	0.029	98	429.2	0.015	50	219.0	0.0048	16	70.1	Neg.	<0.1	<0.1	0.00052	1.7	7.4
75	10	0.059	143	626.3	0.0040	10.1	44.2	0.023	56	245.3	0.015	37	162.1	0.0035	8.4	36.8	Neg.	<0.1	<0.1	0.00054	1.3	5.7
	65	0.059	140	613.2	0.0040	9.8	42.9	0.023	54	236.5	0.015	36	157.7	0.0034	8.2	35.9	Neg.	<0.1	<0.1	0.00054	1.3	5.7
	95	0.059	139	608.8	0.0040	9.8	42.9	0.023	53	232.1	0.015	36	157.7	0.0035	8.2	35.9	Neg.	<0.1	<0.1	0.00054	1.3	5.7

(1) Emission rates include emissions from the Duct Burner (DB) combusting natural gas.
(2) Heat input is calculated on a Gasifier + DB basis.
(3) Filterable PM
(4) TPY estimates are based on 8760 hours per year operation at the specified conditions.

REVISED
Sept. 15, 2009

Table 3-3 - Criteria Pollutant Emission Rates per IGCC Stack - Natural Gas
Mississippi Power Company - IGCC Plant

Unit Load (%)	Ambient Temperature (°F)	NO_X			SO_2			CO			PM/PM_{10}(3)			VOC			Lead			H_2SO_4 Mist		
		lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)	lb/MMBtu(2)	lb/hr	TPY(4)
100(1)	10	0.014	39	170.8	0.0006	1.9	8.3	0.045	127	556.3	0.009	24	105.1	0.0074	20.7	90.7	Neg.	<0.1	<0.1	0.0001	0.29	1.27
	65	0.015	38	166.4	0.0006	1.8	7.9	0.047	126	551.9	0.009	24	105.1	0.0076	20.7	90.7	Neg.	<0.1	<0.1	0.0001	0.27	1.18
	95	0.015	38	166.4	0.0006	1.8	7.9	0.048	126	551.9	0.009	23	100.7	0.0078	20.7	90.7	Neg.	<0.1	<0.1	0.0001	0.27	1.18
75	10	0.013	20	87.6	0.0006	1.0	4.4	0.021	33	144.5	0.009	14	61.3	0.0029	4.5	19.7	Neg.	<0.1	<0.1	0.0001	0.16	0.70
	65	0.014	21	92.0	0.0006	1.0	4.4	0.022	33	144.5	0.009	13	56.9	0.0030	4.6	20.1	Neg.	<0.1	<0.1	0.0001	0.15	0.66
	95	0.014	19	83.2	0.0006	0.9	3.9	0.022	31	135.8	0.009	12	52.6	0.0031	4.2	18.4	Neg.	<0.1	<0.1	0.0001	0.14	0.61
60	10	0.012	16	70.1	0.0006	0.9	3.9	0.059	79	346.0	0.010	13	56.9	0.0027	3.6	15.8	Neg.	<0.1	<0.1	0.0001	0.14	0.61
	65	0.013	16	70.1	0.0006	0.9	3.9	0.062	80	350.4	0.009	12	52.6	0.0029	3.7	16.2	Neg.	<0.1	<0.1	0.0001	0.13	0.57
	95	0.013	15	65.7	0.0006	0.8	3.5	0.063	75	328.5	0.009	11	48.2	0.0029	3.4	14.9	Neg.	<0.1	<0.1	0.0001	0.12	0.53

(1) Emission rates include emissions from the Duct Burner (DB) combusting natural gas.
(2) Heat input is calculated on a CT + DB basis.
(3) Filterable PM
(4) TPY estimates are based on 8760 hours per year operation at the specified conditions.

Table 3-4 - Material Handling Emissions
Mississippi Power Company - IGCC Plant

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Emission Source	Source Type	Emission Control Type	PM/PM_{10}	
			lb/hr	**TPY(1)**
Haul Roads				
Haul Road #1 - Mine to Coal Handling Equipment	Fugitive	BMPs	0.62	2.72
Haul Road #2 - Ash/Salt to Temporary Storage Pile	Fugitive	BMPs	0.34	1.49
Haul Road #3 - Ash/Salt to Hwy	Fugitive	BMPs	0.15	0.66
Haul Road #4 - Ash/Salt on Landfill	Fugitive	BMPs	0.34	1.49
Coal Handling Fugitive Sources				
Dump Truck Unloading to Backup Coal Storage Pile #1	Fugitive	BMPs	0.03	0.14
Wind Erosion Backup Coal Storage Pile #1	Fugitive	BMPs	0.49	2.16
Dump Truck Unloading	Fugitive	Stilling Shed, Wet Suppression, Fogging	0.02	0.07
Primary Sizer	Fugitive	Fogging, partially enclosed	0.27	1.18
Primary Sizer to Conveyor 1	Fugitive	Partially enclosed	0.05	0.20
Secondary Sizer	Fugitive	Fogging, partially enclosed	0.27	1.18
Secondary Sizer to Conveyor 2	Fugitive	Fogging, partially enclosed	0.05	0.20
Conveyor 2 to Conveyor 3	Fugitive	Fogging, partially enclosed	0.05	0.20
Conveyor 3 to Active Storage Pile	Fugitive	Wet Supression, inside coal barn	0.05	0.20
Wind Erosion Active Coal Storage Pile	Fugitive	Wet Supression, inside coal barn (negligible wind emissions expected)	Neg.	Neg.
Transfer Building 1	Fugitive	Fogging, partially enclosed	0.06	0.24
Transfer Building 2	Fugitive	Fogging, partially enclosed	0.06	0.24
Conveyor 3 to Conveyor 4S	Fugitive	Enclosed, Fogging	0.05	0.20
Conveyor 4S to Backup Coal Storage Pile #2	Fugitive	Wet suppression	0.09	0.40
Wind Erosion Backup Coal Storage Pile #2	Fugitive	Pile to be covered with tarp (negligible wind emissions expected)	Neg.	Neg.
Coal Handling Point Sources				
Crushed Coal Storage Silos (6)	Point	Baghouse (single baghouse for the 6 silos)	0.05	0.22
Coal Milling and Drying #1	Point	Baghouse	0.47	2.06
Coal Milling and Drying #2	Point	Baghouse	0.47	2.06
Coal Milling and Drying #3	Point	Baghouse	0.47	2.06
Coal Milling and Drying #4	Point	Baghouse	0.47	2.06
Coal Milling and Drying #5	Point	Baghouse	0.47	2.06
Coal Milling and Drying #6	Point	Baghouse	0.47	2.06
Ash/Salt Handling				
Ash/Salt Temporary Storage Pile (Includes truck unloading, wind erosion, and dozier operations)	Fugitive	Ash will be wetted prior to loading into truck, BMPs	0.66	2.89
Ash/Salt Landfill (Includes truck unloading, wind erosion, and dozier operations)	Fugitive	Ash will be wetted prior to loading into truck, BMPs	1.09	4.79
		Total		**33.2**

(1) TPY estimates are based on 8760 hours per year.

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Table 3-5 - Crietria Pollutant Emission Rates - Miscellaneous Sources
Mississippi Power Company - IGCC Plant

Unit Load (%)	NO_X		SO_2		CO		PM/PM_{10}(3)		VOC		Lead		H_2SO_4 Mist	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
Wet Gas Sulfuric Acid (WSA) Process	16.5	72.3	45.4	198.9	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	5.0	21.9
Flare #1	15.2	66.4	36.3	159.0	12.2	53.2	0.15	0.66	0.11	0.48	<0.1	<0.1	2.8	12.2
Flare #2	15.2	66.4	36.3	159.0	12.2	53.2	0.15	0.66	0.11	0.48	<0.1	<0.1	2.8	12.2
AGR Process Vent MP1	NA	NA	NA	NA	260.0	--(4)	NA	NA	NA	NA	NA	NA	NA	NA
AGR Process Vent LP1	NA	NA	NA	NA	15.0	--(4)	NA	NA	NA	NA	NA	NA	NA	NA
AGR Process Vent MP2	NA	NA	NA	NA	260.0	--(4)	NA	NA	NA	NA	NA	NA	NA	NA
AGR Process Vent LP2	NA	NA	NA	NA	15.0	--(4)	NA	NA	NA	NA	NA	NA	NA	NA
Auxiliary Boiler(1)	18.4	13.8	0.17	0.13	11.2	8.4	2.83	2.12	1.41	1.06	<0.1	<0.1	0.01	0.06
Gasification Cooling Tower	NA	NA	NA	NA	NA	NA	3.0	13.2	NA	NA	NA	NA	NA	NA
Combined Cycle Cooling Tower	NA	NA	NA	NA	NA	NA	3.8	16.4	NA	NA	NA	NA	NA	NA
Fire Water Pumps(2)	4.0	0.10	0.56	0.01	2.4	0.06	0.22	0.01	1.04	0.03	<0.1	<0.1	0.04	0.00
Total		219.1		517.1		114.9		33.0		2.0		Neg.		46.3

(1) TPY emission rates are based on a maximum of 1,500 hr/yr operation.
(2) TPY emission rates are based on a maximum of 52 hr/yr operation.
(3) Filterable PM
(4) TPY to be determined based on total hours described in Section 3.1.9 of the PSD application.

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Table 3-6 - Crietria Pollutant Emissions - Gasifier Startup
Mississippi Power Company - IGCC Plant

Unit Load (%)	NO_X		SO_2		CO		PM/PM_{10}[3]		VOC		Lead		H_2SO_4 Mist	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
Gasifier Startup Stack#1[1]	90.1	14.4	94.7	15.2	1.8	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	7.25	1.16
Gasifier Startup Stack#2[1]	90.1	14.4	94.7	15.2	1.8	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	7.25	1.16
Flare #1[2]	48	1.0	174	3.8	172.0	3.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.32	0.3
Flare #2[2]	48	1.0	174	3.8	172.0	3.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.32	0.3
Total		30.9		37.8		8.0		Neg.		Neg.		Neg.		2.90

[1] lb/hr rates are expressed as an average across Startup period; TPY emission rates are based on 16 hr/startup and 20 starts/year.

[2] lb/hr rates are expressed as an average across Startup period; TPY emission rates are based on 2.2 hr/startup and 20 starts/year.

[3] Filterable PM

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Table 3-7 - Mercury Emissions - IGCC Stacks
Mississippi Power Company - IGCC Plant

Avg. Hg content in Coal	ppm	0.077
Avg. Coal Usage per gasifier	lb/hr	576,000
Avg. Coal Heat content	Btu/lb	5,290
Avg. Heat Input at 100% load per gasifier	MMBtu/hr	3,047
Avg. Hg to gasifier	lb/hr	0.0444
Expected Efficiency of Hg Removal	%	92%
Hg in Cleaned Syngas per CT	lb/hr	0.0035
Hg in Cleaned Syngas per CT	lb/MMBtu	1.16 E-06
Hg emissions (total from 2-CTs)	lb/hr	0.0071
Hg emissions (total from 2-DBs) (AP-42)	lb/hr	0.00025
Hg emissions (total from 2-CT/HRSGs)	lb/hr	0.0073
Expected Hg emissions at 8,760 hrs/year (total from 2-CT/HRSGs)	lb/year	**64.4**

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Table 3-8 - Hazardous Air Pollutants
Mississippi Power Company - IGCC Plant

Source	Total Combined HAPs (TPY)	Maximum Indivdual HAP (TPY)	
		Formaldehyde	COS
IGCC Stacks (#1 and #2)	9.18	3.10	--
Auxiliary Boiler	0.39	0.02	--
Flares	0.29	0.01	--
AGR Process Vents	8.6	0.00	8.6*
Totals	**18.46**	**3.13**	**8.6**

* See Section 3.1.9 of the PSD application.

APPENDIX D

KEMPER COUNTY IGCC PROJECT MINE STUDY AREA SURFACE WATER QUALITY MEASUREMENTS

Table 1. Summary of Surface Water Quality: Surfacewater

		SW-1				SW-2			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	5	9.66	43.88	0.69	5	7.92	35.55	0.72
Field Conductivity	umhos/com	5	61.41	88.91	33.82	5	32.55	41.32	27.92
Field pH	s.u.	5	6.12	6.50	5.67	5	6.59	7.01	5.45
Field Temperature	°F	5	71.18	75.51	61.48	5	67.77	72.72	54.37
Field Dissolved Oxygen	mg/L	5	8.87	11.02	8.21	5	10.06	13.70	8.49
Field Turbidity	NTU	5	56.6	142.0	25.9	5	70.0	238.2	16.6
Cl	mg/L	5	0.052	0.090	0.020	5	0.05	0.13	0.00
Acidity (as CaCO3)	mg/L	5	14	35	7	5	9	17	5
Alkalinity (as CaCO3)	mg/L	5	20	34	5	5	7	14	3
Ammonia Nitrogen	mg/L	4	<0.18	0.38	<0.1	4	<0.12	0.170	<0.1
Bicarbonate (as CaCO3)	mg/L	4	20	32	12	4	12	15	6
BOD (5 day)	mg/L	4	<5.5	<6	<5	4	<5.5	<6	<5
Carbonate	mg/L	4	<2	<2	<2	4	<2	<2	<2
Chloride	mg/L	4	<1.59	2.03	<1.0	4	2.42	3.11	1.27
COD	mg/L	4	31	68	16	4	<30	60	<15
Color	mg/L	4	225.0	300.0	200.0	4	127	200	57
Conductivity	umhos/cm	5	60	88	32	5	35	41	26
Dissolved Al	mg/L	4	1.187	3.200	0.279	4	1.21	2.73	0.192
Dissolved As	mg/L	4	0.0024	0.0041	0.0015	4	<0.001	<0.001	<0.001
Dissolved Barium	mg/L	4	0.099	0.121	0.078	4	0.045	0.059	0.026
Dissolved Beryllium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	4	<.0016	0.002	<0.001	4	<.002	0.002	<0.001
Dissolved Chromium Hexavalent	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
Dissolved Cobalt	mg/L	4	0.002	0.003	0.001	4	<0.002	0.002	<0.001
Dissolved Cu	mg/L	4	<0.002	0.003	<0.001	4	<0.002	0.002	<0.001
Dissolved Fe	mg/L	5	4.73	5.88	3.23	5	3.170	8.470	0.540
Dissolved Pb	mg/L	4	<0.002	0.00174	<0.001	4	<0.005	<0.005	<0.001
Dissolved Mn	mg/L	5	0.590	1.540	0.012	5	0.124	0.214	0.037
Dissolved Hg	mg/L	4	<0.0002	<0.0002	<0.0002	4	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Nickel	mg/L	4	0.0021	0.0032	0.0013	4	<0.002	0.0024	<0.001
Dissolved Oxygen	mg/L	5	8.77	9.64	7.08	5	10.03	11.00	9.61
Dissolved Selenium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	4	0.070	0.103	0.034	4	0.024	0.033	0.014
Dissolved Zinc	mg/L	4	<0.008	0.013	<0.005	4	<0.007	0.012	<.005
Fecal Coliform	cfu/100mL	4	643	1900	70	4	597	1500	50
Fluoride (w/o distillation)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	4	16.1	19.7	10.2	4	12.7	20.1	6.0
Nitrate (NO3-N)	mg/L	4	<0.121	0.182	<0.1	4	0.498	0.283	<0.1
Nitrite (NO2-N)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Odor	DTU	4	<1	<1	0	4	<1	<1	0
Oil and Grease	mg/L	4	<1.9	<2	<1.8	1	<2.1	2.4	<1.9

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-1				SW-2			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	4	2.65	4.37	1.08	4	1.69	3.66	0.665
Ortho Phosphate	mg/L	4	<0.029	0.038	<0.025	4	<0.025	<0.025	<0.025
pH	s.u.	5	6.3	7.1	5.6	5	6.7	7.3	5.5
Phenols (Total)	mg/L	4	<0.05	<0.05	<0.05	4	<0.05	<0.05	<0.05
Resistivity	ohm/cm	5	19420	31300	11400	5	28700	38500	24400
Silicon as SiO2	mg/L	4	15.3	24.7	5.4	4	15.5	17.3	13.9
TOC (Total Organic Carbon)	mg/L	5	9.3	15.2	6.5	5	6.43	14.6	3.97
Total Boron	mg/L	4	0.011	0.017	0.008	4	0.013	0.020	0.008
Total Calcium	mg/L	4	3.63	4.37	2.50	4	1.91	2.31	1.22
Total Coliform	cfu/100mL	4	12625	28000	400	4	15200	31200	450
Total Cyanide	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	5	81	106	51	5	50	80	25
Total Iron	mg/L	5	6.77	7.79	5.52	5	2.47	4.54	0.89
Total Kjeldahl Nitrogen	mg/L	4	2.78	4.51	1.46	4	1.75	3.66	0.76
Total Magnesium	mg/L	4	1.71	2.37	0.96	4	1.069	1.530	0.725
Total Manganese	mg/L	5	0.394	0.773	0.178	5	0.137	0.261	0.037
Total Phosphorus	mg/L	4	0.123	0.161	0.071	4	0.084	0.126	0.033
Total Potassium	mg/L	4	2.22	2.74	1.42	4	1.39	1.89	0.88
Total Settleable Solids	mL/L	4	<0.2	<0.2	<0.1	4	<0.3	0.4	<0.1
Total Sodium	mg/L	4	3.06	4.11	1.40	4	2.28	2.94	1.51
Total Sulfate (SO4)	mg/L	4	2.38	5.33	1.24	4	2.63	3.60	1.49
Total Suspended Solids	mg/L	5	38	108	9	5	<48	144	<2
Total Thallium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	4	0.002	0.002	<0.001	4	<0.003	0.004	<0.001
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	1	<0.00102	<0.00102	<0.00102
Turbidity	NTU	4	39	50	30	4	37	50	17
PCBs	mg/L	2	* <	* <	* <	2	* <	* <	* <
VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	2	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	2	* <	* <	* <
Total Arsenic	mg/L	1	0.003	0.003	0.003	1	<0.001	<0.001	<0.001
Total Chromium	mg/L	1	0.002	0.002	0.002	1	0.004	0.004	0.004
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	1	<0.0002	<0.0002	<0.0002

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-3				SW-4			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	5	34.44	160.59	1.68	4	1.64	6.72	0.00
Field Conductivity	umhos/com	5	46.86	67.07	35.30	4	34.39	40.92	26.33
Field pH	s.u.	5	6.59	7.09	5.88	4	6.27	6.91	5.15
Field Temperature	°F	5	69.81	75.49	58.49	4	66.50	72.44	54.82
Field Dissolved Oxygen	mg/L	5	8.27	12.07	3.98	4	10.17	13.5	8.46
Field Turbidity	NTU	5	65.2	217.1	10.3	4	78.2	213.1	16.2
Cl	mg/L	5	0.05	0.16	0.00	4	0.07	0.10	0.02
Acidity (as CaCO3)	mg/L	5	9	20	4	4	10	15	6
Alkalinity (as CaCO3)	mg/L	5	11	16	4	4	7	14	2
Ammonia Nitrogen	mg/L	4	<0.110	0.110	<0.01	4	<0.1	<0.1	<0.1
Bicarbonate (as CaCO3)	mg/L	4	15	27	10	4	12	15	7
BOD (5 day)	mg/L	4	<5.5	<6	<5	4	<5.5	<6	<5
Carbonate	mg/L	4	<2	<2	<2	4	<2	<2	<2
Chloride	mg/L	4	2.40	2.62	2.00	4	2.19	2.89	1.04
COD	mg/L	4	<25	54	<15	4	<28	67	<15
Color	mg/L	4	125	200	0	4	115	200	80
Conductivity	umhos/cm	5	46	60	38	4	35	43	30
Dissolved Al	mg/L	4	0.748	2.080	0.218	4	0.823	2.03	0.189
Dissolved As	mg/L	4	<0.0011	0.0011	<0.001	4	<0.001	<0.001	<0.001
Dissolved Barium	mg/L	4	0.039	0.048	0.031	4	0.0457	0.0566	0.0395
Dissolved Beryllium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	5	<0.002	0.003	<0.002	4	<0.002	0.0027	<0.001
Dissolved Chromium Hexavalent	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
Dissolved Cobalt	mg/L	4	<0.002	0.002	<0.001	4	<0.0015	0.0026	<0.001
Dissolved Cu	mg/L	4	<0.002	0.002	<0.001	4	<0.002	<0.004	<0.001
Dissolved Fe	mg/L	5	1.88	2.66	0.557	4	2.07	2.27	1.67
Dissolved Pb	mg/L	4	<0.001	0.00115	<0.001	4	<0.002	<0.005	<0.001
Dissolved Mn	mg/L	5	0.172	0.276	0.071	4	0.079	0.154	0.041
Dissolved Hg	mg/L	4	<0.0002	<0.0002	<0.0002	4	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Nickel	mg/L	4	<0.002	0.0027	<0.001	4	0.0018	0.0027	0.0010
Dissolved Oxygen	mg/L	5	10.6	11.5	9.82	4	10.9	12.3	9.4
Dissolved Selenium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	4	0.032	0.037	0.025	4	0.034	0.038	0.028
Dissolved Zinc	mg/L	4	<0.01	0.018	<0.005	4	<0.010	0.013	<0.005
Fecal Coliform	cfu/100mL	4	643	2000	120	4	485	1300	90
Fluoride (w/o distillation)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	4	12.1	14.8	9.2	4	10.10	11.60	9.02
Nitrate (NO3-N)	mg/L	4	<0.123	0.193	<0.1	4	<0.2	0.237	<0.1
Nitrite (NO2-N)	mg/L	4	<0.1	<0.1	0	4	<0.1	<0.1	<0.1
Odor	DTU	4	<1	<1	<1	4	<1	<1	0
Oil and Grease	mg/L	4	<1.5	<2.1	<0.2	1	<1.9	<2	<1.8

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-3				**SW-4**			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	4	1.91	3.24	0.76	4	0.84	1.21	0.64
Ortho Phosphate	mg/L	4	<0.035	0.063	<0.025	4	<0.029	0.029	<0.025
pH	s.u.	5	6.5	7.3	6.0	4	6.4	7.0	5.8
Phenols (Total)	mg/L	4	<0.05	<0.05	<0.05	4	<0.05	<0.05	<0.05
Resistivity	ohm/cm	5	22240	26300	16700	4	29375	33300	23300
Silicon as SiO2	mg/L	4	13.1	15.2	10.9	4	16.1	18.2	14.5
TOC (Total Organic Carbon)	mg/L	5	6.02	10.70	3.56	4	8.28	15.00	5.29
Total Boron	mg/L	4	0.011	0.014	0.009	4	0.0126	0.0197	0.0085
Total Calcium	mg/L	4	2.53	3.10	2.06	4	1.96	1.99	1.92
Total Coliform	cfu/100mL	4	6080	16800	320	4	11800	25000	700
Total Cyanide	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	5	61	80	29	4	52	67	32
Total Iron	mg/L	5	3.59	5.91	2.37	4	3.56	5.12	2.94
Total Kjeldahl Nitrogen	mg/L	4	1.96	3.24	0.858	4	1.21	2.14	0.715
Total Magnesium	mg/L	4	1.41	1.85	0.976	4	1.26	1.62	0.986
Total Manganese	mg/L	5	0.227	0.466	0.084	4	0.094	0.195	0.045
Total Phosphorus	mg/L	4	0.216	0.557	0.071	4	<0.15	0.420	<0.025
Total Potassium	mg/L	4	1.79	2.52	1.38	4	1.58	2.06	1.23
Total Settleable Solids	mL/L	4	<0.15	<0.2	<0.1	4	<0.3	0.6	<0.1
Total Sodium	mg/L	4	2.45	2.88	1.94	4	2.14	2.55	1.25
Total Sulfate (SO4)	mg/L	4	<2.75	4.92	<1	4	3.17	4.00	2.68
Total Suspended Solids	mg/L	5	50	222	5	4	58	188	10
Total Thallium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	4	<0.003	0.004	<0.001	4	0.0021	0.0027	0.0011
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	1	<0.00102	<0.00102	<0.00102
Turbidity	NTU	4	35	80	20	4	30	60	10
PCBs	mg/L	2	* <	* <	* <	2	* <	* <	* <
VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	2	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	2	* <	* <	* <
Total Arsenic	mg/L	1	<0.001	<0.001	<0.001	1	<0.001	<0.001	<0.001
Total Chromium	mg/L	1	0.004	0.004	0.004	1	0.003	0.003	0.003
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	1	<0.0002	<0.0002	<0.0002

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-5				SW-6			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	3	3.39	16.50	0.00	2	0.57	2.38	0.00
Field Conductivity	umhos/com	3	37.76	44.97	26.37	2	48.56	52.51	44.68
Field pH	s.u.	3	6.33	6.88	5.65	2	6.01	6.05	5.97
Field Temperature	°F	3	65.53	72.04	55.42	2	73.21	74.23	72.18
Field Dissolved Oxygen	mg/L	3	10.33	13.25	8.57	2	8.14	8.26	8.02
Field Turbidity	NTU	3	90.0	217.6	25.8	2	97.8	175.2	20.3
Cl	mg/L	3	0.23	0.60	0.03	1	0.04	0.04	0.04
Acidity (as CaCO3)	mg/L	3	12	22	6	2	8	8	8
Alkalinity (as CaCO3)	mg/L	3	8	11	3	2	11	11	11
Ammonia Nitrogen	mg/L	3	<0.1	<0.1	<0.1	2	<0.1	<0.1	<0.1
Bicarbonate (as CaCO3)	mg/L	3	10	11	10	2	14	17	10
BOD (5 day)	mg/L	3	<5.5	<6	<5	2	<5.5	<6	<5
Carbonate	mg/L	3	<2	<2	<2	2	<2	<2	<2
Chloride	mg/L	3	<2.0	2.73	<1.0	2	2.94	4.03	1.84
COD	mg/L	3	<29	51.0	<15	2	39	49	28
Color	mg/L	3	167	200	100	2	250	300	200
Conductivity	umhos/cm	3	34	39	26	2	43	43	42
Dissolved Al	mg/L	3	1.321	3.24	0.208	2	0.683	0.774	0.592
Dissolved As	mg/L	3	<0.001	<0.001	<0.001	2	0.0018	0.0024	0.0013
Dissolved Barium	mg/L	3	0.0355	0.0398	0.0328	2	0.026	0.035	0.017
Dissolved Beryllium	mg/L	3	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	3	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	3	<0.0025	0.0030	<0.001	2	<0.0017	0.0025	<0.001
Dissolved Chromium Hexavalent	mg/L	3	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	0	NT	NT	NT
Dissolved Cobalt	mg/L	3	<0.0015	0.0018	<0.001	2	<0.002	0.0028	<0.001
Dissolved Cu	mg/L	3	<0.0025	0.0031	<0.001	2	<0.003	<0.004	0.002
Dissolved Fe	mg/L	3	2.67	3.86	1.90	2	2.67	4.61	0.725
Dissolved Pb	mg/L	3	<0.0025	<0.005	<0.001	2	<0.003	<0.005	<0.001
Dissolved Mn	mg/L	3	0.068	0.094	0.034	2	0.225	0.440	0.0106
Dissolved Hg	mg/L	3	<0.0002	<0.0002	<0.0002	2	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	3	<0.0011	0.0013	<0.001	2	<0.0012	0.0013	<0.001
Dissolved Nickel	mg/L	3	0.0027	0.0037	0.002	2	0.00132	0.00134	0.00130
Dissolved Oxygen	mg/L	3	10.6	10.9	10.3	2	10.4	11.8	9.980
Dissolved Selenium	mg/L	3	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	3	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	3	0.027	0.032	0.021	2	0.0160	0.0165	0.0155
Dissolved Zinc	mg/L	3	<0.010	0.012	<0.005	2	<0.008	0.011	<0.005
Fecal Coliform	cfu/100mL	3	553	1300	40	2	1765	2600	930
Fluoride (w/o distillation)	mg/L	3	<0.1	<0.1	<0.1	2	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	3	12.3	14.6	9.4	2	14.0	14.0	13.9
Nitrate (NO3-N)	mg/L	3	<0.125	0.175	<0.1	2	<0.1	<0.1	<0.1
Nitrite (NO2-N)	mg/L	3	<0.1	<0.1	0.000	2	<0.1	<0.1	<0.1
Odor	DTU	3	<1	<1	<1	2	2	1	0
Oil and Grease	mg/L	3	<2.5	4.1	<1.8	2	<1.85	<1.9	<1.8

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-5				SW-6			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	3	2.66	4.11	1.10	2	3.14	3.43	2.84
Ortho Phosphate	mg/L	3	<0.025	<0.025	<0.025	2	<0.25	0.512	<0.025
pH	s.u.	3	5.7	6.0	5.4	2	6.7	6.9	6.5
Phenols (Total)	mg/L	3	<0.05	<0.05	<0.05	2	<0.05	<0.05	<0.05
Resistivity	ohm/cm	3	30367	38500	25600	2	23550	23800	23300
Silicon as SiO2	mg/L	3	16.3	19.0	13.8	2	5.35	7.18	3.52
TOC (Total Organic Carbon)	mg/L	3	7.22	11.2	4.77	2	13.3	13.5	13.1
Total Boron	mg/L	3	0.0142	0.0179	0.0121	2	0.015	0.0184	0.0116
Total Calcium	mg/L	3	2.15	2.38	1.79	2	3.34	3.61	3.06
Total Coliform	cfu/100mL	3	6967	17600	500	2	16700	30000	3400
Total Cyanide	mg/L	3	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	3	54	72	45	2	74.5	81	68
Total Iron	mg/L	3	5.16	6.72	3.43	2	3.59	6.02	1.16
Total Kjeldahl Nitrogen	mg/L	3	2.66	4.11	1.10	2	3.14	3.43	2.84
Total Magnesium	mg/L	3	1.68	2.10	1.20	2	1.38	1.55	1.20
Total Manganese	mg/L	3	0.093	0.138	0.045	2	0.254	0.481	0.028
Total Phosphorus	mg/L	3	0.055	0.074	0.042	2	1.130	1.990	0.269
Total Potassium	mg/L	3	1.52	1.87	1.22	2	3.69	4.29	3.09
Total Settleable Solids	mL/L	3	<0.2	<0.2	<0.1	2	<0.15	0.200	<0.1
Total Sodium	mg/L	3	2.19	2.89	1.20	2	1.94	2.70	1.17
Total Sulfate (SO4)	mg/L	3	3.08	4.19	2.45	2	2.18	2.18	2.17
Total Suspended Solids	mg/L	3	91	258	6	2	80	100	60
Total Thallium	mg/L	3	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	3	0.0030	0.0031	0.0028	2	<0.002	0.00251	0.001
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	0	NT	NT	NT
Turbidity	NTU	3	34	60	20	2	55	100	10
PCBs	mg/L	2	* <	* <	* <	1	* <	* <	* <
VOCs	mg/L	2	* <	* <	* <	1	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	1	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	1	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	1	* <	* <	* <
Total Arsenic	mg/L	1	0.0014	0.0014	0.0014	0	NT	NT	NT
Total Chromium	mg/L	1	0.003	0.003	0.003	0	NT	NT	NT
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	0	NT	NT	NT

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-7				SW-8			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	5	1.96	2.56	1.41	5	1.10	4.65	0.00
Field Conductivity	umhos/com	5	54.78	72.86	41.80	5	89.62	160.4	33.33
Field pH	s.u.	5	6.60	6.99	6.05	5	6.19	6.86	5.68
Field Temperature	°F	5	74.29	80.80	61.69	5	75.39	88.96	68.49
Field Dissolved Oxygen	mg/L	5	8.21	10.95	6.98	5	8.11	9.53	5.86
Field Turbidity	NTU	5	55.7	136.7	24.1	5	142.8	268	61.3
Cl	mg/L	5	0.02	0.06	0.00	5	0.02	0.04	0.00
Acidity (as CaCO3)	mg/L	5	8	15	4	5	15	21	10
Alkalinity (as CaCO3)	mg/L	5	12	16	5	5	28	54	6
Ammonia Nitrogen	mg/L	4	<0.125	0.180	<0.1	4	<0.23	0.560	<0.1
Bicarbonate (as CaCO3)	mg/L	4	16	22	10	4	40	99	15
BOD (5 day)	mg/L	4	<5.5	<6	<5	4	<5.5	<6	<5
Carbonate	mg/L	4	<2	<2	<2	4	<3	6	<2
Chloride	mg/L	4	2.99	3.34	2.74	4	2.11	2.48	1.40
COD	mg/L	4	<25	55.0	<15	4	35	58	22
Color	mg/L	4	125	200	100	4	200	300	100
Conductivity	umhos/cm	5	52	68	39	5	153	493	29
Dissolved Al	mg/L	4	0.835	2.300	0.258	4	0.842	1.81	0.273
Dissolved As	mg/L	4	<0.0012	0.0015	<0.001	4	0.0022	0.0038	0.0012
Dissolved Barium	mg/L	4	0.048	0.052	0.044	4	0.070	0.115	0.040
Dissolved Beryllium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	4	<0.0015	0.0024	<0.001	4	<0.0015	0.0023	<0.001
Dissolved Chromium Hexavalent	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
Dissolved Cobalt	mg/L	4	<0.0014	0.0020	<0.001	4	0.0037	0.0067	0.0017
Dissolved Cu	mg/L	4	<0.002	<0.004	<0.001	4	<0.003	0.0054	<0.001
Dissolved Fe	mg/L	5	<2.28	3.40	<0.25	5	5.05	9.56	1.21
Dissolved Pb	mg/L	4	<0.004	0.00121	<0.001	4	<0.002	<0.005	<0.001
Dissolved Mn	mg/L	4	0.702	2.360	0.188	5	1.13	1.97	0.201
Dissolved Hg	mg/L	4	<0.0002	<0.0002	<0.0002	4	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Nickel	mg/L	4	<0.0023	0.0045	<0.001	4	0.0022	0.0039	0.001
Dissolved Oxygen	mg/L	5	9.8	11.1	8.85	5	9.6	10.3	9.04
Dissolved Selenium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	4	0.0485	0.0633	0.0297	4	0.061	0.102	0.012
Dissolved Zinc	mg/L	4	<0.009	0.016	<0.005	4	0.0206	0.0487	<0.005
Fecal Coliform	cfu/100mL	4	425	1200	40	4	73	170	10
Fluoride (w/o distillation)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	4	15.1	19.5	11.3	4	22.2	30.4	9.6
Nitrate (NO3-N)	mg/L	4	<0.17	0.361	<0.1	4	<0.1	<0.1	<0.1
Nitrite (NO2-N)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Odor	DTU	4	<1	<1	0.000	4	1	2	0
Oil and Grease	mg/L	3	<1.8	<1.9	<1.6	4	<1.8	<1.9	<1.7

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-7				SW-8			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	4	3.07	5.18	1.06	4	2.18	3.58	0.97
Ortho Phosphate	mg/L	4	<0.030	0.044	<0.025	4	<0.10	0.361	<0.025
pH	s.u.	5	6.3	7.0	5.5	5	5.7	6.1	5.5
Phenols (Total)	mg/L	4	<0.05	<0.05	<0.05	4	<0.05	<0.05	<0.05
Resistivity	ohm/cm	5	16316	25600	1980	5	15824	34500	2030
Silicon as SiO2	mg/L	4	12.87	14.7	9.58	4	13.1	14.9	9.77
TOC (Total Organic Carbon)	mg/L	5	6.60	12.3	2.76	5	8.02	9.97	5.94
Total Boron	mg/L	4	0.0161	0.0257	0.0109	4	0.0132	0.0179	0.0099
Total Calcium	mg/L	4	3.42	4.77	2.69	4	4.61	6.68	1.97
Total Coliform	cfu/100mL	4	28825	96000	900	4	8575	18400	600
Total Cyanide	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	5	119	325	44	5	80	119	49
Total Iron	mg/L	5	3.55	4.62	2.08	5	10.6	18.8	6.74
Total Kjeldahl Nitrogen	mg/L	4	3.15	5.18	1.18	4	2.39	4.14	1.09
Total Magnesium	mg/L	4	1.60	2.01	1.11	4	2.60	3.33	1.15
Total Manganese	mg/L	5	0.861	3.09	0.194	5	1.498	2.620	0.246
Total Phosphorus	mg/L	4	0.112	0.138	0.071	4	<0.05	0.073	<0.025
Total Potassium	mg/L	4	2.07	2.47	1.73	4	2.05	2.61	1.47
Total Settleable Solids	mL/L	4	<0.3	0.600	<0.1	4	<0.3	0.8	<0.1
Total Sodium	mg/L	4	2.97	3.27	2.27	4	2.70	3.35	1.78
Total Sulfate (SO4)	mg/L	4	2.67	3.91	1.96	4	2.21	4.06	1.33
Total Suspended Solids	mg/L	5	52	134	8	5	77	222	36
Total Thallium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	4	<0.0017	0.0024	<0.001	4	<0.002	0.0031	<0.001
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	1	<0.00102	<0.00102	<0.00102
Turbidity	NTU	4	33	40	20	4	49	60	40
PCBs	mg/L	2	* <	* <	* <	2	* <	* <	* <
VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	2	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	2	* <	* <	* <
Total Arsenic	mg/L	1	0.00115	0.00115	0.00115	1	0.00261	0.00261	0.00261
Total Chromium	mg/L	1	0.002	0.002	0.002	1	0.003	0.003	0.003
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	1	<0.0002	<0.0002	<0.0002

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-9				SW-10			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	5	20.53	102.31	0.00	8	125.77	532.38	0.80
Field Conductivity	umhos/com	5	61.51	93.91	32.71	6	65.93	90.10	38.60
Field pH	s.u.	5	6.63	7.01	6.04	6	6.84	7.23	5.9
Field Temperature	°F	5	73.77	83.41	63.05	6	72.37	82.78	60.59
Field Dissolved Oxygen	mg/L	5	8.63	10.57	6.50	6	8.62	11.33	6.48
Field Turbidity	NTU	5	78.9	252.9	23.2	6	35.3	111.2	4.0
Cl	mg/L	5	0.04	0.11	0.00	5	0.05	0.12	0.01
Acidity (as CaCO3)	mg/L	5	9	14	4	5	8	15	4
Alkalinity (as CaCO3)	mg/L	5	21	36	5	5	17	29	6
Ammonia Nitrogen	mg/L	4	<0.12	0.18	<0.1	4	<0.18	0.43	<0.1
Bicarbonate (as CaCO3)	mg/L	4	19	32	10	4	14	18	10
BOD (5 day)	mg/L	4	<5.5	<6	<5	4	<5.5	<6	<5
Carbonate	mg/L	4	<2	<2	<2	4	<2	<2	<2
Chloride	mg/L	4	2.23	3.06	1.13	5	3.016	3.7	1.790
COD	mg/L	4	<24	50	<15	4	<25	53	<1
Color	mg/L	4	150	200	100	5	100	200	20
Conductivity	umhos/cm	5	62	97	32	5	63	95	35
Dissolved Al	mg/L	4	0.719	2.17	0.152	4	0.677	2.01	0.105
Dissolved As	mg/L	4	<0.002	0.0050	<0.001	4	<0.001	0.0011	<0.001
Dissolved Barium	mg/L	4	0.046	0.060	0.036	4	0.0459	0.0470	0.0439
Dissolved Beryllium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	4	<0.0013	0.0020	<0.001	4	<0.0011	0.0017	<0.001
Dissolved Chromium Hexavalent	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
Dissolved Cobalt	mg/L	4	<0.0016	0.0027	<0.001	4	<0.0011	0.0016	<0.001
Dissolved Cu	mg/L	4	<0.0015	0.0028	<0.001	4	<0.0014	0.0027	<0.001
Dissolved Fe	mg/L	5	2.80	4.89	1.64	6	1.82	2.91	0.78
Dissolved Pb	mg/L	4	<0.0011	0.0012	<0.001	4	<0.001	0.00106	<0.001
Dissolved Mn	mg/L	5	0.208	0.600	0.026	6	0.198	0.283	0.095
Dissolved Hg	mg/L	4	<0.0002	<0.0002	<0.0002	4	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	4	<0.0011	0.0013	<0.001	4	<0.001	<0.001	<0.001
Dissolved Nickel	mg/L	4	0.0017	0.0024	0.001	4	0.0018	0.0031	0.001
Dissolved Oxygen	mg/L	5	10.6	12.1	9.49	6	9.8	11.2	6.5
Dissolved Selenium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	4	0.0448	0.0625	0.0238	4	0.064	0.106	0.031
Dissolved Zinc	mg/L	4	<0.0104	0.0152	<0.005	4	<0.010	0.0133	<0.005
Fecal Coliform	cfu/100mL	4	378	1100	60	4	325	1040	30
Fluoride (w/o distillation)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	4	17.4	23.3	10.8	5	17.3	19.6	10.1
Nitrate (NO3-N)	mg/L	4	<0.112	0.176	<0.1	5	<0.1	0.120	<0.1
Nitrite (NO2-N)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Odor	DTU	4	<1	2	0	4	<1	<1	0
Oil and Grease	mg/L	4	<1.8	<2	<1.7	4	<1.8	<1.9	<1.7

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-9				SW-10			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	4	2.47	5.73	0.994	4	3.08	6.28	0.578
Ortho Phosphate	mg/L	4	<0.101	0.329	<0.025	4	<0.034	0.054	<0.025
pH	s.u.	5	6.5	7.2	6.0	5	6.5	7.1	6.1
Phenols (Total)	mg/L	4	<0.05	<0.05	<0.05	4	<0.05	<0.05	<0.05
Resistivity	ohm/cm	5	18660	31300	10300	5	17720	28600	10500
Silicon as SiO2	mg/L	4	13.6	17.6	7.21	4	17.0	22.5	13.0
TOC (Total Organic Carbon)	mg/L	4	7.76	12.90	4.54	6	6.56	13.9	3.8
Total Boron	mg/L	4	0.0137	0.0171	0.0104	4	0.013	0.019	0.010
Total Calcium	mg/L	4	3.69	5.61	2.32	5	3.63	4.30	2.33
Total Coliform	cfu/100mL	4	13763	50000	250	4	6720	16000	200
Total Cyanide	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	5	68	97	23	6	70	84	50
Total Iron	mg/L	5	5.24	7.29	3.70	5	3.22	3.70	2.76
Total Kjeldahl Nitrogen	mg/L	4	2.51	5.73	0.994	4	3.19	6.28	0.578
Total Magnesium	mg/L	4	1.99	2.55	1.22	5	2.01	2.41	1.04
Total Manganese	mg/L	5	0.675	2.27	0.126	5	0.265	0.423	0.101
Total Phosphorus	mg/L	4	0.093	0.158	0.068	4	0.100	0.146	0.059
Total Potassium	mg/L	4	2.33	3.33	1.49	5	2.06	2.36	1.41
Total Settleable Solids	mL/L	4	<0.17	<0.2	<0.1	4	<0.2	<0.2	<0.1
Total Sodium	mg/L	4	2.26	3.17	1.30	5	3.62	5.17	1.98
Total Sulfate (SO4)	mg/L	4	4.74	8.29	2.54	5	4.79	11.40	2.70
Total Suspended Solids	mg/L	5	42	120	3	6	42	100	3
Total Thallium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	4	<0.0015	0.0020	<0.001	4	<0.0014	0.0017	<0.001
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	1	<0.00102	<0.00102	<0.00102
Turbidity	NTU	4	23	30	20	4	23	30	10
PCBs	mg/L	2	* <	* <	* <	2	* <	* <	* <
VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	2	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	2	* <	* <	* <
Total Arsenic	mg/L	1	0.00119	0.00119	0.00119	1	<0.001	<0.001	<0.001
Total Chromium	mg/L	1	0.002	0.002	0.002	1	0.002	0.002	0.002
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	1	<0.0002	<0.0002	<0.0002

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-11				SW-12			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	7	54.26	210.37	0.46	6	116.26	376.95	5.03
Field Conductivity	umhos/com	6	45.51	54.42	36.69	5	51.38	64.31	37.56
Field pH	s.u.	6	6.78	7.21	5.89	5	6.63	7.21	5.93
Field Temperature	°F	6	70.04	77.83	55.45	5	69.90	76.9	57.09
Field Dissolved Oxygen	mg/L	6	9.51	13.25	7.60	5	9.70	12.59	7.81
Field Turbidity	NTU	6	52.7	173.3	9	5	56.8	179.9	14.0
Cl	mg/L	5	0.05	0.19	0.01	5	0.03	0.06	0.01
Acidity (as CaCO3)	mg/L	5	7	17	3	5	7	13	4
Alkalinity (as CaCO3)	mg/L	5	11	14	4	5	11	18	5
Ammonia Nitrogen	mg/L	3	<0.1	<0.1	<0.1	3	<0.12	0.170	<0.1
Bicarbonate (as CaCO3)	mg/L	4	12	15	7	4	17	27	10
BOD (5 day)	mg/L	4	<5.5	<6	<5	4	<5.5	<6	<5
Carbonate	mg/L	4	<2	<2	<2	4	<2	<2	<2
Chloride	mg/L	5	2.69	3.81	1.71	4	2.46	2.95	1.50
COD	mg/L	4	22	38	<15	4	<25	47	<15
Color	mg/L	5	71	100	<1	4	123	200	90
Conductivity	umhos/cm	5	45	54	35	5	51	71	36
Dissolved Al	mg/L	4	0.716	2.090	0.116	4	0.691	2.050	0.128
Dissolved As	mg/L	4	<0.001	0.0012	<0.001	4	<0.0011	0.0013	<0.001
Dissolved Barium	mg/L	4	0.0391	0.0438	0.0316	4	0.0408	0.0449	0.0360
Dissolved Beryllium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	4	<0.0012	0.0019	<0.001	4	<0.0012	0.0018	<0.001
Dissolved Chromium Hexavalent	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
Dissolved Cobalt	mg/L	4	<0.0012	0.0017	<0.001	4	<0.0014	0.0024	<0.01
Dissolved Cu	mg/L	4	<0.0012	0.0020	<0.001	4	<0.0014	0.0024	<0.01
Dissolved Fe	mg/L	6	1.72	2.37	0.54	5	2.15	2.68	0.634
Dissolved Pb	mg/L	4	<0.001	0.00104	<0.001	4	<0.0011	0.00118	<0.001
Dissolved Mn	mg/L	6	0.124	0.278	0.029	5	0.164	0.331	0.060
Dissolved Hg	mg/L	4	<0.0002	<0.0002	<0.0002	4	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	4	<0.0013	0.002	<0.001	4	<0.001	<0.001	<0.001
Dissolved Nickel	mg/L	4	<0.0017	0.0029	<0.001	4	0.0020	0.0029	0.001
Dissolved Oxygen	mg/L	5	9.73	10.4	9.25	5	10.15	11.40	9.64
Dissolved Selenium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	4	0.0315	0.0370	0.0237	4	0.0376	0.0469	0.0256
Dissolved Zinc	mg/L	4	<0.007	0.0123	<0.005	4	<0.009	0.0115	<0.005
Fecal Coliform	cfu/100mL	4	340	630	90	4	258	720	90
Fluoride (w/o distillation)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	5	12.6	14.6	10.6	4	14.0	16.1	10.4
Nitrate (NO3-N)	mg/L	5	<0.15	0.291	<0.1	4	<0.122	0.188	<0.1
Nitrite (NO2-N)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Odor	DTU	4	<1	<1	0	4	<1	<1	0
Oil and Grease	mg/L	4	<1.9	2.6	<1.7	4	<2	2.4	<1.7

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-11				SW-12			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	4	1.81	2.59	1.11	4	4.61	14.0	0.92
Ortho Phosphate	mg/L	4	<0.03	0.044	<0.025	4	<0.03	0.049	<0.025
pH	s.u.	5	6.3	7.1	5.9	5	6.5	7.2	6.0
Phenols (Total)	mg/L	4	<0.05	<0.05	<0.05	4	<0.05	<0.05	<0.05
Resistivity	ohm/cm	5	22660	28600	18500	5	20880	27800	14100
Silicon as SiO2	mg/L	4	15.2	17.6	12.7	4	16.2	17.4	14.8
TOC (Total Organic Carbon)	mg/L	6	5.21	8.85	3.7	5	6.30	11.2	3.82
Total Boron	mg/L	4	0.0101	0.0141	0.0087	4	0.0102	0.0147	0.0083
Total Calcium	mg/L	5	2.60	2.99	2.30	4	2.84	3.12	2.22
Total Coliform	cfu/100mL	4	7225	15000	300	4	5500	15000	200
Total Cyanide	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	6	59	71	48	5	58	70	41
Total Iron	mg/L	5	3.78	5.20	2.61	5	3.89	6.67	2.96
Total Kjeldahl Nitrogen	mg/L	4	1.81	2.59	1.11	4	4.68	14.0	1.09
Total Magnesium	mg/L	5	1.54	1.85	1.12	4	1.68	2.06	1.18
Total Manganese	mg/L	5	0.196	0.370	0.072	5	0.218	0.438	0.075
Total Phosphorus	mg/L	4	0.091	0.105	0.079	4	<0.076	0.131	<0.025
Total Potassium	mg/L	5	1.77	2.28	1.3	4	1.96	2.28	1.39
Total Settleable Solids	mL/L	4	<0.2	<0.2	<0.1	4	<0.33	0.8	<0.1
Total Sodium	mg/L	5	2.18	2.58	1.61	4	2.43	2.82	1.72
Total Sulfate (SO4)	mg/L	5	2.88	4.68	1.7	4	3.70	4.74	2.54
Total Suspended Solids	mg/L	6	35	128	<2	5	37	150	5
Total Thallium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	4	<0.0012	0.0019	<0.001	4	<0.0012	0.0018	<0.001
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	1	<0.00102	<0.00102	<0.00102
Turbidity	NTU	4	28	40	10	4	20	30	10
PCBs	mg/L	2	* <	* <	* <	2	* <	* <	* <
VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	2	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	2	* <	* <	* <
Total Arsenic	mg/L	1	<0.001	<0.001	<0.001	1	0.00154	0.00154	0.00154
Total Chromium	mg/L	1	<0.001	<0.001	<0.001	1	<0.001	<0.001	<0.001
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	1	<0.0002	<0.0002	<0.0002

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-13				SW-14			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Flow	cfs	5	34.25	169.78	0	5	43.350	215.849	0.904
Field Conductivity	umhos/com	5	62.60	75.59	29.36	5	56.50	71.15	30.14
Field pH	s.u.	5	6.36	7.07	5.63	5	6.48	6.96	5.59
Field Temperature	°F	5	70.69	76.13	57.41	5	70.95	79.17	58.10
Field Dissolved Oxygen	mg/L	5	9.22	12.48	7.97	5	9.06	12.18	7.37
Field Turbidity	NTU	5	48.1	112.8	21.6	5	36.6	85.3	17.6
Cl	mg/L	5	0.03	0.04	0.01	5	0.08	0.15	0.02
Acidity (as CaCO3)	mg/L	5	8	15	3	5	8	14	5
Alkalinity (as CaCO3)	mg/L	5	16	21	6	5	16	22	5
Ammonia Nitrogen	mg/L	4	<0.133	0.220	<0.1	4	<0.11	0.15	<0.1
Bicarbonate (as CaCO3)	mg/L	4	20	27	12	4	22	32	12
BOD (5 day)	mg/L	4	<5.5	<6	<5	4	<5.5	<6	<5
Carbonate	mg/L	4	<2	<2	<2	4	<2	<2	<2
Chloride	mg/L	4	3.12	4.63	1.65	4	2.42	3.47	1.13
COD	mg/L	4	<38	56	<15	4	26	49	<15
Color	mg/L	4	200	200	200	4	175	200	100
Conductivity	umhos/cm	5	59	79	28	5	53	66	30
Dissolved Al	mg/L	4	1.066	2.420	0.185	4	0.773	2.32	0.136
Dissolved As	mg/L	4	<0.0025	0.0051	<0.001	4	<0.0016	0.0021	<0.001
Dissolved Barium	mg/L	4	0.0402	0.0520	0.0221	4	0.0466	0.0540	0.0405
Dissolved Beryllium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Cadmium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Chromium	mg/L	4	<0.0015	0.0021	<0.001	4	<0.0018	0.0033	<0.001
Dissolved Chromium Hexavalent	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Chromium Hexavalent	mg/L	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
Dissolved Cobalt	mg/L	4	<0.0018	0.0032	<0.001	4	<0.0012	0.0014	<0.01
Dissolved Cu	mg/L	4	<0.003	0.0033	<0.001	4	<0.002	<0.004	<0.001
Dissolved Fe	mg/L	5	2.31	3.60	1.12	5	3.04	4.51	1.69
Dissolved Pb	mg/L	4	<0.002	<0.005	<0.001	4	<0.002	<0.005	<0.001
Dissolved Mn	mg/L	5	0.375	0.802	0.023	5	0.180	0.315	0.010
Dissolved Hg	mg/L	4	<0.0002	<0.0002	<0.0002	4	<0.0002	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Nickel	mg/L	4	0.0022	0.0024	0.0020	4	<0.0018	0.0028	<0.001
Dissolved Oxygen	mg/L	5	10.4	11.8	9.31	5	10.0	10.9	8.58
Dissolved Selenium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Silver	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Dissolved Strontium	mg/L	4	0.0269	0.0380	0.0175	4	0.0392	0.0480	0.0201
Dissolved Zinc	mg/L	4	0.0159	0.0198	<0.005	4	<0.007	0.00991	<0.005
Fecal Coliform	cfu/100mL	4	8125	30000	40	4	230	640	70
Fluoride (w/o distillation)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Hardness as CaCO3(SM-2340B)	mg/L	4	17.70	23.3	8.78	4	15.2	18.6	10.4
Nitrate (NO3-N)	mg/L	4	<0.14	0.229	<0.1	4	<0.1	<0.1	<0.1
Nitrite (NO2-N)	mg/L	4	<0.1	<0.1	<0.1	4	<0.1	<0.1	<0.1
Odor	DTU	4	1.5	2	0	4	<0.1	<0.1	0
Oil and Grease	mg/L	4	<1.8	<1.9	<1.6	4	<1.8	2.0	<1.6

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

		SW-13				SW-14			
Parameter	Units	#	Avg	Max	Min	#	Avg	Max	Min
Organic N	mg/L	4	1.82	2.82	1.13	4	1.530	3.250	0.816
Ortho Phosphate	mg/L	4	<0.13	0.406	<0.025	4	<0.025	<0.025	<0.025
pH	s.u.	5	6.3	6.8	5.2	5	6.5	7.7	5.4
Phenols (Total)	mg/L	4	<0.05	<0.05	<0.05	4	<0.05	<0.05	<0.05
Resistivity	ohm/cm	5	19260	16900	12700	5	20460	33300	15200
Silicon as SiO2	mg/L	4	12.8	14.6	11.1	4	13.1	15.5	10.5
TOC (Total Organic Carbon)	mg/L	5	10.08	16.3	5.74	5	7.76	11.5	5.75
Total Boron	mg/L	4	0.0146	0.0196	0.0112	4	0.0125	0.0145	0.0109
Total Calcium	mg/L	4	4.20	6.48	2.22	4	3.43	3.80	2.75
Total Coliform	cfu/100mL	4	12825	40000	2400	4	12775	30000	1600
Total Cyanide	mg/L	4	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Total Dissolved Solids	mg/L	5	98	143	47	5	76	72	54
Total Iron	mg/L	5	3.40	4.22	2.22	5	4.49	4.90	3.47
Total Kjeldahl Nitrogen	mg/L	4	1.91	2.93	1.13	4	1.59	3.4	0.893
Total Magnesium	mg/L	4	1.75	2.53	0.789	4	1.62	2.21	0.863
Total Manganese	mg/L	5	0.549	0.940	0.078	5	0.501	0.923	0.145
Total Phosphorus	mg/L	4	0.301	0.574	0.053	4	0.209	0.609	0.048
Total Potassium	mg/L	4	3.13	5.08	1.99	4	2.21	2.89	1.90
Total Settleable Solids	mL/L	4	<0.175	0.200	<0.1	4	<0.2	<0.2	<0.1
Total Sodium	mg/L	4	2.18	3.22	0.982	4	2.34	3.07	1.10
Total Sulfate (SO4)	mg/L	4	2.12	3.06	1.20	4	1.84	2.35	1.07
Total Suspended Solids	mg/L	5	31	35	6	4	21	55	8
Total Thallium	mg/L	4	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Tri-Valent Chromium	mg/L	4	<0.0016	0.0021	<0.001	4	<0.0018	0.0033	<0.001
Tri-Valent Chromium Dissolved	mg/L	1	<0.00102	<0.00102	<0.00102	1	<0.00102	<0.00102	<0.00102
Turbidity	NTU	4	30	40	20	4	24	30	20
PCBs	mg/L	2	* <	* <	* <	2	* <	* <EXCEPT	* <
VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Semi-VOCs	mg/L	2	* <	* <	* <	2	* <	* <	* <
Pesticides	mg/L	2	* <	* <	* <	2	* <	* <	* <
Dioxin	mg/L	2	* <	* <	* <	2	* <	* <	* <
Total Arsenic	mg/L	1	0.00303	0.00303	0.00303	1	0.00237	0.00237	0.00237
Total Chromium	mg/L	1	<0.001	<0.001	<0.001	1	<0.001	<0.001	<0.001
Total Mercury	mg/L	1	<0.0002	<0.0002	<0.0002	1	<0.0002	<0.0002	<0.0002

* <EXCEPT - chloroform of 0.00114 on Oct.20, 2008

(* <) The analyte was found to have a nondectable limit. For additional information see (C-14.1.2) Surogate Summary.

Table 2. Summary of Surface Water Quality: Surfacewater

Surogates Summary

Surogate	Dilution Factor	Detection Limit	Units	Method
1,1,1,2-Tetrachloroethane	1	1.00	µg/L	624
1,1,1-Trichloroethane	1	1.00	µg/L	624
1,1,2,2-Tetrachloroethane	1	1.00	µg/L	624
1,1,2-Trichloroethane	1	1.00	µg/L	624
1,1-Dichloroethane	1	1.00	µg/L	624
1,1-Dichloroethene	1	1.00	µg/L	624
1,2-Dichlorobenzene	1	1.00	µg/L	624
1,2-Dichloroethane	1	1.00	µg/L	624
1,2-Dichloropropane	1	1.00	µg/L	624
1,3-Dichlorobenzene	1	1.00	µg/L	624
1,4-Dichlorobenzene	1	1.00	µg/L	624
2-Chloroethyl vinyl ether	1	5.00	µg/L	624
Acrolein	1	20.0	µg/L	624
Acrylonitrile	1	20.0	µg/L	624
Benzene	1	1.00	µg/L	624
Bromodichloromethane	1	1.00	µg/L	624
Bromoform	1	1.00	µg/L	624
Bromomethane	1	1.00	µg/L	624
Carbon tetrachloride	1	1.00	µg/L	624
Chlorobenzene	1	1.00	µg/L	624
Chlorodibromomethane	1	1.00	µg/L	624
Chloroethane	1	1.00	µg/L	624
Chloroform	1	1.00	µg/L	624
Chloromethane	1	1.00	µg/L	624
cis-1,3-Dichloropropene	1	1.00	µg/L	624
Ethylbenzene	1	1.00	µg/L	624
Methylene chloride	1	10.0	µg/L	624
Styrene	1	1.00	µg/L	624
Tetrachloroethene	1	1.00	µg/L	624
Toluene	1	5.00	µg/L	624
trans-1,2-Dichloroethene	1	1.00	µg/L	624
trans-1,3-Dichloropropene	1	1.00	µg/L	624
Trichloroethene	1	1.00	µg/L	624
Trichlorofluoromethane	1	1.00	µg/L	624
Vinyl chloride	1	1.00	µg/L	624
Aroclor 1016	1	0.526	µg/L	608
Aroclor 1221	1	0.526	µg/L	608
Aroclor 1232	1	0.526	µg/L	608
Aroclor 1242	1	0.526	µg/L	608
Aroclor 1248	1	0.526	µg/L	608
Aroclor 1254	1	0.526	µg/L	608

Surogate	Dilution Factor	Detection Limit	Units	Method
Aroclor 1260	1	0.526	µg/L	608
4,4´-DDD	10	0.0421	µg/L	608
4,4´-DDE	10	0.0421	µg/L	608
4,4´-DDT	10	0.0421	µg/L	608
Aldrin	10	0.0421	µg/L	608
alpha-BHC	10	0.0421	µg/L	608
beta-BHC	10	0.0421	µg/L	608
Chlordane	10	0.211	µg/L	608
delta-BHC	10	0.0421	µg/L	608
Dieldrin	10	0.0421	µg/L	608
Endosulfan I	10	0.0421	µg/L	608
Endosulfan II	10	0.0421	µg/L	608
Endosulfan sulfate	10	0.0421	µg/L	608
Endrin	10	0.0421	µg/L	608
Endrin aldehyde	10	0.0421	µg/L	608
Endrin Ketone	10	0.0421	µg/L	608
gamma-BHC	10	0.0421	µg/L	608
Heptachlor	10	0.0421	µg/L	608
Heptachlor epoxide	10	0.0421	µg/L	608
Toxaphene	10	0.316	µg/L	608
Dioxin (2,3,7,8-TCDD) - Screen	1	1.00	µg/L	625
1,2,4-Trichlorobenzene	1	5.52	µg/L	625
1,2-Dichlorobenzene	1	5.52	µg/L	625
1,2-Diphenylhydrazine/Azobenzen	1	5.52	µg/L	625
1,3-Dichlorobenzene	1	5.52	µg/L	625
1,4-Dichlorobenzene	1	5.52	µg/L	625
2,4,6-Trichlorophenol	1	5.52	µg/L	625
2,4-Dichlorophenol	1	5.52	µg/L	625
2,4-Dimethylphenol	1	5.52	µg/L	625
2,4-Dinitrophenol	1	5.52	µg/L	625
2,4-Dinitrotoluene	1	5.52	µg/L	625
2,6-Dinitrotoluene	1	5.52	µg/L	625
2-Chloronaphthalene	1	5.52	µg/L	625
2-Chlorophenol	1	5.52	µg/L	625
2-Nitrophenol	1	5.52	µg/L	625
3,3´-Dichlorobenzidine	1	5.52	µg/L	625
4,6-Dinitro-2-methylphenol	1	11.0	µg/L	625
4-Bromophenyl phenyl ether	1	5.52	µg/L	625
4-Chloro-3-methylphenol	1	5.52	µg/L	625
4-Chlorophenyl phenyl ether	1	5.52	µg/L	625
4-Nitrophenol	1	22.1	µg/L	625
Acenaphthene	1	2.21	µg/L	625
Acenaphthylene	1	2.21	µg/L	625
Anthracene	1	2.21	µg/L	625
Benzidine	1	22.1	µg/L	625
Benzo(a)anthracene	1	2.21	µg/L	625
Benzo(a)pyrene	1	2.21	µg/L	625
Benzo(b)fluoranthene	1	2.21	µg/L	625
Benzo(g,h,i)perylene	1	2.21	µg/L	625
Benzo(k)fluoranthene	1	2.21	µg/L	625
Bis(2-chloroethoxy)methane	1	5.52	µg/L	625

Surogate	Dilution Factor	Detection Limit	Units	Method
Bis(2-chloroethyl)ether	1	5.52	µg/L	625
Bis(2-chloroisopropyl)ether	1	5.52	µg/L	625
Bis(2-ethylhexyl)phthalate	1	11.0	µg/L	625
Butyl benzyl phthalate	1	5.52	µg/L	625
Chrysene	1	2.21	µg/L	625
Di-n-butyl phthalate	1	5.52	µg/L	625
Di-n-octyl phthalate	1	5.52	µg/L	625
Dibenz(a,h)anthracene	1	2.21	µg/L	625
Diethyl phthalate	1	5.52	µg/L	625
Dimethyl phthalate	1	5.52	µg/L	625
Fluoranthene	1	2.21	µg/L	625
Fluorene	1	2.21	µg/L	625
Hexachlorobenzene	1	5.52	µg/L	625
Hexachlorobutadiene	1	5.52	µg/L	625
Hexachlorocyclopentadiene	1	5.52	µg/L	625
Hexachloroethane	1	5.52	µg/L	625
Indeno(1,2,3-cd)pyrene	1	2.21	µg/L	625
Isophorone	1	5.52	µg/L	625
N-Nitrosodi-n-propylamine	1	5.52	µg/L	625
N-Nitrosodimethylamine	1	5.52	µg/L	625
N-Nitrosodiphenylamine	1	11.0	µg/L	625
Naphthalene	1	2.21	µg/L	625
Nitrobenzene	1	5.52	µg/L	625
Pentachlorophenol	1	5.52	µg/L	625
Phenanthrene	1	2.21	µg/L	625
Phenol	1	5.52	µg/L	625
Pyrene	1	2.21	µg/L	625

Table 3. Summary of Surface Impoundment Water Quality:				
Parameter	# Samples	Average	Maximum	Minimal
pH Field (s.u.)	188	7.54	10.26	5.48
Temp. Field (°F)	188	89.05	102.06	70.45
Conductivity Field (umhos/cm)	188	58.83	239.6	22.40
D.O. (mg/L)	188	5.85	16.70	3.64
Turbidity (NTU)	188	28.30	278.4	1.3
Color (PCU)	164	77	>100	12
Acidity (mg/L)	188	6	126	<1
Alk. (as $CaCO_3$) (mg/L)	188	12	82	<2
Bicarbonate (as $CaCO_3$) (mg/L)	188	16	74	<2
Carbonate (as CO_3) (mg/L)	188	2	13	0
Chloride (mg/L)	188	3.32	19.5	1
Total Calcium (mg/L)	188	2.83	15	0.331
TDS (mg/L)	188	71	308	19
Total Fe (mg/L)	188	3.35	23.1	0.202
Total Mg (mg/L)	188	1.30	5.98	0.352
Total Mn (mg/L)	188	0.15	1.03	0.011
Total K (mg/L)	188	3.93	26.8	0.407
Total Na (mg/L)	188	2.33	11.6	0.549
Total SO_4 (mg/L)	188	1.88	11.2	<1.0

Table 4. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters Minimum Standards Applicable to All Waters, Fish and Wildlife (Source: MDEQ, 2007) NA = Not Applicable

Parameter	**Minimum**	**Maximum**	**Monthly Average/Mean**
Dissolved Oxygen			
Daily Average	5.0 mg/L	NA	NA
Instantaneous	4.0 mg/L		
pH	6.0 s.u.	9.0 s.u.	NA
change	1.0 s.u.	1.0 s.u.	
Temperature	NA	90°F	NA
Rise		5°F	
Fecal Coliform	NA		
May - Oct.		400/100ml more than 10% of 30-day period	200/100 mL
Nov. - Apr.		4,000/100ml more than 10% of 30-day period	2,000/100 mL
Specific Conductivity	NA	1,000 µmhos/cm	NA
Total Dissolved Solids	NA	1,500 mg/L	750 mg/L

Table 5. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters Numeric Criteria Applicable to All Waters Upstream of Public Water Supply Intake (Source: MDEQ, 2007) NA = Not Applicable

Parameter	**Fresh Water**		**Human Health**
	Acute (µg/L)	**Chronic (µg/L)**	**Water & Organisms (µg/L)**
Aldrin	3	NA	0.00013
Ammonia	NA[g]	NA[g]	NA
Arsenic (III), Total Dissolved	340[f]	150[f]	NA
Arsenic, Total Dissolved	NA	NA	0.078[i]
Cadmium, Total Dissolved	1.03[b,f]	0.15[b,f]	5
Chlordane	2.4	0.0043	0.0021
Chlorine	19	11	NA
Chromium (Hex), Total Dissolved	16[f]	11[f]	98
Chromium (III), Total Dissolved	323[b,f]	42[b,f]	100
Copper, Total Dissolved	7.0[b,f]	5.0[b,f]	1000
Cyanide	22.0	5.2	200
4,4 DDT	1.1	0.001	0.00059
Dieldrin	0.24	0.056	0.000135
2,3,7,8 TCDD (Dioxin)	NA	NA	1.0 ppq[d]
alpha-Endolsulfan	0.22[j]	0.056[j]	110[k]
beta-Endosulfan	0.22[j]	0.056[j]	110[k]
Endosulfan Sulfate	0.22[j]	0.056[j]	110[k]
Endrin	0.086	0.036	0.76
Heptachlor	0.52	0.0038	0.000208
gamma-BHC (Lindane)	0.95	0.08	0.0186
Lead, Total Dissolved	30[b,f]	1.18[b,f]	15
Mercury (II), Total Dissolved	2.1[f]	0.012	NA
Mercury	NA	NA	0.151
Nickel, Total Dissolved	260[b,f]	29[b,f]	607
Phenol	300	102	300
Pentachlorophenol	8.7	6.7	0.28
PCB 1242	0.2	0.014	NA
PCB 1254	0.2	0.014	NA
PCB 1221	0.2	0.014	NA
PCB 1232	0.2	0.014	NA
PCB 1248	0.2	0.014	NA
PCB 1260	0.2	0.014	NA

Table 5. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters Numeric Criteria Applicable to All Waters Upstream of Public Water Supply Intake (Source: MDEQ, 2007) NA = Not Applicable

Parameter	**Fresh Water**		**Human Health**
	Acute (µg/L)	**Chronic (µg/L)**	**Water & Organisms (µg/L)**
PCB 1016	0.2	0.014	NA
Total PCB	NA	NA	0.00035
Selenium, Total Dissolved	11.8 a,[f]	4.6 [f]	50
Silver, Total Dissolved	0.98 [b,f]	NA	100
Toxaphene	0.73	0.0002	0.00073
Zinc, Total Dissolved	65 [b,f]	65 [b,f]	5000

[b] Hardness dependent parameter. Criteria are indicated at hardness of 50 mg/l as CaCO3. Equations for criteria calculation of hardness dependent parameters can be found in *Quality Criteria for Water.* The equation is applicable for instream hardness ranges from 25 mg/l to 400 mg/l. If instream hardness is less than 25 mg/l, then a hardness value of 25 mg/l should be used to calculate the criteria. If instream hardness is greater than 400 mg/l, then a hardness of 400 mg/l should be used to calculate the criteria.

[d] Criteria for 2,3,7,8 TCDD based on a risk factor of one in one hundred thousand (10-5).

[f] Parameter subject to water effects ratio equations where:
CMC = WER * Acute
CCC = WER * Chronic

[g] Ammonia criteria are dependent on pH, temperature, and/or salinity

[i] Refers to the inorganic form only.

[j] Applies to the sum of α and β isomers.

[k] Applies to individual isomers of Endosulfan including α, β, and Endosulfan Sulfate.

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APPENDIX E

KEMPER COUNTY IGCC PROJECT SITE WETLAND ASSESSMENT AND ECOLOGICAL SURVEY REPORTS

WETLAND ASSESSMENT OF THE INTEGRATED GASIFICATION COMBINED CYCLE GENERATING STATION IN KEMPER COUNTY, MISSISSIPPI

Prepared for

MISSISSIPPI POWER COMPANY
2992 WEST BEACH BOULEVARD
GULFPORT, MISSISSIPPI 39501

Prepared by

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

(Contract No. BSU 0067717)

March 30, 2007

INTRODUCTION

Barry A. Vittor & Associates, Inc. (Vittor & Associates) was contracted by Mississippi Power Company to conduct surveys of wetlands within the 1,670-acre Integrated Gasification Combined Cycle generating station site in Kemper County, Mississippi. Vittor & Associates' wetland assessment involved detailed delineation and mapping of jurisdictional wetlands within a 128-acre core site, where the plant would be located, and a 500-foot wide access road corridor between Mississippi State Road 493 and the 128-acre block. Vittor & Associates also estimated the wetlands boundaries on 1,542 acres surrounding the 128-acre plant site property. The estimated wetland acreage was determined using information gathered from the detailed wetland survey on the plant site property, field groundtruthing and collecting GPS data at numerous predetermined locations throughout the 1,542 acres property, by referencing county soil maps, USGS topographic quadrangle maps for the area, and available aerial photography. Using that methodology, Vittor & Associates determined that wetlands occupy approximately 475 acres (30%) of the total 1,670-acre study area, including the 16.4 acres delineated on the 128-acre plant site.

Field studies were performed March 7-8, 2007 by Terry Whitehurst, Howard E. Horne, and David Knowles of Vittor & Associates. Mr. Horne conducted a follow-up field inspection on March 21, in conjunction with field surveys of the property by Archaeological Services, Inc.

GENERAL CHARACTERISTICS OF THE OVERALL STUDY AREA

The 128-acre plant site is comprised for the most part, of managed pine timberlands with mixed hardwood forest areas occurring. Large portions of the site had been clearcut at the time of this survey. The property is also presently being managed for deer and turkey hunting and numerous food plots were distributed across the property. Topography on the site is characterized by undulating sand/clay hills with maximum elevations reaching over 480 feet. The lowest elevations on the site are along the west and south property boundaries where elevations drop below 420 feet as the site slopes to the Chickasawhay Creek drainageway.

Various land use activities occur on the 1,542 acres surrounding the 128-acre plant site. The study area consists of undeveloped woodlands, managed pine timberlands, open fields and pastures, and light residential development. Wetlands throughout the study area are associated with tributaries to Chickasawhay Creek.

WETLAND DELINEATION METHODOLOGY

Vittor & Associates conducted this wetland survey according to the methodology and criteria set forth in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual. According to the Manual, jurisdictional wetlands must exhibit all of the following criteria: hydric soils; a dominance of wetland vegetation; and sufficient hydrology to sustain hydrophytic plants. A list of hydric soils has been compiled by the Natural Resources Conservation Service (NRCS) for the nation and each state. NRCS also distributes soil maps for most counties, giving the location of each soil type and a description of each soil. Also, lists are available that classify plant species on the basis of the likelihood of its occurrence in a wetland. To have a dominance of wetland vegetation, one must have hydrophytic species comprising 50% or more of the total species in that area. Sufficient hydrology is defined as water and/or indicators of water at or near the surface of the ground. Hydrologic indicators are factors such as water stained leaves, oxidized root channels, drainage patterns, watermarks on the trunks of the trees, etc. Field data sheets were compiled within each different wetland and contiguous upland habitat type, to document the basis for the delineation.

Once the soil map of the area was thoroughly studied and the USGS Topographic Quadrangle referenced, staff biologists mapped the wetlands based upon topographic features, soil types and the presence of wetland characteristics (as described above). Soil probes were used to give the biologist a clear view of the soil and allow the biologist to determine the taxonomic subgroup to which the soil belonged. Hydrologic indicators in the soil (*ie*., oxidized root channels, the presence of water, or saturated soil near the surface of the ground) were used to determine if the area was a wetland. The biologist studied the vegetation of the area to determine if the area was dominated by wetland vegetation. If any one criterion is not met, the area will not be delineated as a jurisdictional wetland.

Boundaries of jurisdictional wetlands were clearly marked with flagging labeled "WETLAND BOUNDARY" and placed along the wetland boundaries, at approximately 50- to 75-foot intervals. Each flag location was determined with a Trimble ® GPS survey instrument that had sub-meter accuracy. A wetland delineation map will be prepared for review and use by Mississippi Power.

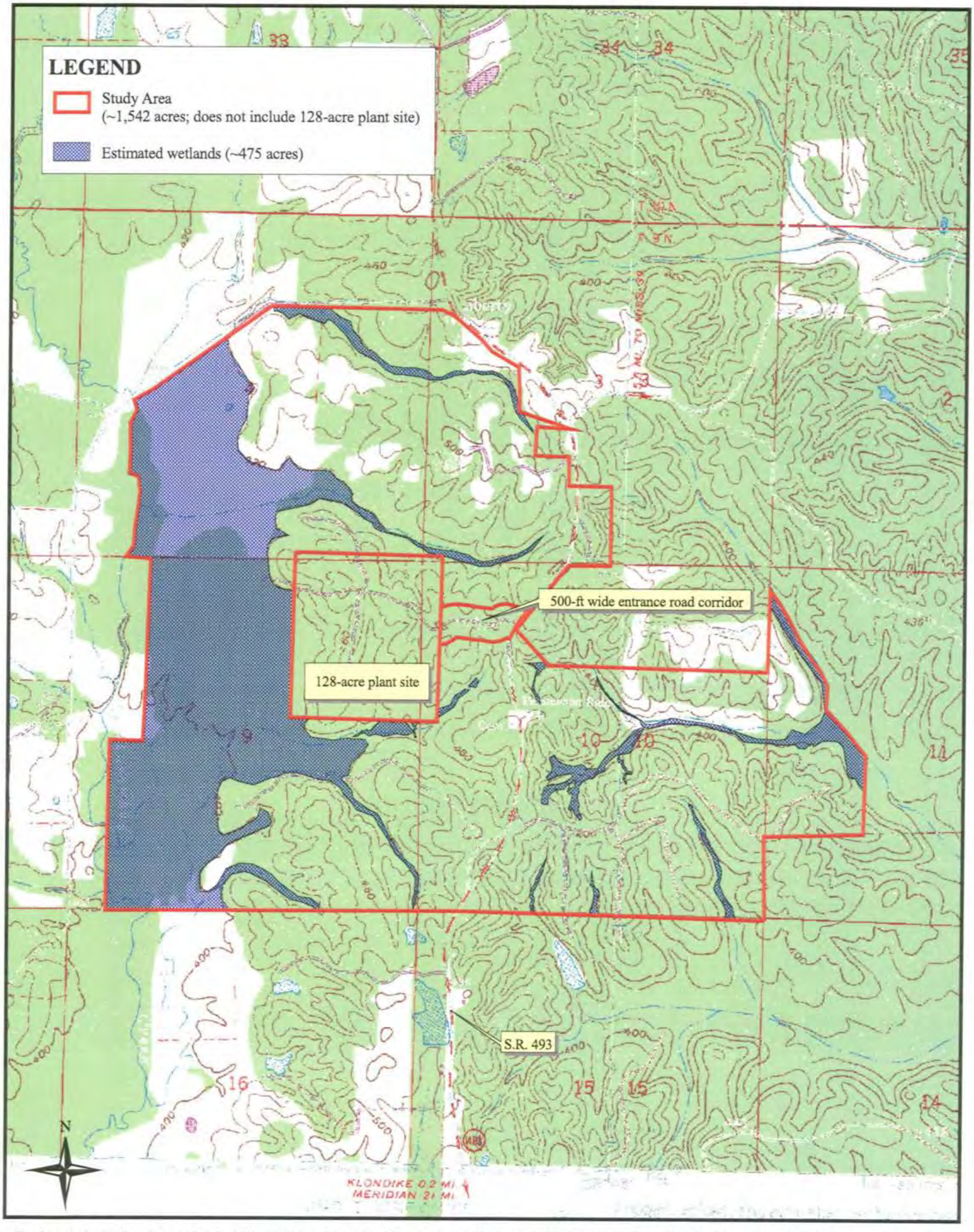
WETLAND SURVEY OF THE 128-ACRE PLANT SITE

Vittor & Associates conducted a detailed wetland survey on the 128-acre plant site on March 7-8, 2007. Specifically, the site is located in Sections 3, 4, 9, and 10, Township 9N, Range 15E, on the Moscow, MS USGS 7.5-minute Quadrangle. Site locator maps are attached.

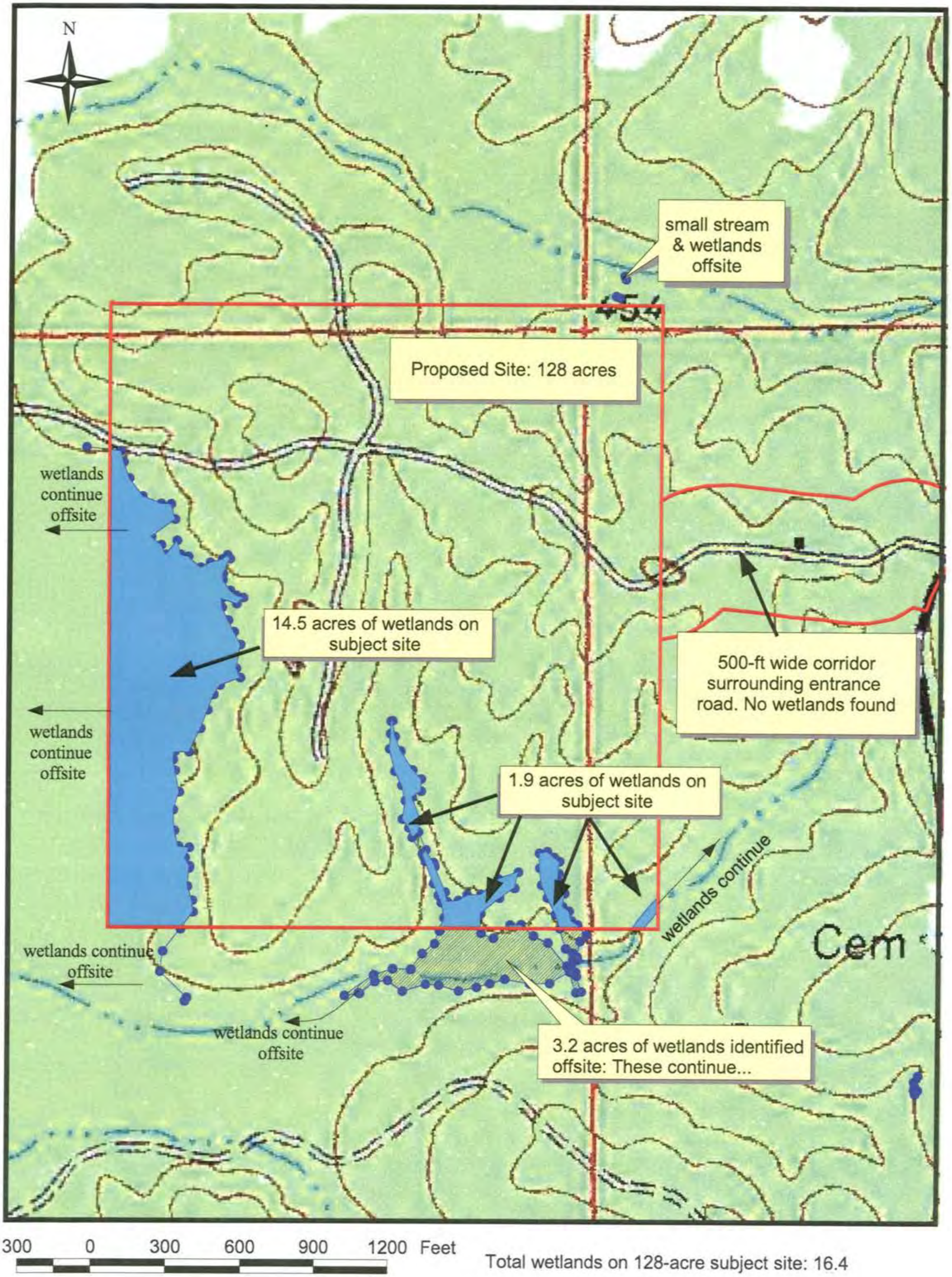
Vittor & Associates delineated and mapped a total of 16.4 acres of jurisdictional wetlands within the 128-acre plant site property. A 14.5-acre floodplain wetland encroaches into the site along much of the west property boundary and a small tributary to Chickasawhay Creek that comprises 1.9 acres originates near the southeast property line. These wetlands have been heavily impacted by clear cutting. Very few canopy trees remain and logging slash has been left in wetlands. Many wetland areas have been further degraded by silt run-off from the highly erodable, cut over upland slopes. The sparse canopy in the cut-over wetland areas is comprised of regenerating loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), and water oak, (*Quercus nigra*), while the shrub and herbaceous layer is dominated by wax myrtle broom sedge (*Andropogon virginicus*), slender wood oats (*Chasmanthium laxum*), giant plume grass (*Erianthus giganteus*), greenbriar (*Smilax glauca*), soft rush (*Juncus effusus*), trifoliate orange (*Poncirus trifoliate*), wooly bulrush (*Scirpus virginicus*), and saw-toothed blackberry (*Rubus argutus*). The few remaining undisturbed wetlands are vegetated by white oak (*Quercus alba*), red maple (*A. rubrum*), sweet gum (*L. styraciflua*), water oak (*Q. nigra*), willow oak (*Quercus phellos*), poplar (*Liriodendron tulipifera*), red cedar (*Juniperus virginiana*), Japanese honeysuckle (*Lonicera japonica*), wax myrtle (*Myrica cerifera*), trifoliate orange (*P. trifoliate*), blueberry (*Vaccinium* sp.), and Christmas fern (*Polystichum acrostichoides*). Wetland soils were poorly drained, low-chroma, sandy clay, and were saturated near the surface at all sampling points. Surface water was frequently present in the floodplain wetlands in the southwest corner of the site.

The remaining 111.7 acres of the 128-acre plant site consists of uplands. Vegetation on the uplands includes primarily loblolly pine (*P. taeda*) with water oak (*Q. nigra*), black cherry (*Prunus serotina*), yaupon (*Ilex vomitoria*), blueberry (*Vaccinium elliottii*), Japanese honeysuckle (*L. japonica*), and green briar (*S. glauca*) intermixed. Upland soils were well-drained, reddish-brown, sandy clay and slopes ranged from 5 to 35 percent.

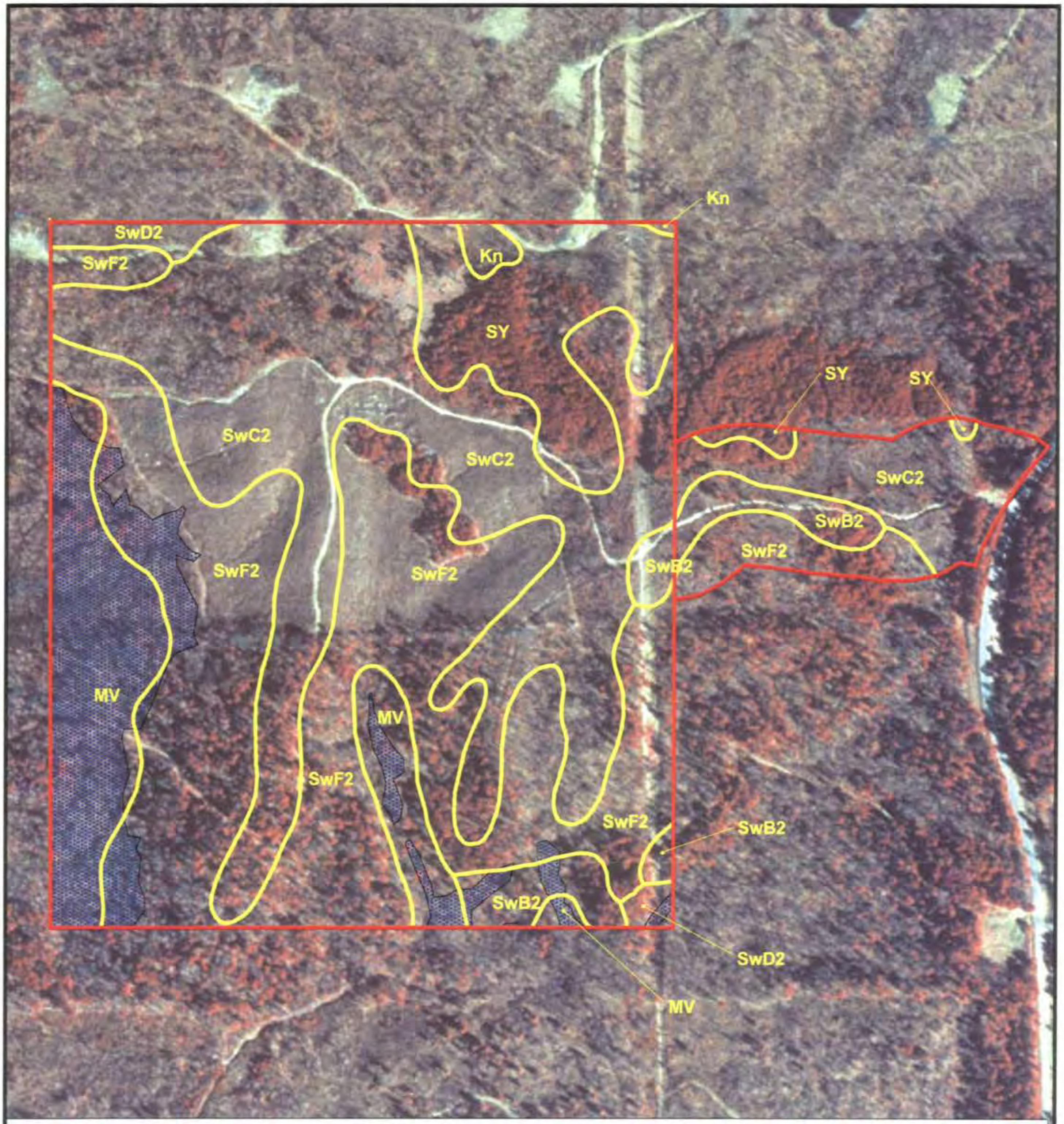
Vittor & Associates also performed a wetland survey on a 500-foot-wide corridor along the access road that enters the plant site from Highway 493. No wetlands were found in the access road corridor.



Estimated wetlands on the 1,542-acre study area. Does not include the 16.4 acres of wetlands found on the 128-acre plant site.



Total wetlands on 128-acre subject site: 16.4



Nonhydric/Upland Soils

SwB2 = Sweatman fine sandy loam, 2 to 5 percent slope
SwC2 = Sweatman fine sandy loam, 5 to 8 percent slope
SwD2 = Sweatman fine sandy loam, 8 to 12 percent slope
SwF2 = Sweatman fine sandy loam, 12 to 30 percent slope
SY = Sweatman-Smithdale Association, 12 to 35 percent slope
SX = Sweatman - Smithdale association, 5 to 12 percent slope

Hydric/Wetland Soils

Kn = Kinston
MV = Mooreville-Kinston-Mantachie Association

▨ **Wetlands Delineated by BVA (16.4 acres)**

250 0 250 500 750 1000 Feet

N

BARRY A. VITTOR & ASSOCIATES, INC.
Environmental Research and Consulting

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Plant Site
Application/Owner:
Investigator: Terry Whitehurst & David Knowles
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 03-07-07
County: Kemper
State: Kemper
Community ID:
Transect ID:
Plot ID: Southwest

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Liriodendron tulipifera	T	Fac	*Juniperus virginiana*	T	Fac
Quercus phellos	T	Fac W-	*Poncirus trifoliata*	S	Fac
Liquidambar styraciflua	T	Fac +	*Myrica cerifera*	S	Fac +
Quercus nigra	T	Fac	*Smilax glauca*	H	Fac
Acer rubrum	T	Fac			
Chasmanthium laxum	H	Fac W-			
Polystichum acrostichoides	H	Fac			
Lonicera japonica	H	Fac -			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: 10 (in.)
Depth to Saturated Soil: 4 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- X Saturated in Upper 12 inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- X Water-Stained Leaves
- X Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): Mooreville-Kinston-Mantachie
Drainage Class: Poorly Drained
Field Observations:
Taxonomy (Subgroup):
Confirm Mapped Type? [✓ Yes] No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		10 yr 5/1	10 yr 5/8	Common/Distinct	Sandy Clay

Hydric Soil Indicators:
- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- X Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Plant Site
Application/Owner:
Investigator: Terry Whitehurst & David Knowles
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? [✓ Yes] No
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 03-07-07
County: Kemper
State: Mississippi
Community ID:
Transect ID:
Plot ID: Northwest

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
**Pinus taeda*	T	Fac			
Prunus serotina	T	Fac U			
Ilex vomitoria	S	Fac			
Acer rubrum	T	Fac			
Vaccinium elliottii	S	Fac +			
Lonicera japonica	H	Fac -			
Smilax glauca	H	Fac			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 85%

HYDROLOGY

____ Recorded Data (Describe in Remarks):
  ____ Stream, Lake, or Tide Gauge
  ____ Aerial Photographs
  ____ Other
____ No Recorded Data Available

Field Observations:
Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: N/A (in.)

Wetland Hydrology Indicators:

Primary Indicators:
____ Inundated
____ Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
____ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 inches
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): Sweatman
Taxonomy (Subgroup):
Drainage Class: Well Drained
Field Observations:
Confirm Mapped Type? [✓ Yes] No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6		5 yr 4/4			Sandy Clay Loam
6-18		5 yr 4/6			Clay Loam

Hydric Soil Indicators:

____ Histosol
____ Histic Epipedon
____ Sulfidic Odor
____ Aquic Moisture Regime
____ Reducing Conditions
____ Gleyed or Low-Chroma Colors
____ Concretions
____ High Organic Content in Surface Layer in Sandy Soils
____ Organic Streaking in Sandy Soils
____ Listed on Local Hydric Soils List
____ Listed on National Hydric Soils List
____ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? Yes [✓ No]
Hydric Soils Present? Yes [✓ No]

Is this Sampling Point within a Wetland? Yes [✓ No]

Remarks: (use back if necessary)

*Sampling point was in a planted pine stand.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Plant Site

Application/Owner:

Investigator: Terry Whitehurst & David Knowles

Do Normal Circumstances exist on the site? [✓ Yes] No

Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]

Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 03-07-07

County: Kemper

State: Mississippi

Community ID:

Transect ID:

Plot ID: Northwest at edge of floodplain

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Quercus alba	T	Fac U	*Ligustrum sinense*	S	Fac
Acer rubrum	T	Fac			
Liquidambar styraciflua	T	Fac +			
Liriodendron tulipifera	T	Fac			
Vaccinium elliottii	S	Fac			
Chasmanthium laxum	H	Fac W-			
Juncus effusus	H	Fac W+			
Lonicera japonica	H	Fac			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

HYDROLOGY

____ Recorded Data (Describe in Remarks):
- ____ Stream, Lake, or Tide Gauge
- ____ Aerial Photographs
- ____ Other

____ No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)

Depth of Free Water in Pit: 8 (in.)

Depth to Saturated Soil: 2 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ____ Inundated
- X Saturated in Upper 12 inches
- X Water Marks
- ____ Drift Lines
- ____ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- X Water-Stained Leaves
- X Local Soil Survey Data
- ____ FAC-Neutral Test
- ____ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): Mooreville-Kinston-Mantachie

Taxonomy (Subgroup):

Drainage Class: Poorly

Field Observations:
Confirm Mapped Type? [✓ Yes] No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		2.5 yr 3/2			Sandy Clay Loam

Hydric Soil Indicators:
- ____ Histosol
- ____ Histic Epipedon
- ____ Sulfidic Odor
- ____ Aquic Moisture Regime
- ____ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ____ Concretions
- ____ High Organic Content in Surface Layer in Sandy Soils
- ____ Organic Streaking in Sandy Soils
- X Listed on Local Hydric Soils List
- ____ Listed on National Hydric Soils List
- ____ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No

Wetland Hydrology Present? [✓ Yes] No

Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Plant Site

Application/Owner:

Investigator: Terry Whitehurst & David Knowles

Do Normal Circumstances exist on the site? Yes [✓ No]

Is the site significantly disturbed (Atypical Situation)? [✓ Yes] No

Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

clearcut, few canopy trees remaining

Date: 03-08-07

County: Kemper

State: Mississippi

Community ID:

Transect ID:

Plot ID: Southeast drain (cut over)

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Liquidambar styraciflua	T	Fac +	*Smilax glauca*	H	Fac
Quercus nigra	T	Fac	*Polystichum acrostichoides*	H	Fac
Acer rubrum	T	Fac			
Erianthus giganteus	H	Fac W			
Andropogon virginicus	H	Fac -			
Chasmanthium laxum	H	Fac W-			
Pinus taeda (regen.)	T	Fac			
Myrica cerifera	S	Fac +			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 90%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: ___ (in.)

Depth of Free Water in Pit: ___ (in.)

Depth to Saturated Soil: 12 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- X Saturated in Upper 12 inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- X Water-Stained Leaves
- X Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase):

Taxonomy (Subgroup):

Drainage Class: Poorly Drained

Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4		10 yr 3/1			Sandy Loam
4-18		10 yr 5/1	7.5 yr 5/8	common/distinct	Sandy Loam

Hydric Soil Indicators:
- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No

Wetland Hydrology Present? [✓ Yes] No

Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

THREATENED AND ENDANGERED SPECIES REPORT FOR THE INTEGRATED GASIFICATION COMBINED CYCLE GENERATING STATION IN KEMPER COUNTY, MISSISSIPPI

Prepared for

MISSISSIPPI POWER COMPANY
2992 WEST BEACH BOULEVARD
GULFPORT, MISSISSIPPI 39501

Prepared by

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

(Contract No. BSU 0067717)

March 30, 2007

INTRODUCTION

Barry A. Vittor & Associates, Inc. performed a threatened and endangered species survey of the proposed 128-acre Mississippi Power Company Integrated Gasification Combined Cycle (IGCC) generating station in Kemper County, Mississippi. This report details the results of our survey and discusses the potential for occurrence of federal and/or state protected species within the project site.

PROJECT LOCATION

The 128-acre study area is located in Kemper County, Mississippi on the west side of State Road 493, approximately 10 air miles south of the community of DeKalb. **Figure 1** depicts the subject property on the Moscow and Lauderdale, NW, Mississippi, United States Geological Survey (USGS) 7.5-minute topographic quadrangles. The project site is located in Township 9 North, Range 15 East and contains multiple sections: 3, 4, 9, and 10.

TARGET SPECIES

A review of the pertinent and available literature was conducted to help generate a list of federally and state protected species that could possibly occur on the property. The United States Fish & Wildlife Service's list of Mississippi's federally protected species by county was consulted as the primary reference on potentially occuring species (Ecological Services Field Office; http://www.fws.gov/southeast/jackson/index.html). The United States Fish and Wildlife Service (USFWS) lists the threatened Price's potato bean (*Apios priceana*) as the only federally protected species currently known to occur in Kemper County, Mississippi. Detailed natural history information on this species is provided for reference in **Appendix A** (Kral, 1983; Natureserve, 2006).

Other broadly distributed and wide ranging species such as Bald Eagle (*Halieetus leucocephalus*) and Red-cockaded Woodpecker (*Picoides borealis*) could possibly occur throughout Mississippi and Vittor & Associates usually considers these taxa as potential targets for all threatened and endangered species surveys performed in the state.

The Mississippi Department of Wildlife Fisheries and Parks is responsible for the regulation of protected nongame species in the state. A list of wildlife species protected by the state was generated from the following regulations on the Department of Wildlife Fisheries and Parks' website (http://www.mdwfp.com/Level2/Wildlife/hunting_regs.asp):

> "All birds of prey (eagles, hawks, osprey, owls, kites and vultures) and other nongame birds are protected and may not be hunted, molested, bought or sold.. The following endangered species are also protected: black bear, Florida panther, gray bat, Indiana bat, all sea turtles, gopher tortoise, sawback turtles (black-knobbed, ringed, yellow-blotched), black pine snake, eastern indigo snake, rainbow snake and the southern hognose snake "

In addition to the above sources, a data request was submitted to the Mississippi Natural Heritage Program (MNHP) to determine whether any federally protected species have been previously documented from the project site. For purposes of this investigation, Vittor & Associates utilized a 1,670-acre study area that included the 128-acre proposed plant site. MNHP performed a data search of records occuring within a 2-mile search distance surrounding the boundary of the larger tract.

FIELD SURVEY AND NATURAL COMMUNITIES

Field surveys of the property were performed on March 7, 8, and 21, 2007 to search for both federal and state protected species and to assess the natural communities and wildlife habitats found within the project boundaries. Topography on the site is characterized by undulating sand/clay hills with the maximum elevation reaching over 480 feet above sea level. The lowest elevations on the study area occur on the western edge of the property along the floodplain of the Chickasawhay River.

Historically, the property was most likely dominated by an upland mixed hardwood forest community based on the presence of remnant vegetation. Areas along the floodplain of Chickasaw River would have consisted of bottomland hardwood forest. A large majority of the property is now currently managed for timber production and is heavily impacted through logging activities. Based on our observations in the field and examination of 1996 aerial imagery of the site, we calculated that approximately 45 acres (~33%) of the property are planted in loblolly pine (*Pinus taeda*). Stand age was estimated to be between 15 to 20 years. Approximately 55 acres located on the southern portions of the study site have been recently clear cut and are regenerating in young sweetgum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), and wax myrtle (*Myrica cerifera*). Herbaceous and groundcover species present in this clear cut area include broom sedge (*Andropogon virginicus*), sawtooth blackberry (*Rubus argutus*), and slender woodoats (*Chasmanthium laxum*). An additional 30 acres of clear cut land occurs on the western and northern portions of the property with large areas converted into planted food plots for hunting. There is the remains of an old home site located on the north side of the entrance road leading into the subject property. The vegetation here is dominated by non-native species such as Chinese wisteria (*Wisteria sinense*) and Chinese privet (*Ligustrum sinense*) most likely naturalized from previous cultivation around the former home.

RESULTS AND FINDINGS

No federal or state protected species were observed during our survey. An electronic search of MNHP's Biological Conservation Database (BCD) performed on March 27, 2007 revealed no reports of any federally protected species from the project site nor were any protected species identifed within a two-mile search distance of the 1,670-acre study area. Since Price's potato bean has been previously documented from Kemper County, a specific request was made to identify the nearest element occurrence (EO) of *Apios priceana* in their database. According to MNHP records, the nearest EO in Kemper County is located approximately 25 air miles northeast of the project site and was last visited in 2001. Although no point locality data were provided for this EO, the general location would place the record in the extreme northeast corner of the county. An examination of the Environmental Protection Agency's Level IV Ecoregions of Mississippi (**Figure 2**; Chapman, et al. 2004) shows that this northeast portion of Kemper County contains two different Level IV ecoregions: Blackland prairie (65a) and Flatwoods/Blackland Prairie Margins (65B). The study site is located well outside of these ecoregions in the Southern Hilly Gulf Coastal Plain (65d) . Nearby populations of Price's potato bean in Mississippi and Alabama are not known to occur in this particular ecoregion and are restricted to the ecoregions found further north of the project site. Additionally, the project falls within the drainage basin for the Chickasawhay River for which there are not any known records of this protected species. Price's potato bean is not expected to occur within the project boundaries and suitable habitat for this species does not exist on the site (e.g. rocky woodlands with calcareous substrates).

No individuals of Red-cockaded Woodpecker were observed on the project site. Red-cockaded Woodpecker is a specialist of fire-maintained pine ecosystems (*i.e.* longleaf pine forest) of the Southeastern United States. The species typically requires old growth longleaf pine (*Pinus palustris*) for its breeding cavities, but other pine species have also been utilized (Conner *et al*., 2001). Large areas of the property are in commerical loblolly pine timber production and appear to lack the necessary old growth trees required for breeding (average stand age for planted loblolly pine was estimated to be between 15 & 20 years). Based on our field assessment, Red-cockaded Woodpecker is not likely to occur within the project boundaries and suitable habitat for Red-cockaded Woodpecker does not occur on the proposed plant site.

Bald Eagle is unlikely to occur as a breeder on the property, which lacks the large bodies of open water necessary for foraging. No eagles were seen during our field surveys of the property and the species is not expected to occur there.

STATE LISTED SPECIES

Black-knobbed map turtle (*Graptemys nigrinoda*)

Black-knobbed map turtle is found in rivers and streams with moderate current and sandy or clay substrates in the upper Tombigbee, Tibbee, Middle Tombigee-Lubbub river drainages in Alabama and Mississippi, all of which are outside of the Chickasawhay river basin (Natureserve, 2006; Ernst *et al*., 1994). This species is not expected to occur within the property boundaries of the study area.

Yellow-blotched map turtle (*Graptemys flavimaculata*)

Yellow-blotched map turtle is federally protected as a threatened species. This species is restricted to the Pascagoula River system and its associated tributaries. *G. flavimaculata* is typically found in "wide rivers with strong currents" with sandbars suitable for nesting (Ernst, et al. 1994). The species has been documented from the Upper Chickasawhay River basin as far north as Clarke County, Mississippi (Natureserve, 2006). There are no known occurrences of yellow-blotched map turtle from Kemper County, Mississippi, based on Natural Heritage Program records (Natureserve, 2006). Although the western property boundary of the 1,670-acre study area abuts portions of the Chickasawhay River, the species is not expected there.

Ringed map turtle (*Graptemys oculifera*)

This species is restricted to the Pearl River drainage system in Mississippi and Louisiana (Natureserve, 2006; Ernst *et al.* 1994). It is not found in the Chickasawhay River basin and is not expected to occur within the project boundaries.

Southern hognose snake (*Heterodon simus*).

The Mississippi Natural Heritage Program considers *H. simus* extirpated from the state with no recent records reported during 1983 -1998 (Natureserve, 2006). There are old records from Forrest, Pearl River, and Stone counties (Natureserve, 2006). Southern hognose snake is typically found in xeric sandhill communities with well-drained sandy soils (Natureserve, 2006) and these community types do not exist within the study area. It is not expected to occur within the project boundaries.

Black pine snake (*Pituophis melanoleucus lodingi*)

Black pine snake is a candidate species for Federal protection under the Endangered Species Act (ESA) This designation indicates that the USFWS has sufficient biological information to propose a particular species for listing under the ESA but such an action is precluded due to higher listing priorities. The species is also state protected in Mississippi. There are no known records of black pine snake from Kemper County and it has only been documented as far north as Marion and Lamar Counties in Mississippi (Natureserve, 2006). Black pine snake is not expected to occur on the property.

Rainbow Snake (*Farancia erytrogramma*)

Rainbow snake is state-protected in Mississippi. Ernst & Ernst (2003) considered this species endangered in the state. Rainbow snake is not federally protected under the Endangered Species Act. This secretive snake is typically found along "coastal plain waterways" such as "rivers, streams, canals, lakes, swamps and tidal and freshwater marshes" of the southeast (Ernst & Ernst, 2003). Conant and Collins (1998) state that it appears to prefer swamp with bald cypress (*Taxodium distichum*). Natureserve (2006) only lists records from as far north as Lamar County in Mississippi. Suitable habitat for rainbow snake does not occur within the project boundaries and it is not expected to occur there.

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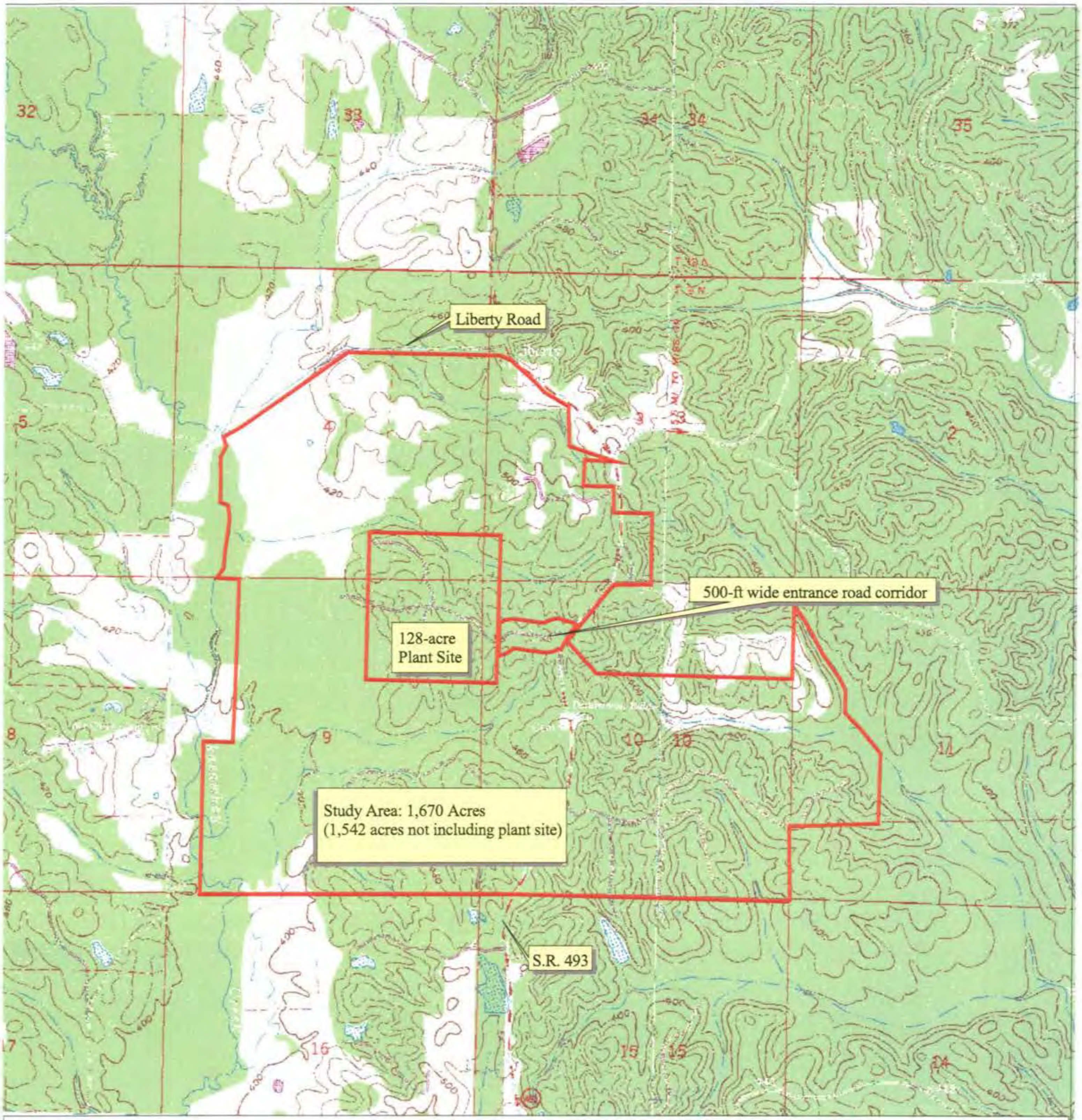

Figure 1: Site Location and Vicinity Map

Base Maps: Moscow and Lauderdale, NW, MS USGS topographic quadrangles.

Ecoregions of Mississippi

PRINCIPAL AUTHORS: Shannon S. Chapman (Dynamac Corporation), Glenn E. Griffith (Dynamac Corporation), James M. Omernik (USEPA, retired), Jeffrey A. Comstock (Indus Corporation), Michael C. Beiser (MS DEQ), and Delaney Johnson (NRCS).

COLLABORATORS AND CONTRIBUTORS: Jim Harrison (USEPA), Mike Lilly (NRCS), Mike Bograd (MS DEQ), Larry Handley (USGS), Barb Kleiss (USACE), Alice Dossett (MS DEQ), Katherine Williams (MS DEQ), Chip Bray (MS DEQ), and Tom Loveland (USGS).

REVIEWERS: David Beckett (University of Southern Mississippi), J. Stephen Brewer (University of Mississippi), David Dockery (MS DEQ), Jerry Griffith, (University of Southern Mississippi), George Martin (NRCS), Robert Wales (University of Southern Mississippi), and Ron Wieland (Mississippi Natural Science Museum).

CITING THIS POSTER: Chapman, S.S., Griffith, G.E., Omernik, J.M., Comstock, J.A., Beiser, M.C., and Johnson, D., 2004, Ecoregions of Mississippi, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).

This project was partially supported by funds from the Mississippi Department of Environmental Quality through grants provided by the U.S. Environmental Protection Agency Region IV under the provisions of Section 319(h) of the Federal Water Pollution Control Act.

For additional information about ecoregions, see http://www.epa.gov/wed/pages/ecoregions/ecoregions.htm. Digital files of the Mississippi ecoregion boundaries can be downloaded from ftp://ftp.epa.gov/wed/ecoregions/ms.

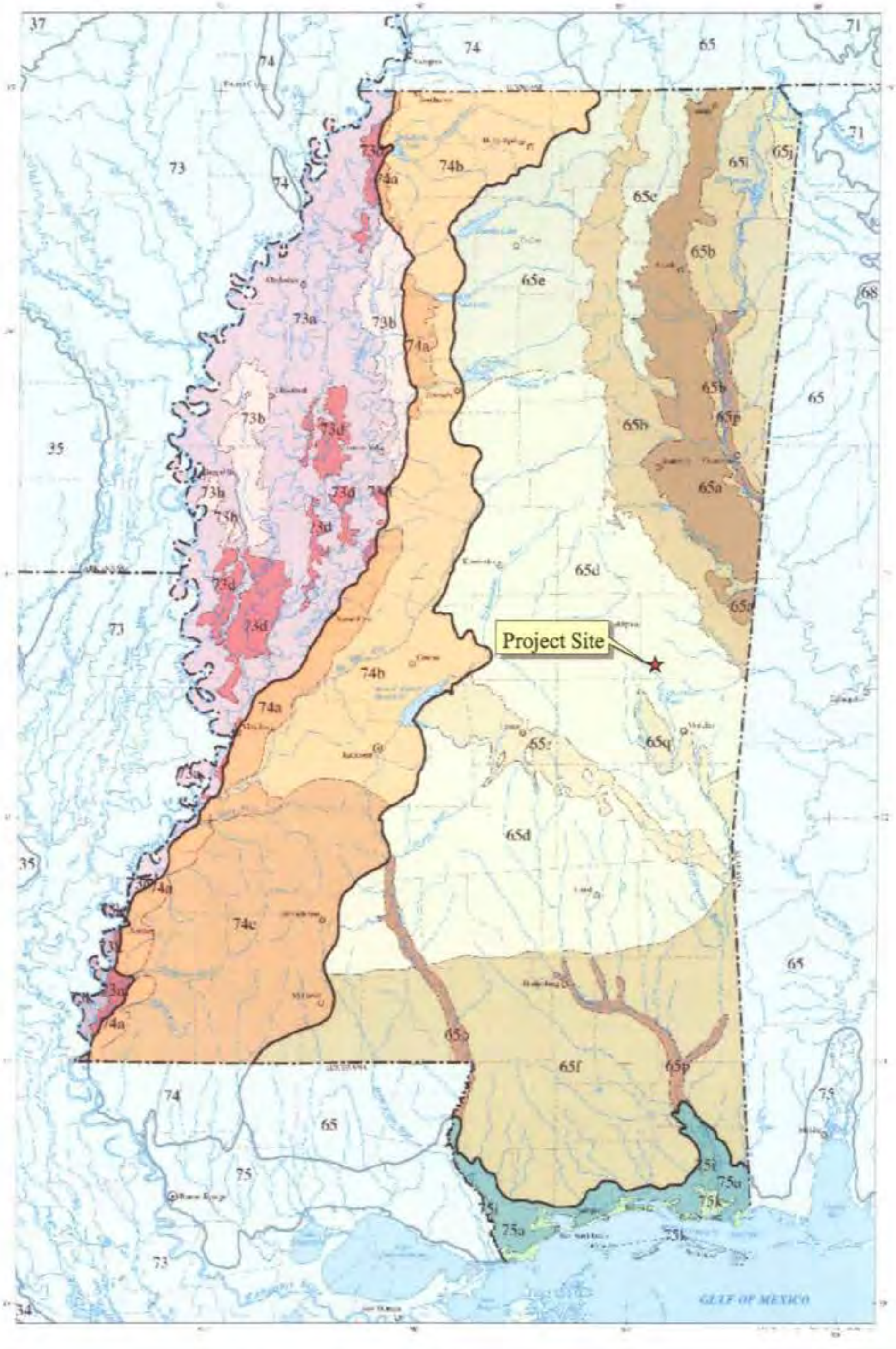

Figure 2: Location of Project Site overlaid on the Level IV Ecoregions of Mississippi.

APPENDIX A

Text & map by:
Robert Kral

FABACEAE

Apios priceana B. L. Robinson. Price's groundnut
Glycine priceana (Robinson) Britton

Technical Description

Herbaceous perennial, sometimes rampant, vine from a stoutish, thickened tuber.
Stems.--TWining, also somewhat twisted, terete and also low-ridged, yellow-green or tan, smooth or with a scattering of stiff hairs, forming a large vine.
Leaves.--Alternate, the stipules linear with a round attachment scar, odd-pinnately compound, mostly 2-3 dm long, spreading on slender but stiff, sparingly pubescent petioles one-third to one-half the length of the leaf; leaflets on stalks 3-5 mm long, spreading, 5-9, mostly 7, broadly to narrowly ovate, the lowest pair usually the largest, acuminate, entire, the bases rounded, the upper surface at maturity smooth, dark yellow-green, reticulate, the lower surface paler, puberulent, reticulate-veiny.
Inflorescence.--All but the lower leaves bearing rather compact panicles or racemes 5-9 cm long on stout, hairy stalks 3-4 cm long. Flowers one or more in axils of pale green, ovate, hairy, acuminate bracts, on pedicels 3-5 mm long, in total length ca. 2 cm.
Flowers.--Calyx a thin, pale green, villous cup ca. 3-4 cm high, this bearing at its lower edge a very narrow projecting lobe ca. 3 mm long. Corolla as in pea or bean, brownish-green with maroon tints, when viewed from the side strongly curved outwardly below, concave on the keeled greenish-yellow or pink standard blade above, this blade folded over most of the rest of the corolla and longest, its tip fleshier than the rest, beak-like, its base short-auricled; wings oblong linear, short-clawed, each bearing a short auricle basally; keel petals rather fleshy, strongly curved upward and linear, blunt, short clawed.
Fruit.--Pods 13-20 cm long, linear, somewhat turgid, the base cuneate, the apex abruptly attenuated into a prominent slender beak, the surface smooth, the valves firm with somewhat thickened margins. Beans oblong, smooth, dark brown, 7-8 mm long.

Distribution and Flowering Season

Rocky wooded slopes and floodplain edges, middle Kentucky southward through middle Tennessee into northern Alabama and Mississippi. Flowering from late June into August; fruit maturing in August.

Special Identifying Features

This plant is distinguished from *A. americana* Medic as follows:

1. The leaves are larger, the leaflets usually with one pair more.
2. The standard petal (uppermost petal) is larger, pink or with yellow-green tints rather than purple-maroon (as in *A. americana*), bearing at its tip a thickened, mucro-like appendage. In *A. americana*

the standard tip is blunt, even emarginate.
3. The fruits are longer, with the shorter ones about equal to the longest ones produced by A. americana.

Habitat and Management Implications

A. priceana is usually found under mixed hardwoods or in clearings therein, usually where ravine slopes or banks break into creek or river bottoms. It is on well-drained loams either on old alluvium or over calcareous boulders.

This is such a rare plant that little is yet known for sure of its response to disturbance, grazing, etc. It has been collected in secondary growth hardwood forest, thus is known to survive in the wake of logging. I have observed it in an area of recent burning and it may be conceded that it may react well to fire disturbance as do many other leguminous plants that have large tuberous rootstocks (Gleason, 1952, measured some rootstocks to be 18 cm wide!) However, the very rarity of the plants is an indication that this species has a narrow ecological amplitude.

References

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Small, J.K. 1933. Manual of the southeastern flora, p. 723. Chapel Hill, N.C.

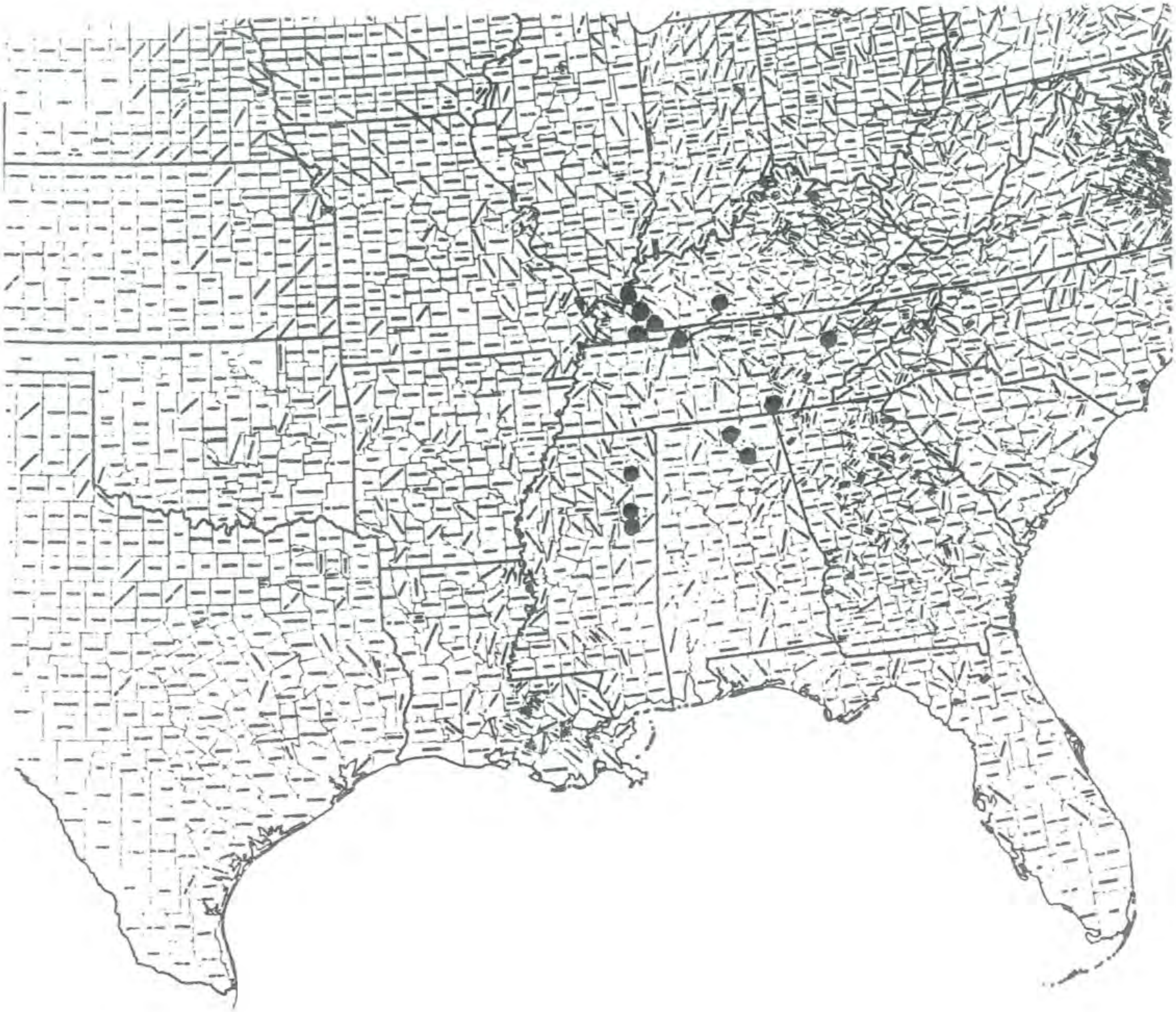
SPECIES Apios priceana B.L. Robinson

Expected* Effect on the Species	Management Practices							
	Prescribe Burn	Bulldoze or Root Rake	Bed	Chop	Thin over-story	Cut over-story	Establish Plantation	Graze
Destroy		X	NA	NA				
Damage					X	X		?
No Lasting Effect								
Beneficial if Done Properly	X							

Other Comments:

*Expected effect on the species is an estimate made by Dr. Robert Kral based on his knowledge of the habitat and on knowledge gained from personal field observations. Estimates are "rough" in many instances. Results of practices may be modified depending upon the degree of application, intensity of treatment, nearness to plant communities, etc. A management practice for which no entry is made indicates a lack of sufficient information from which to predict expected results. As observations are made in the field by users of the data, the expected effect will be refined.

<u>Apios</u> <u>priceana</u> B. L. Robinson



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Apios priceana - B.L. Robins.
Price's Potato-bean
Unique Identifier: ELEMENT_GLOBAL.2.138209
Element Code: PDFAB0D020
Informal Taxonomy: Plants, Vascular - Flowering Plants - Pea Family

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Kingdom	Phylum	Class	Order	Family	Genus
Plantae	Anthophyta	Dicotyledoneae	Fabales	Fabaceae	Apios

Check this box to expand all report sections: ☑

Concept Reference

Concept Reference: Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.
Concept Reference Code: B94KAR01HQUS
Name Used in Concept Reference: *Apios priceana*
Taxonomic Comments: One of the two U.S. species in this small genus.

Conservation Status

NatureServe Status

Global Status: G2
Global Status Last Reviewed: 09Jul2004
Global Status Last Changed: 25Jul1983
Rounded Global Status: G2 - Imperiled
Reasons:
Currently known from about 25 widely scattered populations, most with fewer than 50 individuals. *Apios priceana* is apparently dependant on a moderate level of disturbance; however, excessive habitat modification is threatening the existence of the species. Many of these few remaining occurrences are threatened by successional canopy closure, cattle grazing/trampling, right-of-way maintenance and forestry activities.
Nation: United States
National Status: N2

U.S. & Canada State/Province Status	
United States	Alabama (S2), Illinois (SX), Kentucky (S1), Mississippi (S1), Tennessee (S2)

Other Statuses

U.S. Endangered Species Act: LT: Listed threatened (05Jan1990)
U.S. Fish & Wildlife Service Lead Region: R4 - Southeast

Comments on official statuses: Apios priceana was proposed threatened on May 12, 1989 and federally listed as a Threatened species by the U.S. Fish and Wildlife Service on January 5, 1990.

NatureServe Conservation Status Factors

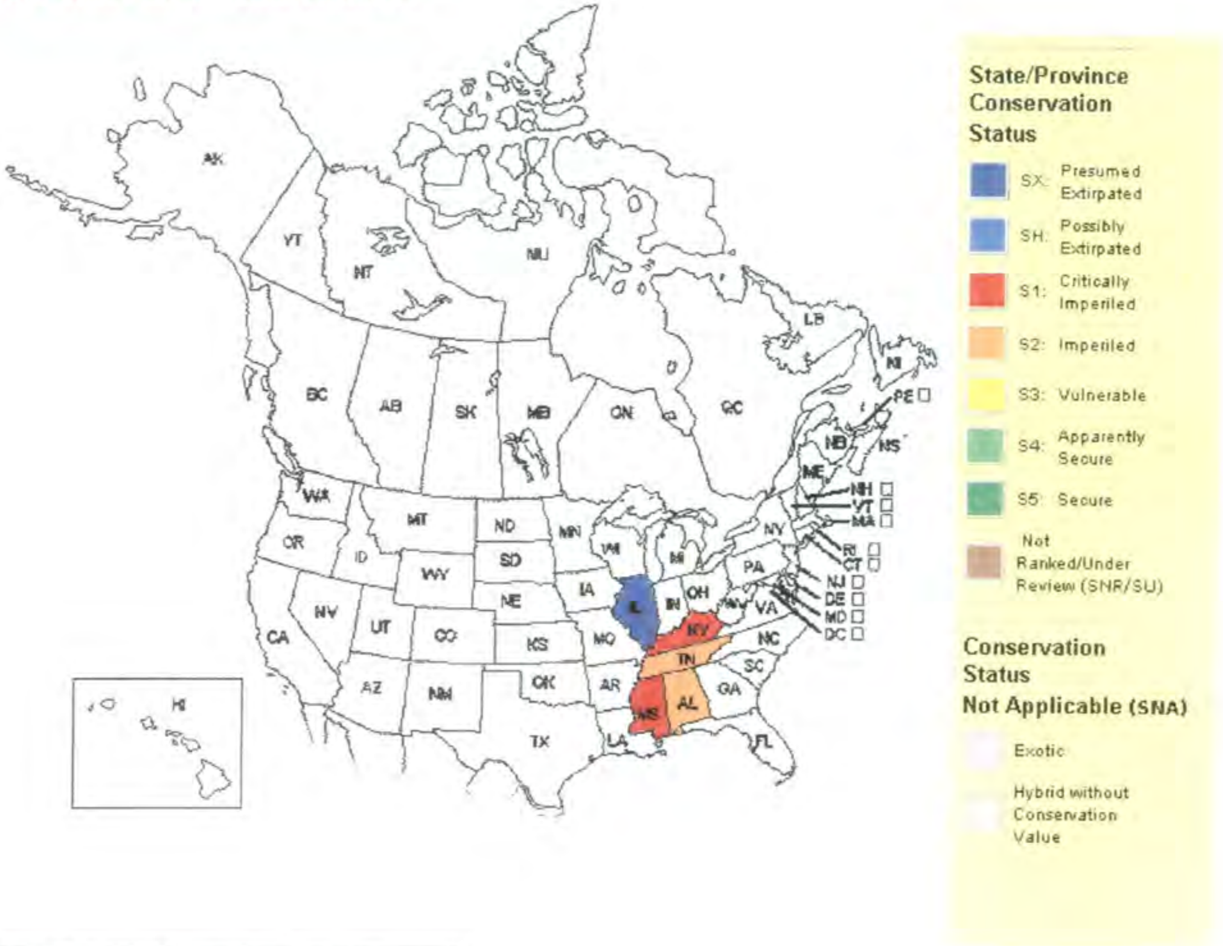
Degree of Threat: Widespread, low-severity threat
Threat Scope: High
Threat Severity: Low
Threat Immediacy: Unknown

Threats: Habitat loss and degradation from heavy or clear-cut logging, highway right-of-way maintenance, trampling and soil compaction by cattle are threats to this early successional species (Bender pers comm., Norquist 1990, USFWS 1989, Medley 1980). Development of lands for housing or other uses is a potential threat to occurrences of this species (Medley 1980). Brush-clearing (bush-hogging) during the growing season, line replacement and upgrading are additional threats to some sites (Bender pers. comm.). Some sites are threatened by non-native invasive species.

Threats at the Trigg County, Kentucky, sites include trampling by hikers, overcrowding by shrubs, canopy closure, mowing, highway maintenance and competition from introduced crown vetch (Coronilla varia) (Chester and Holt 1990). Succession is considered a major threat at some sites (Norquist 1990).

Distribution

U.S. States and Canadian Provinces



U.S. & Canada State/Province Distribution	
United States	AL, IL►, KY, MS, TN

Range Map
No map available.

Global Range Comments: Mississippi (Clay, Oktibbeha and Lee counties); Alabama (Madison, Autsuga and Marshall counties); Kentucky (Lyon, Livingston and Trigg counties); Tennessee (Marion, Montgomery and Williamson counties). Historic in Illinois.

U.S. Distribution by County (based on available natural heritage records)	
State	County Name (FIPS Code)

AL	Autauga (01001), Dallas (01047), Jackson (01071), Lawrence (01079), Madison (01089), Marshall (01095)
KY	Calloway (21035), Livingston (21139), Lyon (21143), Marshall (21157), Trigg (21221)
MS	Clay (28025), Kemper (28069), Lee (28081), Oktibbeha (28105)
TN	DeKalb (47041), Giles (47055), Hickman (47081), Marion (47115), Maury (47119), Montgomery (47125), Stewart (47161), Williamson (47187)

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	**Watershed Name (Watershed Code)**
03	Upper Alabama (03150201), Middle Alabama (03150203), Town (03160102), Tibbee (03160104), Noxubee (03160108)
05	Caney (05130108), Harpeth (05130204), Lower Cumberland (05130205), Lower Ohio-Bay (05140203), Lower Ohio (05140206)
06	Sequatchie (06020004), Guntersville Lake (06030001), Wheeler Lake (06030002), Lower Elk (06030004), Lower Duck (06040003), Buffalo (06040004), Kentucky Lake (06040005)

Ecology & Life History

Technical Description: Plant a herbaceous, twining, perennial vine, to 5 m, scrambling over other vegetation, arising from a large, starchy underground tuber. Stems slender, twining, round in cross-section, ridged; green or tan, smooth or with scattered, stiff hairs. Leaves alternate, 0.6-1 foot long, composed of 5-9 (mostly 7) ovate leaflets; the lowest pair of leaflets usually the largest. Leaflets entire-margined, with rounded bases and narrowed points, widest below the middle, the upper surface smooth at maturity, dark yellow-green, net-veined, the lower surface paler, fine-hairy; tiny (but evident) rusty-brown hairs on the short stem at the base of each leaflet. The flowers are swollen, greenish-pink with maroon tints and a beak-like tip. They are arranged in compact racemes, on stout hairy stalks, in the axils of pale green, ovate, hairy, pointed bracts. Fruit an elongated legume, 5-8 inches long, somewhat swollen, abruptly narrowing into a slender beak. The seeds are oblong, smooth, dark brown, and about 0.3 inch long.

Diagnostic Characteristics: This species most closely resembles Apios americana (= A. tuberosa), from which it is distinguished by the following characteristics: (a) larger leaves, usually with 7 rather than 5 leaflets; (b) the uppermost petal (standard) has an elongated tip, is larger, and is pink with green tints rather than maroon; (c) the fruits are longer, the shortest ones similar in length to the longest ones in A. americana. Wisteria is similar, but can have more leaflets (5-11) which are all about the same size and widest in the middle (in contrast to those of Apios); the leaf rachis of Wisteria is hairy, and its flowers are purple and bloom in the early spring.

Reproduction Comments: Flowers of A. priceana bloom from June through August, possibly as late as September (Kral 1983, Mahler 1970). Legumes mature in August to September (Kral 1983). Early reports by the discoverer of the species, Sadie Price, suggested that it does not frequently set fruit (Robinson 1898).

Ecology Comments
Unlike its close relative, Apios americana, which produces numerous tubers, A. priceana produces only one. This fact may serve to severely limit natural dispersal of the species. Since A. priceana has just the single tuber, it is unable to be dispersed effectively along rivers by spring freshets as is A. americana (Seabrook and Dionne 1976).

Apios priceana has a potential value to humans as a food source (USFWS 1989). The large single tubers from which the plant grows are edible and may have been used by Native American Indians and early settlers as food, as was Apios americana. The ability of the species to grow in highly alkaline (pH > 8.0) and acidic (pH < 5.0) (Duke 19) soils could provide genetic resources for the development of Apios hybrids in cultivated lands otherwise marginal for most other crops (USFWS 1989, Walter et al. 1986). Perhaps the most valuable aspect of A. priceana is as a source of germ plasm for breeding with other Apios species (Norquist 1990, Walter et al 1986).

According to a recent study of A. priceana (Walter et al. 1986), the tubers were found to be composed of 61.9% water, 5.0% fiber, 2.6% crude protein, 2.7% ash, 27.1% carbohydrate and 0.7% fat. For a compositional comparison of A. priceana tubers with those of A. americana and A. fortunei, see Walter et al. (1986). As a food crop, A. priceana tubers are naturally low in essential amino acids. Extraction of nonprotein nitrogen by alcohol resulted in tuber protein that could be useful in human nutrition (Walter et al. 1986).

Open forest canopies tend to correlate with increased flowering in the species (Somers pers. comm.). Flowers of A. priceana bloom from June through August, possibly as late as September (Kral 1983, Mahler 1970). Legumes mature in August to September (Kral 1983). Early reports by the discoverer of the species, Sadie Price, suggested that it does not frequently set fruit (Robinson 1898). Potential pollinators include a butterfly (Eudamus tityrus), honey and bumble bees (Robinson 1898). Apparently the bees find the nectaries very difficult to access. Apios priceana can be readily germinated by scarification of the seed coat through chipping (Seabrook 1973) or acid (Walter et al. 1986).

Apios priceana is apparently quite easy to grow from seed, but requires scarification or other natural processes to break physical dormancy (Baskin pers. comm.; Bowden pers. comm.). Following scarification, 18 of 20 seeds planted 1 cm deep in soil grew in a recent test in Kentucky (Baskin pers. comm.). Scarification can be accomplished through a nick with a file, grinding wheel, hot water or sulfuric acid (Bowden pers. comm.). Plants can grow 5-6 feet during the first summer, but do not flower. Flowering is apparently initiated only in plants that have over-wintered (Baskin pers. comm.).

Tubers of A. priceana apparently require vernalization for growth (Bowden pers. comm.). Plants die back to the tuber in the mid-summer.

Additional research has been conducted on A. priceana for horticultural purposes. According to the Missouri Botanical Garden, A.

priceana prefers acidic, water retentive soils, requires no soil additives, can withstand winter temperatures below 5 degrees Celsius, shows no intolerance to supplemental feedings, and possesses no apparent pests (Bowden pers. comm.). The species has been successfully propagated.

Habitat Comments: Open, rocky, wooded slopes and floodplain edges. Sites are usually under mixed hardwoods or in associated forest clearings, often where bluffs or ravine slopes meet creek or river bottoms. Soils are well-drained and loamy, formed on alluvium or over calcareous boulders. Several populations extend onto road or powerline rights-of-way.

Price's potato-bean is an inhabitant of open, mixed-oak forests, forest edges and clearings on river bottoms and ravines, being unable to tolerate deep shade (USFWS 1989, Kral 1983). The species occurs on well-drained loams on old alluvium or over calcareous boulders (Kral 1983). Associates typically include Quercus muhlenbergii, Campanula americana, Lindera benzoin, Arundinaria gigantea, Tilia americana, Fraxinus americana, Acer saccharum, Ulmus rubra, Cercis canadensis, Toxicodendron radicans and Parthenocissus quinquefolius (Medly 1980).

Four extant populations of A. priceana are known from Kentucky. The type location near Bowling Green, Warren County, Kentucky, was characterized as a rocky woods (Robinson 1898); it has been destroyed. A population in Livingston County (estimated at 50-65 plants in 1984) has been severely degraded by cattle since their introduction into the area in 1986 (Norquist 1990). Additional collections in Kentucky have been made in Lyon and Trigg counties (Chester and Holt 1990, Browne and Athey 1976). The Lyon County site consisted of 25-30 individuals, extending onto a right-of-way (Norquist 1990).

The Hematite Lake site in northern Trigg County, Kentucky, was relocated by Woods (1985) and later by Chester and Holt (1990). The population had been considered extirpated (Medley 1980). This site is along a hiking trail at the base of a southeast-facing slope with numerous limestone outcrops (Chester and Holt 1990). The population consisted of 25 plants in 1989, but no plants were observed to set seed in that year. Associates included Arundinaria tecta, Symphoricarpos orbiculatus, Acer saccharum, Celtis laevigata, C. occidentalis, Carya ovata, Ulmus rubra, Quercus muehlenbergii, Ostrya virginiana, Amphicarpa bracteata, Hystrix patula, Solidago rugosa, Matelea gonocarpos, Agrimonia rostellata, Lobelia inflata and a species of Panicum (Chester and Holt 1990). The southern Trigg County, Kentucky, site (previously unseen since 1966) was rediscovered by Chester and Holt (1990). A population of 30-50 plants occurs at the base of a southeast-facing slope with numerous limestone outcrops, in a roadside ditch that is fairly open to light (Chester pers. comm., Chester and Holt 1990). In 1989, at least 15 mature legumes were produced by this population. Associates include Spigelia marilandica, Cimicifuga racemosa, Campanula americana, Geum canadensis, Anemone virginica, Lactuca canadensis, Melilotus officinalis, Rudbeckia triloba, Ptela trifoliata, Fraxinus americana, Morus rubra, Cercis canadensis, Carpinus caroliniana, Ostrya virginiana, Quercus muehlenbergii, Acer saccharum and Ulmus rubra (Chester and Holt 1990).

Tennessee has four extant sites of A. priceana. All occur in soils overlying limestone bedrock in the Highland Rim physiographic region or the Sequatchie Valley, which drains into Alabama (Somers pers. comm.). Associated vegetation varies considerably between sites, but all sites are close to streams or rivers. Western mixed mesophytic forest is present at two of the sites, while a third is present on a bluff. The largest population is in an area recovering from a recent clear-cut operation (Somers pers. comm.). Populations are known from Marion, Montgomery and Williamson counties (Norquist 1990).

Four extant sites occur in three counties in Mississippi: Clay, Oktibbeha and Lee (Norquist 1990). At Kilgore Hills (Clay County), 15-20 plants occur on the banks of a prairie stream. The population occurs on clay alluvial soil over the Demopolis Formation. Soil pH varies between 6.6 and 8.4. The Coonewah Creek (Lee County) and Ray's Woods (Oktibbeha County) sites occur in mixed deciduous forest on a calcareous north-facing slope above the broad expanse of the northeast Prairie Belt. The soil at both sites is a marly clay underlain by a thick bed of a white marine chalk deposit. At both sites the soil pH varies between 7.4 and 8.4 (Medley 1980). For site-specific information pertaining to associated species, see Medley (1980).

Three extant populations are known from Alabama in Madison, Autsuga and Marshall counties (Norquist 1990). Two of the populations are located along the floodplain of the Alabama River (Gunn pers. comm.).

A single population occurred along a swamp border in a federal ecological area in Illinois, but this population has been destroyed. The area has been searched repeatedly with no positive results (Karnes pers. comm.). Ebinger (1981) stated that the habitat of the species in the state was floodplain forests and thickets of the Lower Mississippi River.

Economic Attributes

Not yet assessed

Management Summary

Stewardship Overview: Management techniques to provide long-term survival for the species will need to center around the maintenance of natural openings in the forest canopy brought on by prescribed fire, forest thinning or logging. Monitoring should be done to track population size and stability, fruit production, seed set and recruitment. Changes in these factors with respect to other vegetation and canopy closure are also in need of monitoring.

Restoration Potential: Apios priceana is currently being cultivated at the Missouri Botanical Garden (Pickering 1989). Information gained from the cultivation of Price's groundnut at this and other sites (such as the University of Kentucky) will prove important in the long-term recovery of the species. Early results indicate that seeds from the plant are relatively easy to germinate upon scarification. First-year plants grow rapidly, often reaching 5-6 feet in height during the first year.

Preserve Selection & Design Considerations: Land protection must include land occupied by the primary population as well as adequate buffer to protect the site from outside influences (pesticide drift, etc.). Protection of only the immediate population may lend it susceptible to a number of potential threats.

Management Requirements: Precise management needs are poorly known at this time. Maintenance of natural openings, possibly via artificial cutting or prescribed fire, have been suggested by some authorities. Apios priceana is apparently able to withstand light, selective logging (Kral 1983), but whether this is a suitable management alternative is unknown. It has been suggested that light logging may enhance the species, while heavy clear-cut logging would destroy populations (Kral 1983, Medley 1980). The species may require specific seral stages or seasonal disturbances to arrest succession (Norquist 1990). Determination of precise habitat requirements through research is needed in order to suggest adequate management options.

Protection of the population from excessive grazing and trampling, as well as herbicide application is recommended. Presently, some populations are suffering from the adverse affects of grazing, while potential herbicide application threatens others.

Kral (1983) stated that A. priceana has been observed in secondary forests, suggesting that it is able to survive logging. He also observed that it reacted well to fire disturbance, as do many legumes with tuberous rootstalks. The rarity of the species suggests that it has a narrow ecological amplitude (Kral 1983), so management tolerance levels must be known prior to the undertaking of management options.

Bulldozing or root raking are believed to destroy the plant (Kral 1983). Thinning or cutting of the overstory may possibly damage A. priceana plants if done during the growing season. If undertaken, these methodologies should only be utilized when the plant is dormant.

Monitoring Requirements: Development of adequate monitoring techniques is a need at all sites (Somers pers. comm.). Monitoring should asses the actual number of plants in each extant population over time. Fruit production, seed set and recruitment also should be monitored (Bender pers. comm.). Monitoring should be considered on at least a five-year cycle. Many managers might wish to consider more extensive annual or biennial monitoring programs.

Habitat monitoring is also a major need. Apios priceana is intolerant of excessive canopy shading and competition. Canopy closure should be monitored to determine when canopy thinning or other management activities should be instituted.

Due to the relatively large size of this vine, counts of all individuals would be relatively easy to complete and should be undertaken on a periodical basis. Fruit production, seed set, and recruitment should be documented during the visit. For ease of monitoring, visits should coincide with that of fruit set. Locations of individuals should be mapped on a base map in order to determine life span, recruitment and death rates.

Canopy closure should be monitored on an annual basis using a wide-angle or similar photographic lens. Photographs of the canopy immediately above the population should help determine the extent to which closure is tolerated by the species, as well as the optimal time for appropriate management options.

Management Programs: The two Trigg County, Kentucky, sites occur within the Land Between The Lakes management area of the Tennessee Valley Authority (TVA). The area is designated as a multiple-use facility for recreation, education and conservation activities (Chester and Holt 1990). Contact: Beth Wellbaum, TVA Forester. Telephone No. (502) 924-5602; OR, Dr. Leo Collins, TVA Stewardship Program Botanist, Norris, TN. Telephone No. (615) 494-9800.

After acquisition of the Lyon County site in Kentucky, the State Nature Preserves Commission intends to open the canopy in several areas near the species' present location. Attempts to grow plants from seeds collected at the site, followed by introduction into new openings are also considered. All activities will have the approval of the USFWS prior to implementation. Contact: Joyce Bender, Stewardship Coordinator, Kentucky Heritage Program, KY Nature Preserves Commission, 407 Broadway, Frankfort, KY 40601. Telephone No. (502) 564-2886.

Barnett's Woods Preserve in Tennessee, owned by The Nature Conservancy, protects two element occurrences. At present, no specific management is being conducted for the species. Contact: Geoff Roach, Director of Protection Planning and Stewardship, Tennessee Field Office, The Nature Conservancy, P.O. Box 3017, Nashville, TN 37219. Telephone No. (615) 242-1787.

Monitoring Programs: The Kentucky State Nature Preserves Commission is currently pursuing the purchase of 140 acres in Lyon County to protect the species (Bender pers. comm.). The stem count of the population will be conducted in the summer of 1990 if the site has not been purchased by the time of flowering. Contact: Joyce Bender, Stewardship Coordinator, Kentucky Heritage Program, KY Nature Preserves Commission, 407 Broadway, Frankfort, KY 40601. Telephone No. (502) 564-2886.

The Tennessee Field Office of The Nature Conservancy will hire an independent contractor for the collection of ecological and biological information pertaining to A. priceana at one of its preserves. Duties will include: (1) identification of the community associated with A. priceana, (2) mapping, inventory and monitoring of A. priceana populations, and (3) generation of two reports. Monitoring will include the assessment of growth rates, flowering period, flower number, inflorescence number, seed set, fruit/seed ratio, average rainfall, soil moisture, relative humidity and competition. Contact: Geoff Roach, Land Steward, The Nature Conservancy of Tennessee, P.O. Box 3017, 174 Second Avenue N., Nashville, TN 37219. Telephone No. (615) 242-1787.

The Mississippi Natural Heritage Program does not have an active monitoring program for the species, but does determine if the habitat and the species are still present (Gordon pers. comm.). They continue to maintain contact with the private landowners who possess populations. Contact: Ken Gordon, Coordinator/Botanist, Mississippi Natural Heritage Program, Museum of Natural Science, 111 N. Jefferson St., Jackson, MS 39201-2897. Telephone No. (601) 354-7303.

Management Research Programs: Geoff Roach, Tennessee Field Office of The Nature Conservancy, and Drs. Carol Baskin, Jerry Baskin and Ed Chester are considering doing some life-history research on Apios priceana. Contact: Geoff Roach, Director of Protection Planning and Stewardship, Tennessee Field Office, The Nature Conservancy, P.O. Box 3017, Nashville, TN 37219. Telephone No. (615) 242-1787.

Carol Baskin is currently growing 18 plants in a greenhouse, some of which will be planted at TVA's Land Between the Lakes visitor center. Seed germination has been studied, but insufficient amounts of seed are available for adequate studies regarding flowering requirements and germination phenology. It is hoped that seed produced from the plants at the Land Between the Lakes visitor center will help facilitate these future studies. Contact: Dr. Carol Baskin, University of Kentucky, Lexington, KY. Telephone No. (606) 257-3996.

The Tennessee Ecological Services Division has received Section 6 money from the USFWS to search for additional populations this summer (1990). Contact: Paul Somers, ESD, Tennessee Department of Conservation, 701 Broadway, Nashville, TN 37219-5237. Telephone No. (615) 742-6549.

The Missouri Botanical Garden is currently propagating the species, but no active research is being conducted or is planned for the species. At present, plants are growing on a wall in the Scented Garden as well as six plants in the nursery. Additional plants in the Woodland Garden have died, and research will need to be conducted to determine the reason for death. Plants in the nursery may be used to replace those that died in the Woodland Garden. Contact: Robert Bowden, Director of Horticulture, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166. Telephone No. (314) 577-5189.

Biological Research Needs:

Population/Occurrence Delineation

Alternate Separation Procedure: Use the Habitat-based Plant Element Occurrence Delimitation Guidance (2004).
Date: 01Oct2004

Population/Occurrence Viability

Excellent Viability: An A-rated occurrence of *Apios priceana* is a population that contains 150 or more plants in a mature, relatively undisturbed forest. Ideally the occurrence should be well insulated from potential anthropogenic disturbance where the habitat is characterized by a partially shaded forest with no or minimal influence (< 10 %) by exotic and/or native invasive species.

Good Viability: A B-rated occurrence of *Apios priceana* is a population that contains 50 to 149 plants in a mature, relatively undisturbed forest. Ideally the occurrence should be well insulated from potential anthropogenic disturbance where the habitat is characterized by a partially shaded forest with no or minimal influence (< 10 %) by exotic and/or native invasive species. B-rated specifications also apply to larger occurrences having a greater affluence (to 30 %) of invasive species, logging, and/or development. Easily restored to A-rated conditions.

Fair Viability: A C-rated occurrence of *Apios priceana* is a population that contains 10 to 49 plants in a mature, relatively undisturbed forest. Ideally the occurrence should be well insulated from potential anthropogenic disturbance where the habitat is characterized by a partially shaded forest with no or minimal influence (< 10 %) by exotic and/or native invasive species. C-rated specifications also apply to larger occurrences having a moderate to high affluence (to 75 %) of invasive species, timber harvesting, and/or development. Restoration potential to A- and B-rated specifications is good.

Poor Viability: A D-rated occurrence of *Apios priceana* is a population that contains less than 10 plants in a mature, relatively undisturbed forest. D-rated specifications also apply to larger occurrences in highly modified habitat with minimal or no restoration potential.

Justification: Specifications are based on Element Occurrence Records, academic publications (namely USFWS), personal observations, and expert opinions. Currently limited research is being conducted on this species but no information outlining population dynamics and viability has been published. As new information becomes available, EO specs should be reassessed and updated.
Date: 04Jan2005
Author: Schotz, Alfred

U.S. Invasive Species Impact Rank (I-Rank) Not yet assessed

Authors/Contributors

NatureServe Conservation Status Factors Edition Date: 10Jul1990
NatureServe Conservation Status Factors Author: Ostlie, Wayne MRO; rev. Pyne/Maybury, 1996.
Management Information Edition Date: 30Jun1990
Management Information Edition Author: WAYNE OSTLIE

Botanical data developed by NatureServe and its network of natural heritage programs (see Local Programs), The North Carolina Botanical Garden, and other contributors and cooperators (see Sources).

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Note: Ecological systems data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **February 10, 2007**. All other data were updated as of **October 6, 2006**.
Note: This report was printed on **March 28, 2007**

Citation for data on website including Watershed and State Distribution maps:
NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: March 28, 2007).

Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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"Data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy - Migratory Bird Program, Conservation International - CABS, World Wildlife Fund - US, and Environment Canada - WILDSPACE."

Citation for Mammal Range Maps of North America:

Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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NOTE: Full metadata for the Bird Range Maps of North America is available at: **http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.**

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Version 6.1 (9 November, 2006)
Ecological systems data last updated:
February 10, 2007
All other data last updated: October 6, 2006

WETLAND ASSESSMENT OF THE INTEGRATED GASIFICATION COMBINED CYCLE GENERATING STATION IN KEMPER COUNTY, MISSISSIPPI

Prepared for

MISSISSIPPI POWER COMPANY
2992 WEST BEACH BOULEVARD
GULFPORT, MISSISSIPPI 39501

Prepared by

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

(Contract No. BSU 0067717)

October 2, 2007

INTRODUCTION

Barry A. Vittor & Associates, Inc. (Vittor & Associates) was contracted by Mississippi Power Company to conduct surveys of wetlands within the 1,650-acre Integrated Gasification Combined Cycle (IGCC) generating station site in Kemper County, Mississippi. Specifically, the site is located in Sections 3, 4, 9, and 10, Township 9N, Range 15E, on the Moscow, MS USGS 7.5-minute Quadrangle. Site locator maps are attached.

Vittor & Associates' initial wetland assessment of the IGCC property involved detailed delineation and mapping of jurisdictional wetlands within the initial 128-acre core site (Figure 1) in March, 2007. Subsequent to the March delineation, approximately 622 acres surrounding the original survey area in Sections 3, 4 and 10 were surveyed for presence of jurisdictional wetlands in July and August, 2007. Mississippi Power requested the additional survey to determine whether wetland impacts could be avoided by shifting the plant location to the north of the original site and away from the Chickasawhay River. The remaining wetland acreage, to the south of the original survey site, was estimated using information gathered through field groundtruthing by collecting GPS data at numerous predetermined locations that were chosen by referencing county soil maps, USGS topographic quadrangle maps for the area, and available aerial photography. Using that methodology, Vittor & Associates determined that wetlands occupy approximately 462 acres (~30%) of the total 1,650-acre study area.

The second set of field studies was performed by Terry Whitehurst, Howard E. Horne, Josh Everett, and David Knowles of Vittor & Associates.

GENERAL CHARACTERISTICS OF THE OVERALL STUDY AREA

Various land use activities occur throughout the property. The study area consists of undeveloped woodlands, managed pine timberlands, open fields and grazing pastures, and light residential development. Wetlands throughout the study area are associated with tributaries to Chickasawhay Creek.

The 1,650-acre plant site is comprised for the most part, of managed pine timberlands in the uplands and mixed hardwood forest in the wetlands. Large portions of uplands on the site had been clear-cut at the time of this survey. The property is also presently being managed for deer and turkey hunting and numerous food plots were distributed across the property. Approximately 200 acres of the property, occurring to the north in Section 4, are maintained as cleared pasture for grazing. Livestock were present in this locating on the property at the time of survey.

Topography on the site is characterized by undulating sand/clay hills with maximum elevations reaching over 480 feet. The lowest elevations on the site are along the west and south property boundaries where elevations drop below 420 feet as the site slopes to the Chickasawhay River drainageway.

WETLAND DELINEATION METHODOLOGY

Vittor & Associates conducted this wetland survey according to the methodology and criteria set forth in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual. According to the Manual, jurisdictional wetlands must exhibit all of the following criteria: hydric soils; a dominance of wetland vegetation; and sufficient hydrology to sustain hydrophytic plants. A list of hydric soils has been compiled by the Natural Resources Conservation Service (NRCS) for the nation and each state. NRCS also distributes soil maps for most counties, giving the location of each soil type and a description of each soil. Also, lists are available that classify plant species on the basis of the likelihood of its occurrence in a wetland. To have a dominance of wetland vegetation, one must have hydrophytic species comprising 50% or more of the total species in that area. Sufficient hydrology is defined as water and/or indicators of water at or near the surface of the ground. Hydrologic indicators are factors such as water-stained leaves, oxidized root channels, drainage patterns, watermarks on the trunks of the trees, etc. Field data sheets were compiled within each different wetland and contiguous upland habitat type, to document the basis for the delineation.

Once the soil map of the area was thoroughly studied and the USGS Topographic Quadrangle referenced, staff biologists mapped the wetlands based upon topographic features, soil types and the presence of wetland characteristics (as described above). Soil probes were used to give the biologist a clear view of the soil and allow the biologist to determine the taxonomic subgroup to which the soil belonged. Hydrologic indicators in the soil (*ie.*, oxidized root channels, the presence of water, or saturated soil near the surface of the ground) were used to determine if the area was a wetland. The biologist studied the vegetation of the area to determine if the area was dominated by wetland vegetation. If any one criterion is not met, the area will not be delineated as a jurisdictional wetland.

Boundaries of jurisdictional wetlands were clearly marked with flagging labeled "WETLAND BOUNDARY" and placed along the wetland boundaries, at approximately 50- to 75-foot intervals. Each flag location was determined with a Trimble ® GPS survey instrument that had sub-meter accuracy. A wetland delineation map was prepared for review and use by Mississippi Power Company.

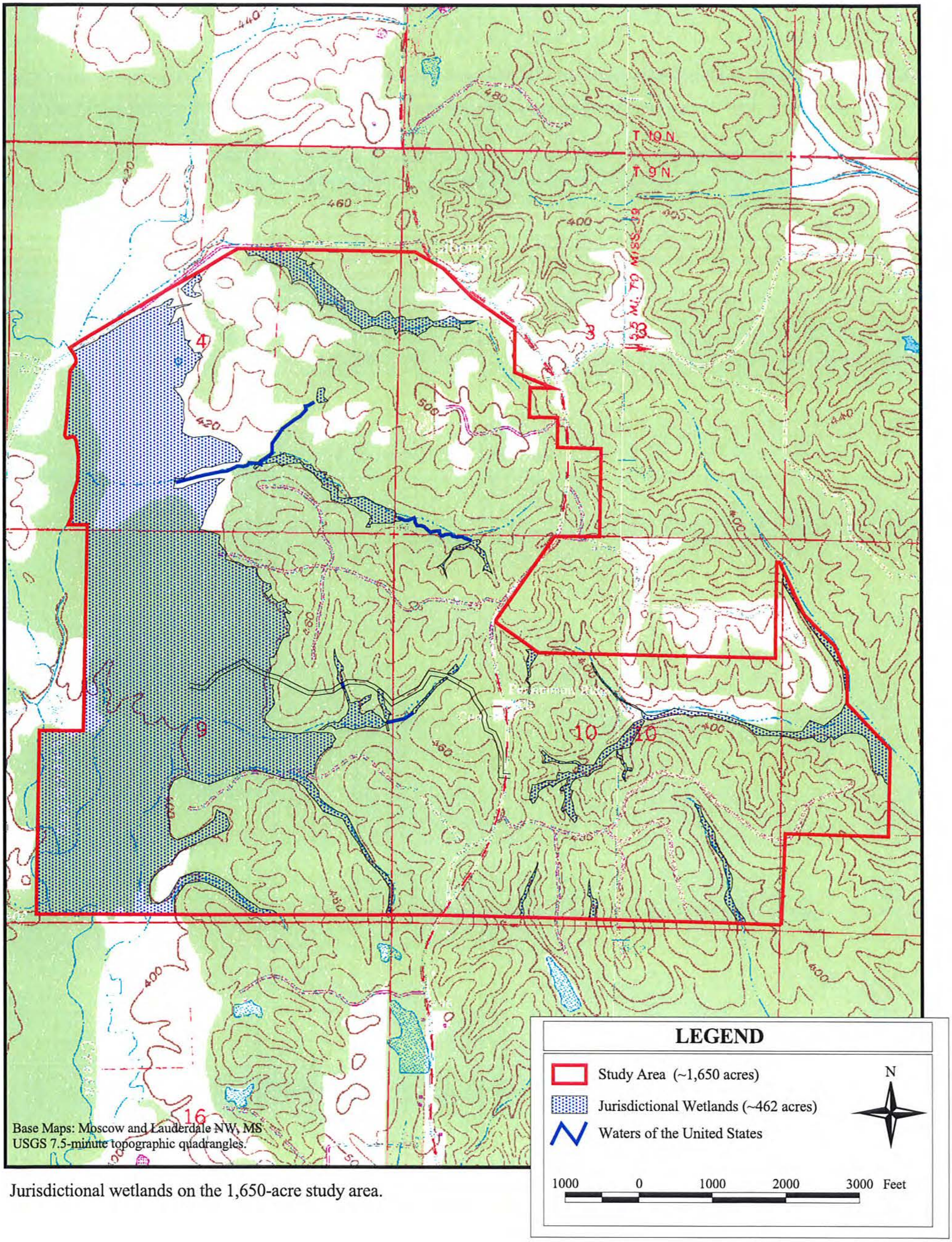
WETLAND SURVEY OF THE 1,650-ACRE PLANT SITE

Vittor & Associates delineated and mapped a total of 462 acres of jurisdictional wetlands within the 1,650-acre plant site property. The wetlands within the initial 128-acre study area were the first to be surveyed and were altered by human influences. A 14.5-acre floodplain wetland encroaches into the initial site along much of its west boundary and a small tributary to Chickasawhay Creek that comprises 1.9 acres originates near the southeast boundary. These wetlands have been heavily impacted by clear cutting. Very few canopy trees remain and logging slash has been left in wetlands. Many wetland areas have been further degraded by silt run-off from the highly erodable, cut over upland slopes. The sparse canopy in the cut-over wetland areas is comprised of regenerating loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), and water oak, (*Quercus nigra*), while the shrub and herbaceous layer is dominated by wax myrtle (*Morella cerifera*), broom sedge (*Andropogon virginicus*), slender wood oats (*Chasmanthium laxum*), giant plume grass (*Erianthus giganteus*), greenbriar (*Smilax glauca*), soft rush (*Juncus effusus*), trifoliate orange (*Poncirus trifoliate*), wooly bulrush (*Scirpus virginicus*), and saw-toothed blackberry (*Rubus argutus*). The few remaining undisturbed wetlands are vegetated by white oak (*Quercus alba*), red maple (*A. rubrum*), sweet gum (*L. styraciflua*), water oak (*Q. nigra*), willow oak (*Quercus phellos*), yellow poplar (*Liriodendron tulipifera*), red cedar (*Juniperus virginiana*), Japanese honeysuckle (*Lonicera japonica*), wax myrtle (*Morella cerifera*), trifoliate orange (*P. trifoliate*), blueberry (*Vaccinium* sp.), and Christmas fern (*Polystichum acrostichoides*). Wetland soils were poorly drained, low-chroma, sandy clay, and were saturated near the surface at all sampling points. Surface water was frequently present in the floodplain wetlands in the southwest corner of the initial study site.

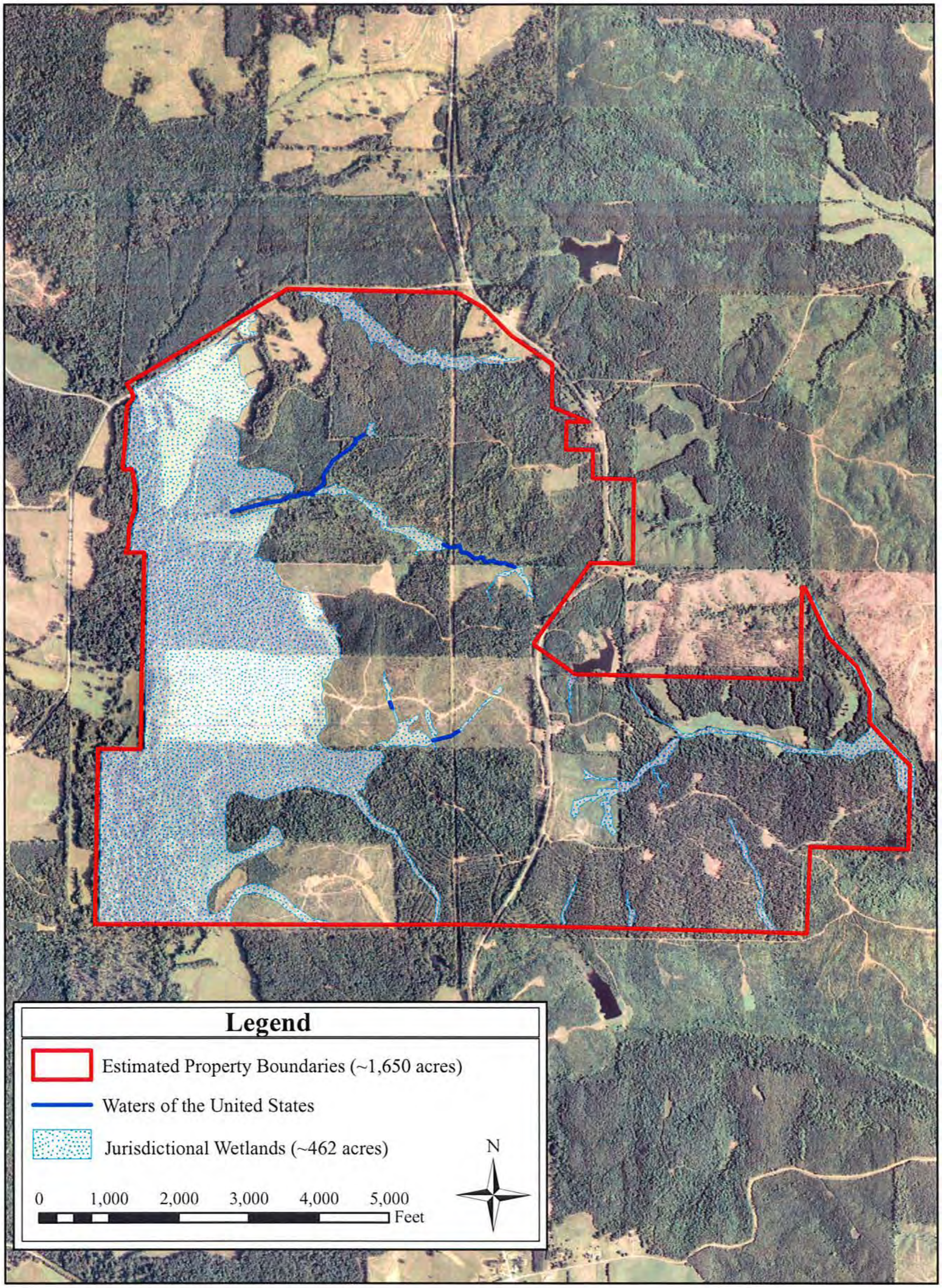
Wetlands to the south of the initial 128-acre study site on the property were generally less severely impacted. Siltation of streams was less evident and the vegetation present was more consistent with natural plant communities in the area. The canopy of these wetlands were dominated by red maple, yellow poplar and sweet gum. Shrub layers were primarily made up of wax myrtles and sapling trees, and the herbaceous layers contained Christmas ferns and young seedling trees.

The two northernmost wetland drains on the property in Sections 3 and 4 were more heavily impacted than those to the south of the original 128-acre survey. These wetlands have been ditched in several places and other portions have been converted to large grazing pastureland. The sections of these wetlands that remain forested have a canopy consisting primarily of yellow poplar, red maple, sweet gum, swamp tupelo (*Nyssa biflora*), water hickory (*Carya aquati*ca) and green ash (*Fraxinus pennsylvanica*). The shrub layer consists of wax myrtle, green briar, grapevine (*Vitis rotundifolia*) and saw-toothed blackberry. Due to thick canopy and shrub layers the herbaceous layer has been shaded out and is very sparse.

The uplands on the property are primarily planted pine sandhills. Vegetation on the uplands includes primarily loblolly pine (*P. taeda*) with water oak (*Q. nigra*), black cherry (*Prunus serotina*), yaupon (*Ilex vomitoria*), blueberry (*Vaccinium elliottii*), Japanese honeysuckle (*L. japonica*), and green briar (*S. glauca*) intermixed. Upland soils were well-drained, reddish-brown, sandy clay and slopes ranged from 5 to 35 percent.



Jurisdictional wetlands on the 1,650-acre study area.



2006 Aerial Imagery from the National Agriculture Imagery Program

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner:
Investigator: T. Whitehurst & J. Everett
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-24-07
County: Kemper
State: MS
Community ID:
Transect ID:
Plot ID: Data Point D1

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Liquidambar styraciflua	T	Fac	*Smilax rotundifolia*	H	Fac
Pinus taeda	T	Fac U-			
Carya alba	T	Fac U+			
Acer rubrum	T	Fac U			
Diospyros virginiana	T	Fac U+			
Aralia spinosa	S	Fac			
Asplenium platyneuron	H	Fac U			
Quercus phellos	T	Fac W-			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 70%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- X Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:
- Depth of Surface Water: ___ (in.)
- Depth of Free Water in Pit: ___ (in.)
- Depth to Saturated Soil: ___ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase):
Taxonomy (Subgroup):
Drainage Class: Somewhat poorly drained
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6		10 yr 5/3			Sandy Clay
6-12		10 yr 6/4			Sandy Clay
12-18		10 yr 7/2 7/3			Sandy Clay Loam

Hydric Soil Indicators:
- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? Yes [✓ No]
Hydric Soils Present? Yes [✓ No]

Is this Sampling Point within a Wetland? Yes [✓ No]

Remarks: (use back if necessary)

BARRY A. VITTOR ASSOCIATES, INC.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner:
Investigator:
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]

Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-24-07
County: Kemper
State: MS
Community ID:
Transect ID:

Plot ID: Data Point D2

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Pinus taeda	T	Fac	*Toxicodendron radicans*	H	Fac
Liquidambar styraciflua	T	Fac +			
Cdnea alba	T	Upl			
Callicaupa americana	H	Fac U-			
Vaccinium elliottii	S	Fac +			
Ilex opaca	T	Fac -			
Ulnus americana	T	Fac W			
Asplenium platyneuron	H	Fac U			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 70%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:
Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: N/A (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 inches
- X Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase):
Taxonomy (Subgroup):

Drainage Class: Very Poorly
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		10 yr 6/2	7.5 yr 4/4	C/D	Sandy Clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner: ____
Investigator: T. Whitehurst & J. Everett
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-25-07
County: Kemper
State: MS
Community ID: ____
Transect ID: ____
Plot ID: Data Point D3

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Pinus taeda	T	Fac	*Nyssa sylvatica*	T	Obl
Liquidambar styraciflua	T	Fac +			
Quercus nigra	T	Fac			
Carya alba	T	Upl			
Quercus stellata	T	Fac U			
Vaccinium elliottii	S	Fac U			
Calicarpa americana	H	Fac U-			
Ilex opaca	T	Fac -			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 50%

HYDROLOGY

____ Recorded Data (Describe in Remarks):
____ Stream, Lake, or Tide Gauge
____ Aerial Photographs
____ Other
____ No Recorded Data Available

Wetland Hydrology Indicators:

Primary Indicators:
____ Inundated
____ Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
____ Drainage Patterns in Wetlands

Field Observations:

Depth of Surface Water: ____ (in.)
Depth of Free Water in Pit: ____ (in.)
Depth to Saturated Soil: ____ (in.)
(Standing water only in deeper scour pools)

Secondary Indicators (2 or more reqnired):
____ Oxidized Root Channels in Upper 12 inches
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): Heuvelton-Millsite Rock Outcrop
Taxonomy (Subgroup): Undulating; HmB
Drainage Class: Moderately Well Drained
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6		7.5 yr 4/4			Clay
6-18		7.5 yr 4/6			Clay

Hydric Soil Indicators:

____ Histosol
____ Histic Epipedon
____ Sulfidic Odor
____ Aquic Moisture Regime
____ Reducing Conditions
____ Gleyed or Low-Chroma Colors
____ Concretions
____ High Organic Content in Surface Layer in Sandy Soils
____ Organic Streaking in Sandy Soils
____ Listed on Local Hydric Soils List
____ Listed on National Hydric Soils List
____ Other (Explaiu in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? Yes [✓ No]
Hydric Soils Present? Yes [✓ No]

Is this Sampling Point within a Wetland? Yes [✓ No]

Remarks: (use back if necessary)

BARRY A. VITTOR ASSOCIATES, INC.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner: ____
Investigator: T. Whitehurst & J. Everett
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-25-07
County: Kemper
State: MS
Community ID: ____
Transect ID: ____
Plot ID: Data Point D4

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Paspalum notatum	H	Fac U+			
Juncus effusus	H	Fac W+			
Hypericum hypericoides	H	Fac			
Liquidambar styraciflua	S	Fac +			
Sorghum halepense	H	Fac U			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 60%

HYDROLOGY

____ Recorded Data (Describe in Remarks):
____ Stream, Lake, or Tide Gauge
X Aerial Photographs
____ Other

____ No Recorded Data Available

Field Observations:
Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: N/A (in.)

(Standing water only in deeper scour pools.)

Wetland Hydrology Indicators:

Primary Indicators:
____ Inundated
____ Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 inches
X Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): Muskellunge Silt Loam
Taxonomy (Subgroup): 3-8% Slopes; MwB
Drainage Class: Poorly Drained
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		2.5 yr 6/2	7.5 yr 5/8	C/D	Sandy Clay Loam

Hydric Soil Indicators:

____ Histosol
____ Histic Epipedon
____ Sulfidic Odor
____ Aquic Moisture Regime
____ Reducing Conditions
____ Gleyed or Low-Chroma Colors
____ Concretions
____ High Organic Content in Surface Layer in Sandy Soils
____ Organic Streaking in Sandy Soils
____ Listed on Local Hydric Soils List
____ Listed on National Hydric Soils List
____ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

BARRY A. VITTOR ASSOCIATES, INC.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE WetlandS Delineation Manual)

Project/Site: Mississippi Power IGCC

Application/Owner:

Investigator: T. Whitehurst & J. Everett

Do Normal Circumstances exist on the site? [✓ Yes] No

Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]

Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-26-07

County: Kemper

State: MS

Community ID:

Transect ID:

Plot ID: Data Point D5

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Pinus taeda	T	Fac			
Juncus effusus	H	Fac W+			
Fraxinus pennsylvanica	T	Fac W			
Nyssa sylvatica	T	Obl			
Rubus argutus	H	Fac U+			
Paspalum notatum	H	Fac U+			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 67%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- X Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: NA (in.)

Depth of Free Water in Pit: NA (in.)

Depth to Saturated Soil: NA (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 inches
- ___ Water Marks
- X Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase):

Taxonomy (Subgroup):

Drainage Class: Well Drained

Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12		10 yr 4/3 6/2	7..5 yr 4/4	C/D	Sandy Clay
12-18		10 yr 6/1	10 yr 6/6	C/D	Sandy Clay

Hydric Soil Indicators:
- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No

Wetland Hydrology Present? Yes [✓ No]

Hydric Soils Present? Yes [✓ No]

Is this Sampling Point within a Wetlaod? Yes [✓ No]

Remarks: (use back if necessary)

BARRY A. VITTOR ASSOCIATES, INC.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner: ___
Investigator: T. Whitehurst & J. Everett
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-26-07
County: Kemper
State: MS
Community ID: ___
Transect ID: ___
Plot ID: Data Point D6

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Quercus alba	T	Fac U			
Quercus pagoda	T	NA			
Fayinus sylvatica	T	Fac			
Ulnus americana	T	Fac W			
Poncirus trifoliata	S	NA			
Chasmanthium laxum	H	Fac W			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 50%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- X Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:
Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: N/A (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): ___
Taxonomy (Subgroup): ___
Drainage Class: Moderately well drained
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		10 yr 4/6			Sandy Clay Loam

Hydric Soil Indicators:
- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? Yes [✓ No]
Hydric Soils Present? Yes [✓ No]

Is this Sampling Point within a Wetland? Yes [✓ No]

Remarks: (use back if necessary)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner:
Investigator: T. Whitehurst & J. Everett
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-26-07
County: Kemper
State: MS
Community ID:
Transect ID:
Plot ID: Data Point D7

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Nyssa biflora	T	Obl			
Liriodendron tulipifera	T	Fac			
Acer rubrum	T	Fac			
Ulnus americana	T	Fac W			
Juncus effusus	H	Fac W+			
Erianthus giganteus	H	Fac W			
Typha latifolia	H	Obl			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

HYDROLOGY

____ Recorded Data (Describe in Remarks):
- ____ Stream, Lake, or Tide Gauge
- X Aerial Photographs
- ____ Other

____ No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: 12 in (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ____ Inundated
- X Saturated in Upper 12 inches
- X Water Marks
- ____ Drift Lines
- ____ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- ____ Water-Stained Leaves
- ____ Local Soil Survey Data
- ____ FAC-Neutral Test
- ____ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase):
Taxonomy (Subgroup):

Drainage Class: Very Poorly
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		10 yr 6/1	7.5 yr 5/8	C/D	Clay Loam

Hydric Soil Indicators:

- ____ Histosol
- ____ Histic Epipedon
- ____ Sulfidic Odor
- ____ Aquic Moisture Regime
- ____ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ____ Concretions
- ____ High Organic Content in Surface Layer in Sandy Soils
- ____ Organic Streaking in Sandy Soils
- ____ Listed on Local Hydric Soils List
- ____ Listed on National Hydric Soils List
- ____ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

BARRY A. VITTOR ASSOCIATES, INC.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner:
Investigator: David Knowles & A. Pate
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-26-07
County: Kemper
State: MS
Community ID:
Transect ID:
Plot ID: Data Point D8

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Paspalum notatum	H	Fac U+	*Scirpus cyperinus*	H	Obl
Juncus effusus	H	Fac W+			
Liquidambar styraciflua	S	Fac +			
Nussa sylvatica var biflora	S	Obl			
Rubus argutus	H	Fac U+			
Rhexia mariana	H	Fac W+			
Liriodendron tulipifera	S	Fac			
Quercus nigra	S	Fac			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) *78%*

HYDROLOGY

Recorded Data (Describe in Remarks):
- Stream, Lake, or Tide Gauge
- X Aerial Photographs
- Other

No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: N/A (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- Inundated
- Saturated in Upper 12 inches
- Water Marks
- Drift Lines
- Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 inches
- Water-Stained Leaves
- Local Soil Survey Data
- FAC-Neutral Test
- Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase):
Taxonomy (Subgroup):

Drainage Class: Poorly Drained
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Mnncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12		7.5 yr 5/8			Sandy Loam
12-18		10 yr 6/1	7.5 yr 5/8	Common Distinct	Sandy Clay

Hydric Soil Indicators:
- Histosol
- Histic Epipedon
- Sulfidic Odor
- Aquic Moisture Regime
- Reducing Conditions
- Gleyed or Low-Chroma Colors
- Concretions
- High Organic Content in Surface Layer in Sandy Soils
- Organic Streaking in Sandy Soils
- Listed on Local Hydric Soils List
- Listed on National Hydric Soils List
- Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

BARRY A. VITTOR ASSOCIATES, INC.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Mississippi Power IGCC
Application/Owner: ___
Investigator: T. Whitehurst & J. Everett
Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem area? Yes [✓ No]
(If needed, explain on reverse.)

Date: 07-26-07
County: Kemper
State: MS
Community ID: ___
Transect ID: ___
Plot ID: Data Point D9

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Fraxinus pennsylvanica	T	Fac W			
Ulnus americana	T	Fac W			
Juncus effusus	H	Fac W+			
Paspalum notatum	H	Fac U+			
Baccharis hamilifolia	S	Fac			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 90%

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
X Aerial Photographs
___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)
Depth of Free Water in Pit: N/A (in.)
Depth to Saturated Soil: 12 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
___ Inundated
X Saturated in Upper 12 inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
X Oxidized Root Channels in Upper 12 inches
X Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): ___
Taxonomy (Subgroup): ___
Drainage Class: Poorly
Field Observations:
Confirm Mapped Type? Yes [✓ No]

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Muncell Moist)	Mottle Colors (Muncell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-18		10 yr 6/1	7.5 yr 5/8		Sandy Clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
X Gleyed or Low-Chroma Colors

___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in wetland)

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

Is this Sampling Point within a Wetland? [✓ Yes] No

Remarks: (use back if necessary)

THREATENED AND ENDANGERED SPECIES REPORT FOR THE INTEGRATED GASIFICATION COMBINED CYCLE GENERATING STATION IN KEMPER COUNTY, MISSISSIPPI

Prepared for

MISSISSIPPI POWER COMPANY
2992 WEST BEACH BOULEVARD
GULFPORT, MISSISSIPPI 39501

Prepared by

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

(Contract No. BSU 0067717)

October 2, 2007

INTRODUCTION

In July-August, 2007, Barry A. Vittor & Associates, Inc. performed a threatened and endangered species survey of the additional lands within the proposed Mississippi Power Company Integrated Gasification Combined Cycle (IGCC) generating station site in Kemper County, Mississippi. This report details the results of our survey and discusses the potential for occurrence of federal and/or state protected species within the project site.

PROJECT LOCATION

The 1,650-acre study area is located in Kemper County, Mississippi on the east and west sides of State Road 493, approximately 10 air miles south of the community of DeKalb. **Figure 1** depicts the subject property on the Moscow and Lauderdale, NW, Mississippi, United States Geological Survey (USGS) 7.5-minute topographic quadrangles. The project site is located in Township 9 North, Range 15 East and contains multiple sections: 3, 4, 9, 10 and 11.

TARGET SPECIES

A review of the pertinent and available literature was conducted to help generate a list of federally and state protected species that could possibly occur on the property. The United States Fish & Wildlife Service's list of Mississippi's federally protected species by county was consulted as the primary reference on potentially occuring species (Ecological Services Field Office; http://www.fws.gov/southeast/jackson/index.html). The United States Fish and Wildlife Service (USFWS) lists the threatened Price's potato bean (*Apios priceana*) as the only federally protected species currently known to occur in Kemper County, Mississippi. Detailed natural history information on this species is provided for reference in **Appendix A** (Kral, 1983; Natureserve, 2006).

Other broadly distributed and wide ranging species such as Bald Eagle (*Halaieetus leucocephalus*) and Red-cockaded Woodpecker (*Picoides borealis*) could possibly occur throughout Mississippi and Vittor & Associates usually considers these taxa as potential targets for all threatened and endangered species surveys performed in the state.

The Mississippi Department of Wildlife Fisheries and Parks is responsible for the regulation of protected nongame species in the state. A list of wildlife species protected by the state was generated from the following regulations on the Department of Wildlife Fisheries and Parks' website (http://www.mdwfp.com/Level2/Wildlife/hunting_regs.asp):

> "All birds of prey (eagles, hawks, osprey, owls, kites and vultures) and other nongame birds are protected and may not be hunted, molested, bought or sold.. The following endangered species are also protected: black bear, Florida panther, gray bat, Indiana bat, all sea turtles, gopher tortoise, sawback turtles (black-knobbed, ringed, yellow-blotched), black pine snake, eastern indigo snake, rainbow snake and the southern hognose snake "

In addition to the above sources, a data request was submitted to the Mississippi Natural Heritage Program (MNHP) to determine whether any federally protected species have been previously documented from the project site. For purposes of this investigation, Vittor & Associates utilized a 1,650-acre study area that included the original 128-acre proposed plant site. MNHP performed a data search of records occuring within a 2-mile search distance surrounding the boundary of the larger tract.

FIELD SURVEY AND NATURAL COMMUNITIES

The field survey of the initial 128-acre proposed plant site, and the adjacent acreage to its South and East on the property, was performed on March 7, 8, and 21, 2007 to search for both federal and state protected species and to assess the natural communities and wildlife habitats found within the project boundaries. The remainder of the property was searched on July 30 and 31, 2007 and August 23, 2007. Topography in the site is characterized by undulating sand/clay hills with the maximum elevation reaching over 480 feet above sea level. The lowest elevations on the study area (394 feet above sea level) occur on the western edge of the property along the floodplain of the Chickasawhay River.

Historically, the property was most likely dominated by an upland mixed hardwood forest community, based on the presence of remnant vegetation. Areas along the floodplain of Chickasawhay River would have consisted of bottomland hardwood forest. Hardwoods still dominate the banks of the River and small portions of the floodplain; however, the majority of the property is now currently managed for pine timber production and has been heavily impacted through logging activities. Based on found conclude that a vast majority of the uplands on the property had been planted in loblolly pine (*Pinus taeda*). There is a recent clear-cut of approximately 55 acres located in the south-central portion of the study site, that is regenerating in young sweetgum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), and wax myrtle (*Myrica cerifera*). Herbaceous and groundcover species present in this clear-cut area include broom sedge (*Andropogon virginicus*), sawtooth blackberry (*Rubus argutus*), and slender woodoats (*Chasmanthium laxum*). An additional 30 acres of clear-cut land occurs in close proximity to the west and north of the previously mentioned clear-cut, and has been converted into planted food plots for hunting. There are remains of an old home site located on the north side of the entrance road leading into the subject property. The vegetation here is dominated by non-native species such as Chinese wisteria (*Wisteria sinense*) and Chinese privet (*Ligustrum sinense*) most likely naturalized from previous cultivation around the former home.

RESULTS AND FINDINGS

No federal or state protected species were observed during our survey. An electronic search of MNHP's Biological Conservation Database (BCD) performed on March 27, 2007 revealed no reports of any federally protected species from the project site nor were any protected species identified within a two-mile search distance of the 1,650-acre study area. Since Price's potato bean (*Apios priceana*) has been previously documented from Kemper County, a specific request was made to identify the nearest element occurrence

(EO) of *A. priceana* in their database. According to MNHP records, the nearest EO in Kemper County is located approximately 25 air miles northeast of the project site and was last visited in 2001. Although no point locality data were provided for this EO, the general location would place the record in the extreme northeast corner of the county. An examination of the Environmental Protection Agency's Level IV Ecoregions of Mississippi (**Figure 2**; Chapman, et al. 2004) shows that this northeast portion of Kemper County contains two different Level IV ecoregions: Blackland prairie (65a) and Flatwoods/Blackland Prairie Margins (65B). The study site is located well outside of these ecoregions in the Southern Hilly Gulf Coastal Plain (65d). Nearby populations of Price's potato bean in Mississippi and Alabama are not known to occur in this particular ecoregion and are restricted to the ecoregions found farther north of the project site. Additionally, the project falls within the drainage basin for the Chickasawhay River for which there are no known records of this protected species. No individuals of Price's potato bean were observed within the project boundaries and suitable habitat for this species does not exist on the site (e.g. rocky woodlands with calcareous substrates).

No individuals of Red-cockaded Woodpecker (*Picoides borealis*)were observed on the project site. Red-cockaded Woodpecker is a specialist of fire-maintained pine ecosystems (*i.e.* longleaf pine forest) of the Southeastern United States. The species typically requires old growth longleaf pine (*Pinus palustris*) for its breeding cavities, but other pine species have also been utilized (Conner *et al.*, 2001). Large areas of the property are in commerical loblolly pine timber production and appear to lack the necessary old growth trees required for breeding (average stand age for planted loblolly pine was estimated to be between 15 & 20 years). Based on our field assessment, Red-cockaded Woodpecker is not likely to occur within the project boundaries and suitable habitat for Red-cockaded Woodpecker does not occur on the proposed plant site.

Bald Eagle (*Haliaeetus leucocephalus*) is unlikely to occur as a breeder on the property, which lacks the large bodies of open water necessary for foraging. No eagles were seen during our field surveys of the property and the species is not expected to occur there.

STATE LISTED SPECIES

Black-knobbed map turtle (*Graptemys nigrinoda*)

Black-knobbed map turtle is found in rivers and streams with moderate current and sandy or clay substrates in the upper Tombigbee, Tibbee, Middle Tombigee-Lubbub river drainages in Alabama and Mississippi, all of which are outside of the Chickasawhay river basin (Natureserve, 2006; Ernst *et al.*, 1994). This species is not expected to occur within the property boundaries of the study area.

Yellow-blotched map turtle (*Graptemys flavimaculata*)

Yellow-blotched map turtle is federally protected as a threatened species. This species is restricted to the Pascagoula River system and its associated tributaries. *G. flavimaculata* is typically found in "wide rivers with strong currents" with sandbars suitable for nesting (Ernst, et al. 1994). The species has been documented from the Upper Chickasawhay River basin as far north as Clarke County, Mississippi (Natureserve, 2006). There are no known occurrences of yellow-blotched map turtle from Kemper County, Mississippi, based on Natural Heritage Program records (Natureserve, 2006). Although the western property boundary of the 1,650-acre study area abuts portions of the Chickasawhay River, the species is not expected there.

Ringed map turtle (*Graptemys oculifera*)

This species is restricted to the Pearl River drainage system in Mississippi and Louisiana (Natureserve, 2006; Ernst *et al.* 1994). It is not found in the Chickasawhay River basin and is not expected to occur within the project boundaries.

Southern hognose snake (*Heterodon simus*).

The Mississippi Natural Heritage Program considers *H. simus* extirpated from the state with no recent records reported during 1983 -1998 (Natureserve, 2006). There are old records from Forrest, Pearl River, and Stone counties (Natureserve, 2006). Southern hognose snake is typically found in xeric sandhill communities with well-drained sandy soils (Natureserve, 2006) and these community types do not exist within the study area. It is not expected to occur within the project boundaries.

Black pine snake (*Pituophis melanoleucus lodingi*)

Black pine snake is a candidate species for Federal protection under the Endangered Species Act (ESA) This designation indicates that the USFWS has sufficient biological information to propose a particular species for listing under the ESA but such an action is precluded due to higher listing priorities. The species is also state protected in Mississippi. There are no known records of black pine snake from Kemper County and it has only been documented as far north as Marion and Lamar Counties in Mississippi (Natureserve, 2006). Black pine snake is not expected to occur on the property.

Rainbow Snake (*Farancia erytrogramma*)

Rainbow snake is state-protected in Mississippi. Ernst & Ernst (2003) considered this species endangered in the state. Rainbow snake is not federally protected under the Endangered Species Act. This secretive snake is typically found along "coastal plain waterways" such as "rivers, streams, canals, lakes, swamps and tidal and freshwater marshes" of the southeast (Ernst & Ernst, 2003). Conant and Collins (1998) state that it appears to prefer swamp with bald cypress (*Taxodium distichum*). Natureserve (2006) only lists records from as far north as Lamar County in Mississippi. Suitable habitat for rainbow snake does not occur within the project boundaries and it is not expected to occur there.

LITERATURE CITED

Chapman, S.S,Griffith, G.E., Omernik, J.M., Comstock, J.A., Beiser, M.C., and Johnson, D., 2004, Ecoregions of Mississippi, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geologica Survey (map scale 1:1,000,000).

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Chickasawhay River floodplain, Northwest corner of the property.

Sandy/Clayey Pinehills, North central portion of the property.

Open grazing pasture adjacent to Liberty Road, in the Northeast section of the property.

Dirt road through a large clear-cut near the center of the property.

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APPENDIX F

KEMPER COUNTY IGCC PROJECT MISSISSIPPI MUSEUM OF NATURAL SCIENCE DATA REQUEST AND RESPONSE

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MISSISSIPPI
DEPARTMENT OF WILDLIFE, FISHERIES AND PARKS
SAM POLLES, Ph.D.
Executive Director

July 18, 2008

Maya Scohier
Environmental Consulting & Technology, Inc.
3701 NW 98th Street
Gainesville, FL 32606

Re: Data Request from the Mississippi Museum of Natural Science
Threatened and Endangered Species Consultation **# 6718**
Lauderdale and Kemper Counties, Mississippi

To Maya Scohier:

In response to your request for information dated July 1, 2008, we have searched our database for occurrences of state or federally listed species and species of special concern that occur within 2 miles of the site of the proposed project. Please see the table below for a list of these species/communities and find our comments and recommendations below.

SCIENTIFIC NAME	COMMON NAME	FED	STATE	STATE RANK
PROCAMBARUS LAGNIAPPE	LAGNIAPPE CRAYFISH			S1
ACCIPITER STRIATUS	SHARP-SHINNED HAWK			S1B
ANAS RUBRIPES	AMERICAN BLACK DUCK			S2N
EUPHAGUS CAROLINUS	RUSTY BLACKBIRD			S2N
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	LE	LE	S1
NYCTICORAX VIOLACEUS	YELLOW-CROWNED NIGHT HERON			S3B,S1N
AIMOPHILA AESTIVALIS	BACHMAN'S SPARROW			S3B
SEIURUS MOTACILLA	LOUISIANA WATERTHRUSH			S3B
ACCIPITER COOPERI	COOPER'S HAWK			S3B
GRAPTEMYS GIBBONSI	PASCAGOULA MAP TURTLE			S3

State Rank

S1 – Critically imperiled in Mississippi because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it vulnerable to extirpation.

S2 – Imperiled in Mississippi because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it vulnerable to extirpation.

State and Federal Status
LE Endangered – A species which is in danger of extinction throughout all or a significant portion of its range.
LT Threatened – A species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
PS – Partial Status. Species is listed in part of its range.

Comments and Recommendations:

- **Red-Cockaded Woodpecker (*Picoides borealis*); LE (Federal), LE (MS)**
  If any red-cockaded woodpeckers, their cavities, or cavity starts are observed please contact Nick Winstead ((601) 354-7303, ext. 108) with MS Dept. Wildlife, Fisheries, & Parks. The red-cockaded woodpecker, a relatively small woodpecker about 20 cm (8 in.) in length, is listed as endangered by the U.S. Fish and Wildlife Service and by the state of Mississippi, where the species has been recorded primarily from the southern two-thirds of the state and only sporadically in the northern counties. *Picoides borealis* occur in southern pine forests where their preferred nesting habitat is open, park-like, mature pine woodlands with few or no hardwood trees present. Preferred feeding habitats are pine stands with trees 23 cm (9 in.) and greater in diameter. Red-cockaded woodpeckers excavate nesting and roosting cavities in living trees, primarily older, mature trees, and are the only species known to do so exclusively. Most cavities are between 6-15 m (20-50 ft.) above the ground and are usually located on the trunk below the level of the first live limb. The completed cavity is 15-25 cm (6-10 in.) deep and 7.5-12.5 cm (3-5 in.) wide. As long as a cavity is being used for roosting or nesting, the bark is chipped around it, the plate is continually enlarged, and the resin wells are worked to provide a flow of resin to deter predators. The red-cockaded woodpecker has become endangered because of its dependence upon mature pine forests with open understories. These forests were historically maintained by recurring wildfires, but are uncommon today (1) because modern forestry practices that emphasize the growth and cutting of young to middle-aged trees and (2) because fire has been excluded from many pine woodlands, thus depriving red-cockaded woodpeckers of suitable nesting habitat and encouraging the encroachment and growth of hardwood trees. Survival of this species is dependent on wise management of publicly owned lands because the economic value of timber precludes the maintenance of mature forests on most private lands. Mature pine trees should also be maintained along major highway corridors to provide habitat for displaced woodpeckers and to link isolated stands of suitable habitat.

- There have also been documented occurrences of the Bald Eagle, *Haliaeetus leucocephalus*, near this area. If any potential eagle nests are observed please visit the following website to determine what best management practices to utilize:
  http://www.fws.gov/southeast/es/baldeagle/index.html, and for information regarding the life history of Bald Eagles, please visit the following website:
  http://www.fws.gov/southeast/es/baldeagle/baea_nhstry_snstvty.html

- Portions of this project site are located in both priority and suitable habitat (see attached map) for the federally threatened and state endangered Gopher Tortoise (*Gopherus polyphemus*). Although it is unlikely that you would come across any gopher tortoises in this location, we recommend that surveys be done for two other species of special concern that may occur on gopher tortoise priority and suitable soils. These species are the Oldfield Mouse, *Peromyscus polionotus*, and the Florida Harvester Ant, *Pogonomyrmex badius*. The oldfield mouse has burrows that look like small gopher tortoise burrows, with conspicuous sand aprons. The harvester ants create beds that are broad, flat, and generally ringed with bits of charcoal, gravel, and plant detritus. Both species will be in open, very sandy spots, with ample herbaceous vegetation nearby. For information regarding these species, or if either species is discovered during the course of this project please contact Mr. Scott Peyton or Mr. Tom Mann, respectively, at 601-354-7303.

- Please be advised that the proposed pipeline route crosses through a Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) Wildlife Management Area, Okatibbee WMA, in Lauderdale County. We recommend that you contact the appropriate MDWFP personnel about this proposed pipeline and how it may impact their Wildlife Management Area.

- The proposed pipeline route crosses several rivers and streams that are important habitat for many of the rare aquatic species. We strongly recommend that the following rivers/streams be directionally drilled to prevent or minimize negative impacts to their water quality and instream habitat conditions: Yazoo Creek, Pawticfaw Creek, Chickasawhay Creek, Blackwater Creek, Okatibbee Creek, Buckatunna Creek, Baker Creek, and any tributary of these that is 10 feet wide or greater at the water's surface and at the point of construction. We also strongly recommend that adequate measures are taken to mitigate any negative impacts to streams that result from this project. We also recommend that best management practices are implemented and monitored for compliance, specifically measures that will prevent ANY suspended silt and contaminants from leaving the site in stormwater run-off as this may negatively affect water quality and habitat conditions within nearby streams and waterbodies.

- In addition, portions of this project site are underlain by hydric soils and may be designated wetlands. If this project is approved, we ask that serious consideration be given to the cumulative impacts of wetland disturbance and elimination.

Please feel free to contact us if we can provide any additional information, resources, or assistance that will help minimize negative impacts to the species and/or communities identified in this review. We are happy to work with you to ensure that our state's precious natural heritage is conserved and preserved for future Mississippians.

Sincerely,

Andy Sanderson

Andy Sanderson, Conservation Resources Biologist
Mississippi Natural Heritage Program
(601) 354-6367, ext. 117

The Mississippi Natural Heritage Program (MNHP) has compiled a database that is the most complete source of information about Mississippi's rare, threatened, and endangered plants, animals, and ecological communities. The quantity and quality of data collected by MNHP are dependent on the research and observations of many individuals and organizations. In many cases, this information is not the result of comprehensive or site-specific field surveys; most natural areas in Mississippi have not been thoroughly surveyed and new occurrences of plant and animal species are often discovered. Heritage reports summarize the existing information known to the MNHP at the time of the request and cannot always be considered a definitive statement on the presence, absence or condition of biological elements on a particular site.

From: Maya Scohier [mscohier@ectinc.com]
Sent: Thursday, October 09, 2008 4:54 PM
To: 'Jim Poppleton'; 'Jeff Meling'; 'Phil Simpson'
Subject: FW: General T&E Eval for Pipeline
Attachments: USGS_MMNS.pdf; Buffer_of_TLs_merge_2.zip; List_Project_topos.xls; Response to Data Request.PDF

Below is my data request to Mississippi Museum of Natural Science (MMNS) with the first three attachments. The forth attachment is the response from MMNS. Please use this letter response for the entire project and disregard the first letter response we have received earlier, because it did not cover all of the linear corridors.

September 29, 2008

Mississippi Natural Heritage Program

Mississippi Museum of Natural Science

Department of Wildlife, Fisheries and Parks

2148 Riverside Drive

Jackson, MS 39202

Subject: Data Request from the Mississippi Museum of Natural Science

Dear Mr. Philip Sanderson:

Environmental Consulting and Technology, Inc. is submitting a Data Request to the Mississippi Museum of Natural Science (MMNS). The information obtained from MMNS will be used to avoid the listed plant and animal species if found in the study area.

Attached for your convenience are the pdf and the shape files for the study area boundary. The older routes, for which you have kindly provided information (reference # 6718), are also included on the map. If possible, please exclude the information for these routes. Thank you in advance for your help. Should you require additional information, please contact me via phone or email listed below.

Sincerely,

Maya

Maya R. Scohier
Associate Scientist I
Environmental Consulting & Technology, Inc.

3701 NW 98th Street
Gainesville, FL 32606
352-332-0444
mailto:mscohier@ectinc.com

From: Phillip Sanderson [mailto:phillip.sanderson@mmns.state.ms.us]
Sent: Monday, October 06, 2008 12:43 PM
To: Maya Scohier
Subject: General T&E Eval for Pipeline

Hi Maya,

I just finished the review for this project, per our conversation. The new letter includes review for the previous quads you sent us as well as for the new quads; however, we only charged you for the 9 new quads. Since this letter is slightly different than the first, you can feel free to use it for the entire project rather than referring to both the first and second letters. Please feel free to call or email me if you have any questions regarding this or any other project.

Have a great week,

Andy Sanderson, Conservation Resources Biologist
Mississippi Natural Heritage Program
Mississippi Museum of Natural Science
Mississippi Department of Wildlife, Fisheries & Parks
2148 Riverside Drive
Jackson, MS 39202-1353
(601) 354-7303, ext. 117 [office]
(601) 354 -7227 [fax]

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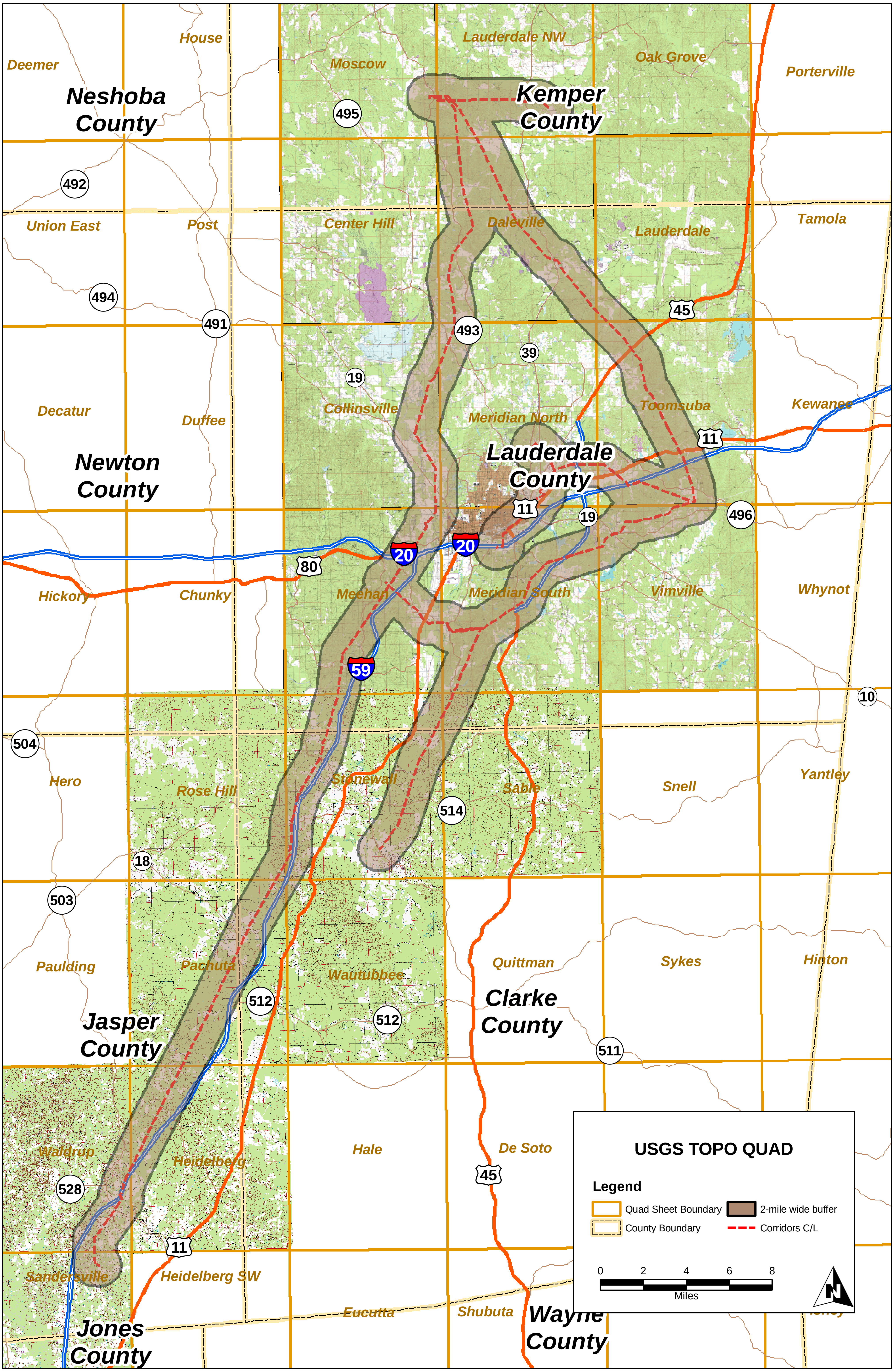


ObjectID	USGS_QD_ID	QUAD_NAME	ST_NAME1
47580	32088-F7	Moscow	Mississippi
47581	32088-F6	Lauderdale NW	Mississippi
47594	32088-E7	Center Hill	Mississippi
47595	32088-E6	Daleville	Mississippi
47608	32088-D7	Collinsville	Mississippi
47609	32088-D6	Meridian North	Mississippi
47621	32088-C7	Meehan	Mississippi
47622	32088-C6	Meridian South	Mississippi
47815	32088-B8	Rose Hill	Mississippi
47816	32088-B7	Stonewall	Mississippi
47817	32088-B6	Sable	Mississippi
47829	32088-A8	Pachuta	Mississippi
47830	32088-A7	Wautubbee	Mississippi
47841	31089-H1	Waldrup	Mississippi
47842	31088-H8	Heidelberg	Mississippi
47856	31089-G1	Sandersville	Mississippi
51288	32088-E5	Lauderdale	Mississippi
51303	32088-D5	Toomsuba	Mississippi
51318	32088-C5	Vimville	Mississippi

MISSISSIPPI
DEPARTMENT OF WILDLIFE, FISHERIES, AND PARKS

Sam Polles, Ph.D.
Executive Director

October 6, 2008

Maya R. Scohier
Environmental Consulting & Technology, Inc.
3701 NW 98th Street
Gainesville, FL 32606

Re: Pipeline
General T & E Evaluation **R#6879**
Multi-County County, Mississippi

To Maya Scohier,

In response to your request for information dated September 29, 2008, we have searched our database for occurrences of state or federally listed species and species of special concern that occur within 2 miles of the site of the proposed project. Please see the table below for a list of these species/communities and find our comments and recommendations below.

SCIENTIFIC NAME	COMMON NAME	FED	STATE	STATE RANK
PROCAMBARUS LAGNIAPPE	LAGNIAPPE CRAYFISH			S1
ACCIPITER STRIATUS	SHARP-SHINNED HAWK			S1B
ANAS RUBRIPES	AMERICAN BLACK DUCK			S2N
EUPHAGUS CAROLINUS	RUSTY BLACKBIRD			S2N
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	LE	LE	S1
PERCINA AURORA	PEARL DARTER	C	LE	S1
PERCINA LENTICULA	FRECKLED DARTER			S2
GRAPTEMYS FLAVIMACULATA	YELLOW-BLOTCHED MAP TURTLE	LT	LE	S2
PEROMYSCUS POLIONOTUS	OLDFIELD MOUSE			S2S3
GRAPTEMYS GIBBONSI	PASCAGOULA MAP TURTLE			S3

State Rank
S1 – Critically imperiled in Mississippi because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it vulnerable to extirpation.
S2 – Imperiled in Mississippi because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it vulnerable to extirpation.

State and Federal Status

LE Endangered – A species which is in danger of extinction throughout all or a significant portion of its range.

LT Threatened – A species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

PS – Partial Status. Species is listed in part of its range.

Comments and Recommendations:

- **Red-Cockaded Woodpecker (*Picoides borealis*); LE (Federal), LE (MS)**
  If any red-cockaded woodpeckers, their cavities, or cavity starts are observed please contact Nick Winstead ((601) 354-7303, ext. 108) with MS Dept. Wildlife, Fisheries, & Parks. The red-cockaded woodpecker, a relatively small woodpecker about 20 cm (8 in.) in length, is listed as endangered by the U.S. Fish and Wildlife Service and by the state of Mississippi, where the species has been recorded primarily from the southern two-thirds of the state and only sporadically in the northern counties. *Picoides borealis* occur in southern pine forests where their preferred nesting habitat is open, park-like, mature pine woodlands with few or no hardwood trees present. Preferred feeding habitats are pine stands with trees 23 cm (9 in.) and greater in diameter. Red-cockaded woodpeckers excavate nesting and roosting cavities in living trees, primarily older, mature trees, and are the only species known to do so exclusively. Most cavities are between 6-15 m (20-50 ft.) above the ground and are usually located on the trunk below the level of the first live limb. The completed cavity is 15-25 cm (6-10 in.) deep and 7.5-12.5 cm (3-5 in.) wide. As long as a cavity is being used for roosting or nesting, the bark is chipped around it, the plate is continually enlarged, and the resin wells are worked to provide a flow of resin to deter predators. The red-cockaded woodpecker has become endangered because of its dependence upon mature pine forests with open understories. These forests were historically maintained by recurring wildfires, but are uncommon today (1) because modern forestry practices that emphasize the growth and cutting of young to middle-aged trees and (2) because fire has been excluded from many pine woodlands, thus depriving red-cockaded woodpeckers of suitable nesting habitat and encouraging the encroachment and growth of hardwood trees. Survival of this species is dependent on wise management of publicly owned lands because the economic value of timber precludes the maintenance of mature forests on most private lands. Mature pine trees should also be maintained along major highway corridors to provide habitat for displaced woodpeckers and to link isolated stands of suitable habitat.

- **Pearl Darter (*Percina aurora*); C (Federal); LE (MS)**
  The pearl darter is a relatively small, nondescript fish. The body is olive to light brown in color with the sides marked with a series of dark oval to oblong blotches and a single black caudal spot located at the base of the caudal fin. The upper sides are speckled with dark "X" shaped markings. The common name, pearl darter, refers to the pearly, pastel blue coloration prominently located on the sides and lower portions of the head. The maximum size is 75 mm (2.95 in.) total length. *Percina aurora* is known only from Louisiana and Mississippi, where it originally occurred in the Chickasawhay, Leaf, and Pascagoula River systems of

the Pascagoula drainage, and in the Pearl and Strong River systems of the Pearl drainage. The pearl darter has been known to occur in rapids or riffles over gravel or bedrock substrata in slow to moderate currents. In the Pascagoula River, it occurs in the slow flowing waters along the downstream edge of sandbar point bars in runs 90-150 cm deep over a substratum of sand with scattered patches of detritus. The pearl darter was last taken from the Pearl drainage in the early 1970's, and it is now assumed that both Mississippi and Louisiana populations in the Pearl drainage are extirpated. Extirpation in the Pearl drainage is attributed to the deterioration of instream habitat. The primary cause is increased sedimentation resulting from localized gravel mining, removal of bankside riparian vegetation, and extensive cultivation near the river's edge. Recent survey efforts (1996-2000) have documented its continued existence in the Leaf, Chickasawhay, Chunky, Bowie, and Pascagoula Rivers. Restrictions on water quality degradation and improved land management practices should be implemented to reduce instream habitat alterations for those streams known to harbor pearl darters.

- **Yellow-Blotched Map Turtle, Yellow-Blotched Sawback (*Graptemys flavimaculata*); LT (Federal), LE (MS)**
  The yellow-blotched map turtle is a medium-sized turtle with males reaching 7-10 cm (3-4 in.) carapace length as adults and females growing to 10-18 cm (4-7 in.). The carapace is olive to brown with large, yellow to orange blotches on the costal scutes and vertebral scutes. The plastron is usually cream-colored, sometimes with black along the seams between the scutes. There is a large, variable bar or spot behind each eye and two broad yellow stripes extending from behind each eye down the neck. The dorsal keel of the carapace has conspicuous black, spine-like projections which are best developed in adult males and juveniles. *Graptemys flavimaculata* is endemic to Mississippi and occurs only in the Pascagoula River and its larger tributaries, including the Escatawpa River, the Leaf River, and the Chickasawhay River. The yellow-blotched map turtle requires streams with strong, consistent current and large sandbars for nesting. It spends much of the day basking, so it needs streams which are wide enough to receive several hours of direct sunlight per day and which have abundant snags and logs on which to bask. *Graptemys flavimaculata* is listed as threatened by the U.S. Fish and Wildlife Service and endangered by the state of Mississippi, because of its limited distribution in the Pascagoula River watershed. Additionally, it has a very low reproductive frequency, a relatively low clutch size, and a very small proportion of nests that successfully produce offspring. Human occupation of nesting beaches for recreational purposes may interfere with the use of beaches by female yellow-blotched map turtles. Many of the sandbars in the lower Pascagoula are being colonized by non-native vegetation such as cogon grass, which reduces their usefulness as nesting sites. In addition, chemical pollutants in the Pascagoula River may be disrupting the hormonal regimes and thus interfering with the reproductive cycles of both male and female turtles.

There have been documented occurrences of the Bald Eagle, *Haliaeetus leucocephalus*, near this area. If any potential eagle nests are observed please visit the following website to determine what best management practices to utilize: **http://www.fws.gov/southeast/es/baldeagle/index.html**, and for information regarding the life history of Bald Eagles, please visit the following website: **http://www.fws.gov/southeast/es/baldeagle/baea_nhstry_snstvty.html**

Portions of this project site are located in suitable/priority habitat (see attached map) for the federally threatened and state endangered Gopher Tortoise (*Gopherus polyphemus*). There are also documented occurrences of gopher tortoises near the proposed project site. **Therefore, we recommend that gopher tortoise burrow surveys be conducted within twenty feet of the project site (particularly in well-drained sandy substrates). If tortoise burrows are found, the following individuals should be contacted:** Tom Mann (601-354-7303, ext. 116) with the MS Dept. of Wildlife, Fisheries, & Parks and Will McDearman (601-321-1124) of the U.S. Fish and Wildlife Services.

- **Please note:**
  There are also two species of special concern that may occur on gopher tortoise priority and suitable soils. These species are the Oldfield Mouse, *Peromyscus polionotus*, and the Florida Harvester Ant, *Pogonomyrmex badius*. The oldfield mouse has burrows that look like small gopher tortoise burrows, with conspicuous sand aprons. The harvester ants create beds that are broad, flat, and generally ringed with bits of charcoal, gravel, and plant detritus. Both species will be in open, very sandy spots, with ample herbaceous vegetation nearby. If either species is discovered during the course of this project, we would deeply appreciate it if your staff would contact the following individuals: Scott Peyton (Oldfield Mouse) or Mr. Tom Mann (FL Harvester Ant) at 601-354-7303. Our staff is currently conducting field surveys for these species. Any additional information provided would be quite supportive in determining the status of these species (Oldfield Mouse and FL Harvester Ant).

Please be advised that the proposed pipeline route crosses through a Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) Wildlife Management Area, Okatibbee WMA, in Lauderdale County. We recommend that you contact the appropriate MDWFP personnel about this proposed pipeline and how it may impact their Wildlife Management Area.

The proposed pipeline route crosses several rivers and streams that are important habitat for many rare aquatic species. We strongly recommend that the following rivers/streams be directionally drilled to prevent or minimize negative impacts to their water quality and instream habitat conditions: **Chunky River**, Yazoo Creek, Pawticfaw Creek, Chickasawhay Creek, Blackwater Creek, Okatibbee Creek, Buckatunna Creek, Baker Creek, and any tributary of these that is 10 feet wide or greater at the water's surface and at the point of construction. We also strongly recommend that adequate measures are taken to mitigate any negative impacts to streams that result from this project. We also recommend that best management practices are implemented and monitored for compliance, specifically measures that will prevent ANY suspended silt and contaminants from leaving the site in stormwater run-off as this may negatively affect water quality and habitat conditions within nearby streams and waterbodies.

In addition, the Chunky River has been designated as a scenic stream. We strongly recommend that the potential negative impacts to the Chunky River that could result from this project be considered, and that all steps are taken to avoid/minimize these potential impacts.

Portions of this project site are underlain by hydric soils and may be designated wetlands. Should this project be approved, we ask that serious consideration be given to the cumulative impacts of wetland disturbance and elimination.

Please feel free to contact us if we can provide any additional information, resources, or assistance that will help minimize negative impacts to the species and/or ecological communities identified in this review. We are happy to work with you to ensure that our state's precious natural heritage is conserved and preserved for future Mississippians.

Sincerely,

Andy Sanderson

Andy Sanderson, Conservation Resources Biologist
Mississippi Natural Heritage Program
(601) 354-6367, ext. 117

APPENDIX G

NATURAL HISTORY AND TAXONOMIC REFERENCES FOR PRICE'S POTATO-BEAN

Natural History and Taxonomic References for Price's potato-bean (*Apios priceana*)

Kral, R. 1983. A report on some rare, threatened or endangered forest related vascular plants of the south. Atlanta, GA: U.S. Forest Service. p.718. USFS technical publication R8-TP2, . Vol. 1.

NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Woods, Michael. 2005. A Revision of the North American Species of Apios (Fabaceae). Castanea 70(2): 85-100.

Kral, R. 1983. A report on some rare, threatened or endangered forest related vascular plants of the south. Atlanta, GA: U.S. Forest Service. p.718. USFS technical publication R8-TP2, . Vol. 1.

Text & map by:
Robert Kral

FABACEAE

Apios priceana B. L. Robinson. Price's groundnut
Glycine priceana (Robinson) Britton

Technical Description

Herbaceous perennial, sometimes rampant, vine from a stoutish, thickened tuber.

Stems.--TWining, also somewhat twisted, terete and also low-ridged, yellow-green or tan, smooth or with a scattering of stiff hairs, forming a large vine.

Leaves.--Alternate, the stipules linear with a round attachment scar, odd-pinnately compound, mostly 2-3 dm long, spreading on slender but stiff, sparingly pubescent petioles one-third to one-half the length of the leaf; leaflets on stalks 3-5 mm long, spreading, 5-9, mostly 7, broadly to narrowly ovate, the lowest pair usually the largest, acuminate, entire, the bases rounded, the upper surface at maturity smooth, dark yellow-green, reticulate, the lower surface paler, puberulent, reticulate-veiny.

Inflorescence.--All but the lower leaves bearing rather compact panicles or racemes 5-9 cm long on stout, hairy stalks 3-4 cm long. Flowers one or more in axils of pale green, ovate, hairy, acuminate bracts, on pedicels 3-5 mm long, in total length ca. 2 cm.

Flowers.--Calyx a thin, pale green, villous cup ca. 3-4 cm high, this bearing at its lower edge a very narrow projecting lobe ca. 3 mm long. Corolla as in pea or bean, brownish-green with maroon tints, when viewed from the side strongly curved outwardly below, concave on the keeled greenish-yellow or pink standard blade above, this blade folded over most of the rest of the corolla and longest, its tip fleshier than the rest, beak-like, its base short-auricled; wings oblong linear, short-clawed, each bearing a short auricle basally; keel petals rather fleshy, strongly curved upward and linear, blunt, short clawed.

Fruit.--Pods 13-20 cm long, linear, somewhat turgid, the base cuneate, the apex abruptly attenuated into a prominent slender beak, the surface smooth, the valves firm with somewhat thickened margins. Beans oblong, smooth, dark brown, 7-8 mm long.

Distribution and Flowering Season

Rocky wooded slopes and floodplain edges, middle Kentucky southward through middle Tennessee into northern Alabama and Mississippi. Flowering from late June into August; fruit maturing in August.

Special Identifying Features

This plant is distinguished from *A. americana* Medic as follows:

1. The leaves are larger, the leaflets usually with one pair more.
2. The standard petal (uppermost petal) is larger, pink or with yellow-green tints rather than purple-maroon (as in *A. americana*), bearing at its tip a thickened, mucro-like appendage. In *A. americana*

the standard tip is blunt, even emarginate.

3. The fruits are longer, with the shorter ones about equal to the longest ones produced by A. americana.

Habitat and Management Implications

A. priceana is usually found under mixed hardwoods or in clearings therein, usually where ravine slopes or banks break into creek or river bottoms. It is on well-drained loams either on old alluvium or over calcareous boulders.

This is such a rare plant that little is yet known for sure of its response to disturbance, grazing, etc. It has been collected in secondary growth hardwood forest, thus is known to survive in the wake of logging. I have observed it in an area of recent burning and it may be conceded that it may react well to fire disturbance as do many other leguminous plants that have large tuberous rootstocks (Gleason, 1952, measured some rootstocks to be 18 cm wide!) However, the very rarity of the plants is an indication that this species has a narrow ecological amplitude.

References

Gleason, H. A. 1952. Illustrated flora, ed. 3, Vol. 11: 448-449. New York.

Small, J.K. 1933. Manual of the southeastern flora, p. 723. Chapel Hill, N.C.

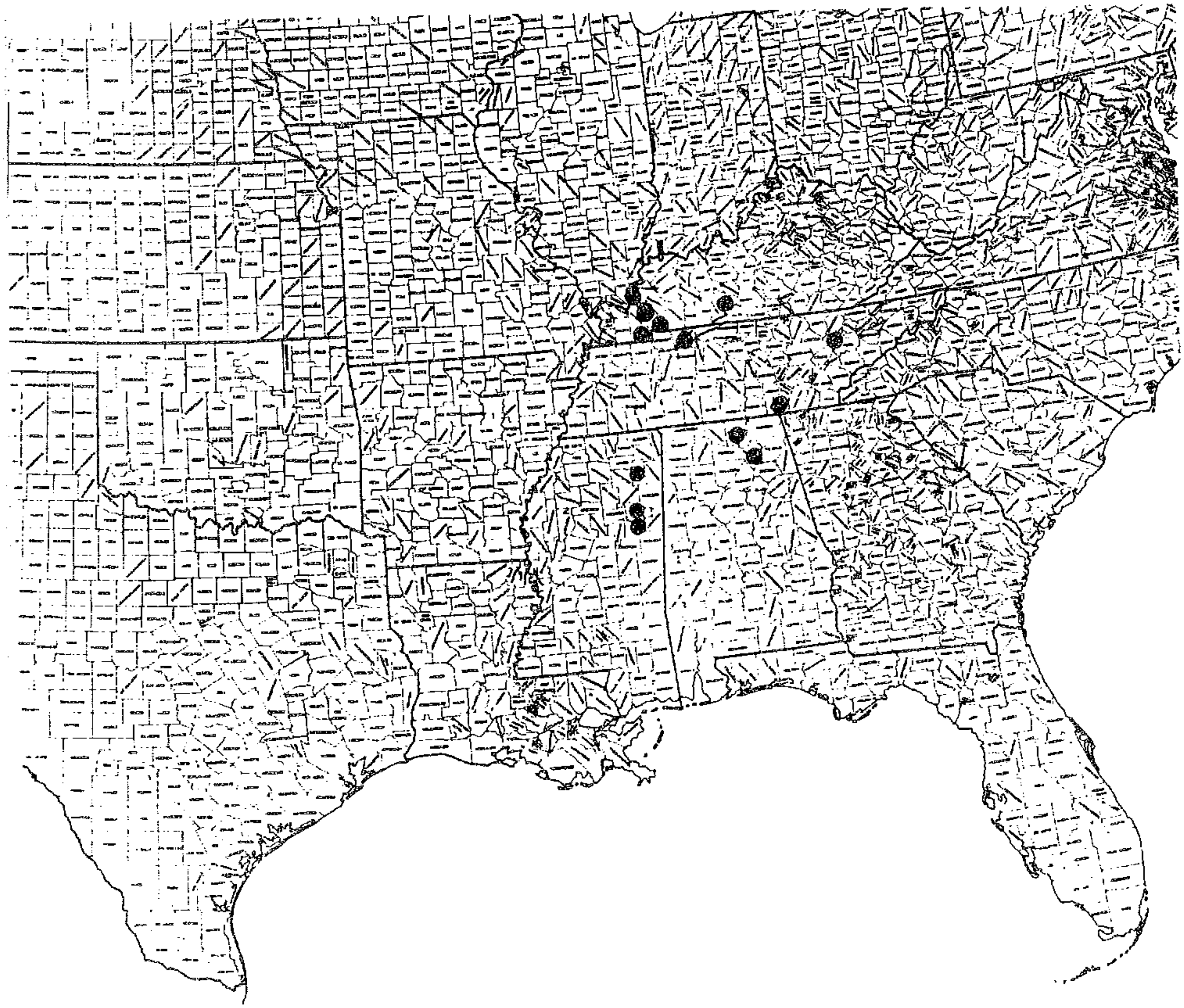
SPECIES Apios priceana B.L. Robinson

Expected* Effect on the Species	Management Practices							
	Prescribe Burn	Bulldoze or Root Rake	Bed	Chop	Thin over-story	Cut over-story	Establish Plantation	Graze
Destroy		X	NA	NA				
Damage					X	X		?
No Lasting Effect								
Beneficial if Done Properly	X							

Other Comments:

*Expected effect on the species is an estimate made by Dr. Robert Kral based on his knowledge of the habitat and on knowledge gained from personal field observations. Estimates are "rough" in many instances. Results of practices may be modified depending upon the degree of application, intensity of treatment, nearness to plant communities, etc. A management practice for which no entry is made indicates a lack of sufficient information from which to predict expected results. As observations are made in the field by users of the data, the expected effect will be refined.

Apios priceana B. L. Robinson



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Apios priceana - B.L. Robins.
Price's Potato-bean
Unique Identifier: ELEMENT_GLOBAL.2.138209
Element Code: PDFAB0D020
Informal Taxonomy: Plants, Vascular - Flowering Plants - Pea Family

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Kingdom	Phylum	Class	Order	Family	Genus
Plantae	Anthophyta	Dicotyledoneae	Fabales	Fabaceae	Apios

Check this box to expand all report sections: ☑

Concept Reference

Concept Reference: Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.
Concept Reference Code: B94KAR01HQUS
Name Used in Concept Reference: *Apios priceana*
Taxonomic Comments: One of the two U.S. species in this small genus.

Conservation Status

NatureServe Status

Global Status: G2
Global Status Last Reviewed: 09Jul2004
Global Status Last Changed: 25Jul1983
Rounded Global Status: G2 - Imperiled
Reasons:
Currently known from about 25 widely scattered populations, most with fewer than 50 individuals. *Apios priceana* is apparently dependant on a moderate level of disturbance; however, excessive habitat modification is threatening the existence of the species. Many of these few remaining occurrences are threatened by successional canopy closure, cattle grazing/trampling, right-of-way maintenance and forestry activities.
Nation: United States
National Status: N2

U.S. & Canada State/Province Status	
United States	Alabama (S2), Illinois (SX), Kentucky (S1), Mississippi (S1), Tennessee (S2)

Other Statuses

U.S. Endangered Species Act: LT: Listed threatened (05Jan1990)
U.S. Fish & Wildlife Service Lead Region: R4 - Southeast

Comments on official statuses: Apios priceana was proposed threatened on May 12, 1989 and federally listed as a Threatened species by the U.S. Fish and Wildlife Service on January 5, 1990.

NatureServe Conservation Status Factors

Global Abundance Comments: Individual EO's often have less than 50 plants present.

Estimated Number of Element Occurrences:21 - 80
Estimated Number of Element Occurrences Comments: Apios priceana has been collected from 21 sites in Alabama, Mississippi, Kentucky, Tennessee and Illinois (Norquist 1990, USFWS 1989, Medley 1980). However, many of these occurrences are no longer extant (Norquist 1990). The greatest concentration of occurrences are from western Kentucky and Tennessee (Medley 1980). The single Illinois site has been destroyed (Medley 1980) and the species is no longer considered extant in the state (Karnes pers. comm.). Apios priceana is considered extant at only 15 sites throughout its range: 4 sites in Kentucky; 4 sites in Tennessee; 4 sites in Mississippi; and 3 sites in Alabama. Several of these sites have multiple EO's, with 58 extant EO's in the central databases (July 2004).

Global Short Term Trend: Declining (decline of 10-30%)

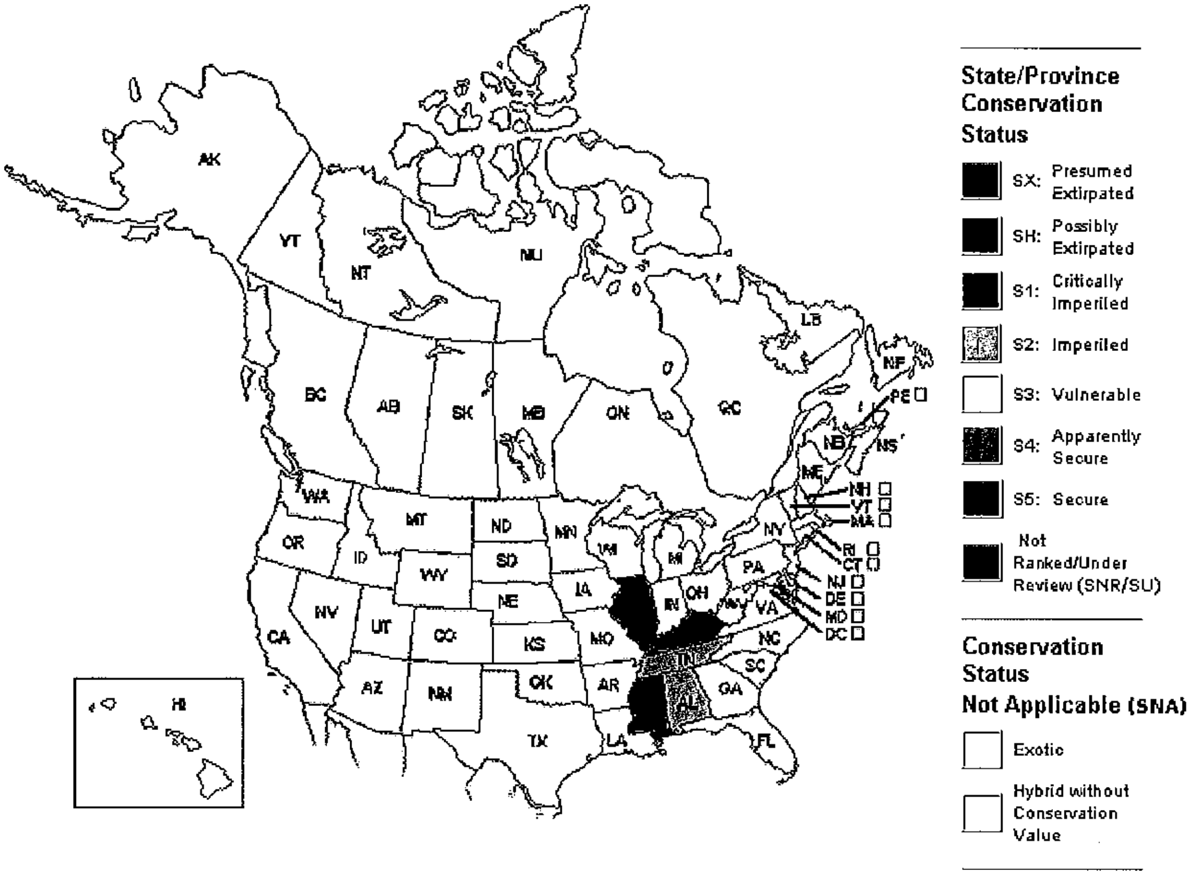
Degree of Threat: Widespread, low-severity threat
Threat Scope: High
Threat Severity: Low
Threat Immediacy: Unknown
Threats: Habitat loss and degradation from heavy or clear-cut logging, highway right-of-way maintenance, trampling and soil compaction by cattle are threats to this early successional species (Bender pers comm., Norquist 1990, USFWS 1989, Medley 1980). Development of lands for housing or other uses is a potential threat to occurrences of this species (Medley 1980). Brush-clearing (bush-hogging) during the growing season, line replacement and upgrading are additional threats to some sites (Bender pers. comm.). Some sites are threatened by non-native invasive species.

Threats at the Trigg County, Kentucky, sites include trampling by hikers, overcrowding by shrubs, canopy closure, mowing, highway maintenance and competition from introduced crown vetch (Coronilla varia) (Chester and Holt 1990). Succession is considered a major threat at some sites (Norquist 1990).

Fragility Comments: Relatively resistant.

Distribution ⓘ

U.S. States and Canadian Provinces



U.S. & Canada State/Province Distribution	
United States	AL, IL*, KY, MS, TN

Range Map
No map available.

Global Range Comments: Mississippi (Clay, Oktibbeha and Lee counties); Alabama (Madison, Autsuga and Marshall counties); Kentucky (Lyon, Livingston and Trigg counties); Tennessee (Marion, Montgomery and Williamson counties). Historic in Illinois.

U.S. Distribution by County (based on available natural heritage records unless otherwise indicated) (?)

State	County Name (FIPS Code)
AL	(01001)+, (01047)+, (01071)+, (01079)+, (01089)+, (01095)+
KY	(21035)+, (21139)+, (21143)+, (21157)+, (21221)+, (21227)+
MS	(28025)+, (28069)+, (28081)+, (28105)+
TN	(47037)+, (47041)+, (47055)+, (47081)+, (47115)+, (47119)+, (47125)+, (47161)+, (47181)+, (47187)+

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records) (?)

Watershed Region (?)	Watershed Name (Watershed Code)
03	Upper Alabama (03150201)+, Middle Alabama (03150203)+, Town (03160102)+, Tibbee (03160104)+, Noxubee (03160108)+
05	Barren (05110002)+, Caney (05130108)+, Lower Cumberland-Sycamore (05130202)+, Harpeth (05130204)+, Lower Cumberland (05130205)+, Lower Ohio-Bay (05140203)+, Lower Ohio (05140206)+
06	Sequatchie (06020004)+, Guntersville Lake (06030001)+, Wheeler Lake (06030002)+, Lower Elk (06030004)+, Lower Tennessee-Beech (06040001)+, Lower Duck (06040003)+, Buffalo (06040004)+, Kentucky Lake (06040005)+

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

Ecology & Life History

Technical Description: Plant a herbaceous, twining, perennial vine, to 5 m, scrambling over other vegetation, arising from a large, starchy underground tuber. Stems slender, twining, round in cross-section, ridged; green or tan, smooth or with scattered, stiff hairs. Leaves alternate, 0.6-1 foot long, composed of 5-9 (mostly 7) ovate leaflets; the lowest pair of leaflets usually the largest. Leaflets entire-margined, with rounded bases and narrowed points, widest below the middle, the upper surface smooth at maturity, dark yellow-green, net-veined, the lower surface paler, fine-hairy; tiny (but evident) rusty-brown hairs on the short stem at the base of each leaflet. The flowers are swollen, greenish-pink with maroon tints and a beak-like tip. They are arranged in compact racemes, on stout hairy stalks, in the axils of pale green, ovate, hairy, pointed bracts. Fruit an elongated legume, 5-8 inches long, somewhat swollen, abruptly narrowing into a slender beak. The seeds are oblong, smooth, dark brown, and about 0.3 inch long.

Diagnostic Characteristics: This species most closely resembles Apios americana (= A. tuberosa), from which it is distinguished by the following characteristics: (a) larger leaves, usually with 7 rather than 5 leaflets; (b) the uppermost petal (standard) has an elongated tip, is larger, and is pink with green tints rather than maroon; (c) the fruits are longer, the shortest ones similar in length to the longest ones in A. americana. Wisteria is similar, but can have more leaflets (5-11) which are all about the same size and widest in the middle (in contrast to those of Apios); the leaf rachis of Wisteria is hairy, and its flowers are purple and bloom in the early spring.

Reproduction Comments: Flowers of A. priceana bloom from June through August, possibly as late as September (Kral 1983, Mahler 1970). Legumes mature in August to September (Kral 1983). Early reports by the discoverer of the species, Sadie Price, suggested that it does not frequently set fruit (Robinson 1898).

Ecology Comments
Unlike its close relative, Apios americana, which produces numerous tubers, A. priceana produces only one. This fact may serve to severely limit natural dispersal of the species. Since A. priceana has just the single tuber, it is unable to be dispersed effectively along rivers by spring freshets as is A. americana (Seabrook and Dionne 1976).

Apios priceana has a potential value to humans as a food source (USFWS 1989). The large single tubers from which the plant grows are edible and may have been used by Native American Indians and early settlers as food, as was Apios americana. The ability of the species to grow in highly alkaline (pH > 8.0) and acidic (pH < 5.0) (Duke 19) soils could provide genetic resources for the development of Apios hybrids in cultivated lands otherwise marginal for most other crops (USFWS 1989, Walter et al. 1986). Perhaps the most valuable aspect of A. priceana is as a source of germ plasm for breeding with other Apios species (Norquist 1990, Walter et al 1986).

According to a recent study of A. priceana (Walter et al. 1986), the tubers were found to be composed of 61.9% water, 5.0% fiber, 2.6% crude protein, 2.7% ash, 27.1% carbohydrate and 0.7% fat. For a compositional comparison of A. priceana tubers with those of A. americana and A. fortunei, see Walter et al. (1986). As a food crop, A. priceana tubers are naturally low in essential amino acids. Extraction of nonprotein nitrogen by alcohol resulted in tuber protein that could be useful in human nutrition (Walter et al. 1986).

Open forest canopies tend to correlate with increased flowering in the species (Somers pers. comm.). Flowers of A. priceana bloom from June through August, possibly as late as September (Kral 1983, Mahler 1970). Legumes mature in August to September (Kral 1983). Early reports by the discoverer of the species, Sadie Price, suggested that it does not frequently set fruit (Robinson 1898). Potential pollinators include a butterfly (Eudamus tityrus), honey and bumble bees (Robinson 1898). Apparently the bees find the nectaries very difficult to access. Apios priceana can be readily germinated by scarification of the seed coat through chipping (Seabrook 1973) or acid (Walter et al. 1986).

Apios priceana is apparently quite easy to grow from seed, but requires scarification or other natural processes to break physical dormancy (Baskin pers. comm.; Bowden pers. comm.). Following scarification, 18 of 20 seeds planted 1 cm deep in soil grew in a recent test in Kentucky (Baskin pers. comm.). Scarification can be accomplished through a nick with a file, grinding wheel, hot water or sulfuric acid (Bowden pers. comm.). Plants can grow 5-6 feet during the first summer, but do not flower. Flowering is apparently initiated only in plants that have over-wintered (Baskin pers. comm.).

Tubers of A. priceana apparently require vernalization for growth (Bowden pers. comm.). Plants die back to the tuber in the mid-summer.

Additional research has been conducted on A. priceana for horticultural purposes. According to the Missouri Botanical Garden, A. priceana prefers acidic, water retentive soils, requires no soil additives, can withstand winter temperatures below 5 degrees Celsius, shows no intolerance to supplemental feedings, and possesses no apparent pests (Bowden pers. comm.). The species has been successfully propagated.

Habitat Comments: Open, rocky, wooded slopes and floodplain edges. Sites are usually under mixed hardwoods or in associated forest clearings, often where bluffs or ravine slopes meet creek or river bottoms. Soils are well-drained and loamy, formed on alluvium or over calcareous boulders. Several populations extend onto road or powerline rights-of-way.

Price's potato-bean is an inhabitant of open, mixed-oak forests, forest edges and clearings on river bottoms and ravines, being unable to tolerate deep shade (USFWS 1989, Kral 1983). The species occurs on well-drained loams on old alluvium or over calcareous boulders (Kral 1983). Associates typically include Quercus muhlenbergii, Campanula americana, Lindera benzoin, Arundinaria gigantea, Tilia americana, Fraxinus americana, Acer saccharum, Ulmus rubra, Cercis canadensis, Toxicodendron radicans and Parthenocissus quinquefolius (Medly 1980).

Four extant populations of A. priceana are known from Kentucky. The type location near Bowling Green, Warren County, Kentucky, was characterized as a rocky woods (Robinson 1898); it has been destroyed. A population in Livingston County (estimated at 50-65 plants in 1984) has been severely degraded by cattle since their introduction into the area in 1986 (Norquist 1990). Additional collections in Kentucky have been made in Lyon and Trigg counties (Chester and Holt 1990, Browne and Athey 1976). The Lyon County site consisted of 25-30 individuals, extending onto a right-of-way (Norquist 1990).

The Hematite Lake site in northern Trigg County, Kentucky, was relocated by Woods (1985) and later by Chester and Holt (1990). The population had been considered extirpated (Medley 1980). This site is along a hiking trail at the base of a southeast-facing slope with numerous limestone outcrops (Chester and Holt 1990). The population consisted of 25 plants in 1989, but no plants were observed to set seed in that year. Associates included Arundinaria tecta, Symphoricarpos orbiculatus, Acer saccharum, Celtis laevigata, C. occidentalis, Carya ovata, Ulmus rubra, Quercus muehlenbergii, Ostrya virginiana, Amphicarpa bracteata, Hystrix patula, Solidago rugosa, Matelea gonocarpos, Agrimonia rostellata, Lobelia inflata and a species of Panicum (Chester and Holt 1990). The southern Trigg County, Kentucky, site (previously unseen since 1966) was rediscovered by Chester and Holt (1990). A population of 30-50 plants occurs at the base of a southeast-facing slope with numerous limestone outcrops, in a roadside ditch that is fairly open to light (Chester pers. comm., Chester and Holt 1990). In 1989, at least 15 mature legumes were produced by this population. Associates include Spigelia marilandica, Cimicifuga racemosa, Campanula americana, Geum canadensis, Anemone virginica, Lactuca canadensis, Melilotus officinalis, Rudbeckia triloba, Ptela trifoliata, Fraxinus americana, Morus rubra, Cercis canadensis, Carpinus caroliniana, Ostrya virginiana, Quercus muehlenbergii, Acer saccharum and Ulmus rubra (Chester and Holt 1990).

Tennessee has four extant sites of A. priceana. All occur in soils overlying limestone bedrock in the Highland Rim physiographic region or the Sequatchie Valley, which drains into Alabama (Somers pers. comm.). Associated vegetation varies considerably between sites, but all sites are close to streams or rivers. Western mixed mesophytic forest is present at two of the sites, while a third is present on a bluff. The largest population is in an area recovering from a recent clear-cut operation (Somers pers. comm.). Populations are known from Marion, Montgomery and Williamson counties (Norquist 1990).

Four extant sites occur in three counties in Mississippi: Clay, Oktibbeha and Lee (Norquist 1990). At Kilgore Hills (Clay County), 15-20 plants occur on the banks of a prairie stream. The population occurs on clay alluvial soil over the Demopolis Formation. Soil pH varies between 6.6 and 8.4. The Coonewah Creek (Lee County) and Ray's Woods (Oktibbeha County) sites occur in mixed deciduous forest on a calcareous north-facing slope above the broad expanse of the northeast Prairie Belt. The soil at both sites is a marly clay underlain by a thick bed of a white marine chalk deposit. At both sites the soil pH varies between 7.4 and 8.4 (Medley 1980). For site-specific information pertaining to associated species, see Medley (1980).

Three extant populations are known from Alabama in Madison, Autsuga and Marshall counties (Norquist 1990). Two of the populations are located along the floodplain of the Alabama River (Gunn pers. comm.).

A single population occurred along a swamp border in a federal ecological area in Illinois, but this population has been destroyed. The area has been searched repeatedly with no positive results (Karnes pers. comm.). Ebinger (1981) stated that the habitat of the species in the state was floodplain forests and thickets of the Lower Mississippi River.

Economic Attributes

Economic Comments: Germplasm of agricultural value.

Management Summary

Stewardship Overview: Management techniques to provide long-term survival for the species will need to center around the maintenance of natural openings in the forest canopy brought on by prescribed fire, forest thinning or logging. Monitoring should be done to track population size and stability, fruit production, seed set and recruitment. Changes in these factors with respect to other vegetation and canopy closure are also in need of monitoring.

Restoration Potential: Apios priceana is currently being cultivated at the Missouri Botanical Garden (Pickering 1989). Information gained from the cultivation of Price's groundnut at this and other sites (such as the University of Kentucky) will prove important in the long-term recovery of the species. Early results indicate that seeds from the plant are relatively easy to germinate upon scarification. First-year plants grow rapidly, often reaching 5-6 feet in height during the first year.

Preserve Selection & Design Considerations: Land protection must include land occupied by the primary population as well as adequate buffer to protect the site from outside influences (pesticide drift, etc.). Protection of only the immediate population may lend it susceptible to a number of potential threats.

Management Requirements: Precise management needs are poorly known at this time. Maintenance of natural openings, possibly via artificial cutting or prescribed fire, have been suggested by some authorities. Apios priceana is apparently able to withstand light, selective logging (Kral 1983), but whether this is a suitable management alternative is unknown. It has been suggested that light logging may enhance the species, while heavy clear-cut logging would destroy populations (Kral 1983, Medley 1980). The species may require specific seral stages or seasonal disturbances to arrest succession (Norquist 1990). Determination of precise habitat requirements through research is needed in order to suggest adequate management options.

Protection of the population from excessive grazing and trampling, as well as herbicide application is recommended. Presently, some populations are suffering from the adverse affects of grazing, while potential herbicide application threatens others.

Kral (1983) stated that A. priceana has been observed in secondary forests, suggesting that it is able to survive logging. He also observed that it reacted well to fire disturbance, as do many legumes with tuberous rootstalks. The rarity of the species suggests that it has a narrow ecological amplitude (Kral 1983), so management tolerance levels must be known prior to the undertaking of management options.

Bulldozing or root raking are believed to destroy the plant (Kral 1983). Thinning or cutting of the overstory may possibly damage A. priceana plants if done during the growing season. If undertaken, these methodologies should only be utilized when the plant is dormant.

Monitoring Requirements: Development of adequate monitoring techniques is a need at all sites (Somers pers. comm.). Monitoring should asses the actual number of plants in each extant population over time. Fruit production, seed set and recruitment also should be monitored (Bender pers. comm.). Monitoring should be considered on at least a five-year cycle. Many managers might wish to consider more extensive annual or biennial monitoring programs.

Habitat monitoring is also a major need. Apios priceana is intolerant of excessive canopy shading and competition. Canopy closure should be monitored to determine when canopy thinning or other management activities should be instituted.

Due to the relatively large size of this vine, counts of all individuals would be relatively easy to complete and should be undertaken on a periodical basis. Fruit production, seed set, and recruitment should be documented during the visit. For ease of monitoring, visits should coincide with that of fruit set. Locations of individuals should be mapped on a base map in order to determine life span, recruitment and death rates.

Canopy closure should be monitored on an annual basis using a wide-angle or similar photographic lens. Photographs of the canopy immediately above the population should help determine the extent to which closure is tolerated by the species, as well as the optimal time for appropriate management options.

Management Programs: The two Trigg County, Kentucky, sites occur within the Land Between The Lakes management area of the Tennessee Valley Authority (TVA). The area is designated as a multiple-use facility for recreation, education and conservation activities (Chester and Holt 1990). Contact: Beth Wellbaum, TVA Forester. Telephone No. (502) 924-5602; OR, Dr. Leo Collins, TVA Stewardship Program Botanist, Norris, TN. Telephone No. (615) 494-9800.

After acquisition of the Lyon County site in Kentucky, the State Nature Preserves Commission intends to open the canopy in several areas near the species' present location. Attempts to grow plants from seeds collected at the site, followed by introduction into new openings are also considered. All activities will have the approval of the USFWS prior to implementation. Contact: Joyce Bender, Stewardship Coordinator, Kentucky Heritage Program, KY Nature Preserves Commission, 407 Broadway, Frankfort, KY 40601. Telephone No. (502) 564-2886.

Barnett's Woods Preserve in Tennessee, owned by The Nature Conservancy, protects two element occurrences. At present, no specific management is being conducted for the species. Contact: Geoff Roach, Director of Protection Planning and Stewardship, Tennessee Field Office, The Nature Conservancy, P.O. Box 3017, Nashville, TN 37219. Telephone No. (615) 242-1787.

Monitoring Programs: The Kentucky State Nature Preserves Commission is currently pursuing the purchase of 140 acres in Lyon County to protect the species (Bender pers. comm.). The stem count of the population will be conducted in the summer of 1990 if the site has not been purchased by the time of flowering. Contact: Joyce Bender, Stewardship Coordinator, Kentucky Heritage Program, KY Nature Preserves Commission, 407 Broadway, Frankfort, KY 40601. Telephone No. (502) 564-2886.

The Tennessee Field Office of The Nature Conservancy will hire an independent contractor for the collection of ecological and biological information pertaining to A. priceana at one of its preserves. Duties will include: (1) identification of the community associated with A. priceana, (2) mapping, inventory and monitoring of A. priceana populations, and (3) generation of two reports. Monitoring will include the assessment of growth rates, flowering period, flower number, inflorescence number, seed set, fruit/seed ratio, average rainfall, soil moisture, relative humidity and competition. Contact: Geoff Roach, Land Steward, The Nature Conservancy of Tennessee, P.O. Box 3017, 174 Second Avenue N., Nashville, TN 37219. Telephone No. (615) 242-1787.

The Mississippi Natural Heritage Program does not have an active monitoring program for the species, but does determine if the habitat and the species are still present (Gordon pers. comm.). They continue to maintain contact with the private landowners who possess populations. Contact: Ken Gordon, Coordinator/Botanist, Mississippi Natural Heritage Program, Museum of Natural Science, 111 N. Jefferson St., Jackson, MS 39201-2897. Telephone No. (601) 354-7303.

Management Research Programs: Geoff Roach, Tennessee Field Office of The Nature Conservancy, and Drs. Carol Baskin, Jerry Baskin and Ed Chester are considering doing some life-history research on Apios priceana. Contact: Geoff Roach, Director of Protection Planning and Stewardship, Tennessee Field Office, The Nature Conservancy, P.O. Box 3017, Nashville, TN 37219. Telephone No. (615) 242-1787.

Carol Baskin is currently growing 18 plants in a greenhouse, some of which will be planted at TVA's Land Between the Lakes visitor center. Seed germination has been studied, but insufficient amounts of seed are available for adequate studies regarding flowering requirements and germination phenology. It is hoped that seed produced from the plants at the Land Between the Lakes visitor center will help facilitate these future studies. Contact: Dr. Carol Baskin, University of Kentucky, Lexington, KY. Telephone No. (606) 257-3996.

The Tennessee Ecological Services Division has received Section 6 money from the USFWS to search for additional populations this summer (1990). Contact: Paul Somers, ESD, Tennessee Department of Conservation, 701 Broadway, Nashville, TN 37219-5237. Telephone No. (615) 742-6549.

The Missouri Botanical Garden is currently propagating the species, but no active research is being conducted or is planned for the species. At present, plants are growing on a wall in the Scented Garden as well as six plants in the nursery. Additional plants in the Woodland Garden have died, and research will need to be conducted to determine the reason for death. Plants in the nursery may be used to replace those that died in the Woodland Garden. Contact: Robert Bowden, Director of Horticulture, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166. Telephone No. (314) 577-5189.

Biological Research Needs:

Population/Occurrence Delineation

Alternate Separation Procedure: Use the Habitat-based Plant Element Occurrence Delimitation Guidance (2004).
Date: 01Oct2004

Population/Occurrence Viability ⓘ

Excellent Viability: An A-rated occurrence of *Apios priceana* is a population that contains 150 or more plants in a mature, relatively undisturbed forest. Ideally the occurrence should be well insulated from potential anthropogenic disturbance where the habitat is characterized by a partially shaded forest with no or minimal influence (< 10 %) by exotic and/or native invasive species.

Good Viability: A B-rated occurrence of *Apios priceana* is a population that contains 50 to 149 plants in a mature, relatively undisturbed forest. Ideally the occurrence should be well insulated from potential anthropogenic disturbance where the habitat is characterized by a partially shaded forest with no or minimal influence (< 10 %) by exotic and/or native invasive species. B-rated specifications also apply to larger occurrences having a greater affluence (to 30 %) of invasive species, logging, and/or development. Easily restored to A-rated conditions.

Fair Viability: A C-rated occurrence of *Apios priceana* is a population that contains 10 to 49 plants in a mature, relatively undisturbed forest. Ideally the occurrence should be well insulated from potential anthropogenic disturbance where the habitat is characterized by a partially shaded forest with no or minimal influence (< 10 %) by exotic and/or native invasive species. C-rated specifications also apply to larger occurrences having a moderate to high affluence (to 75 %) of invasive species, timber harvesting, and/or development. Restoration potential to A- and B-rated specifications is good.

Poor Viability: A D-rated occurrence of *Apios priceana* is a population that contains less than 10 plants in a mature, relatively undisturbed forest. D-rated specifications also apply to larger occurrences in highly modified habitat with minimal or no restoration potential.

Justification: Specifications are based on Element Occurrence Records, academic publications (namely USFWS), personal observations, and expert opinions. Currently limited research is being conducted on this species but no information outlining population dynamics and viability has been published. As new information becomes available, EO specs should be reassessed and updated.
Date: 04Jan2005
Author: Schotz, Alfred

U.S. Invasive Species Impact Rank (I-Rank) **Not yet assessed** ⓘ

Authors/Contributors ⓘ

NatureServe Conservation Status Factors Edition Date: 10Jul1990
NatureServe Conservation Status Factors Author: Ostlie, Wayne MRO; rev. Pyne/Maybury, 1996.
Management Information Edition Date: 30Jun1990
Management Information Edition Author: WAYNE OSTLIE

Botanical data developed by NatureServe and its network of natural heritage programs (see **Local Programs**), The North Carolina Botanical Garden, and other contributors and cooperators (see **Sources**).

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A Revision of the North American Species of *Apios* (Fabaceae)

MICHAEL WOODS*

Department of Biological and Environmental Sciences, Troy University, Troy, Alabama 36082

ABSTRACT

The revision of *Apios* in North America is based on morphological analysis of herbarium specimens as well as field and greenhouse observations. The genus is herein recognized as consisting of two distinct species in North America. *Apios priceana* was described by Robinson in 1898. Currently it is listed as threatened by the United States Fish and Wildlife Service and is known from 47 populations in 22 counties in Alabama, Kentucky, Mississippi and Tennessee. The other species, *A. americana*, widely distributed in eastern North America, was first described by Cornut in 1633 and has been regarded as consisting of six infraspecific taxa, which are not recognized in the present treatment. Demarcation is based primarily on reproductive features as vegetative characteristics, both within and between species, exhibits a significant amount of variation. In addition to the taxonomic descriptions, dichotomous keys, illustrations and distribution maps are presented for each species.

INTRODUCTION

Apios Fabricius (Fabaceae) occurs in Asia and North America. The Asian species are represented by three specific and two infraspecific taxa. Prior to this treatment, *Apios* was represented in North American by two specific and six infraspecific taxa (Woods 1988).

Taxonomic History of Apios

The genus *Apios* was named by Cornut (1633) when he described *A. americana*. Linnaeus (1753) brought *A. americana* into the modern era of botanical nomenclature when he listed it as a synonym for *Glycine apios*. The first revision of *Apios* after Linnaeus was by Fabricius (1759), who recognized *A. americana*, crediting Cornut as the authority. *Glycine apios* was listed as a synonym. Medikus (1787) recognized *A. americana* and listed *G. apios* as a synonym. Of the original eight species Linnaeus (1753) included in the genus *Glycine*, *G. apios* (*A. americana*) was the only one that Medikus accepted. He noted that the flower alone was so distinctive that it was clearly different from the other seven species in Linnaeus' genus *Glycine*.

In 1794, Moench named *A. tuberosa* and described it as having tuberous roots, unevenly pinnate leaflets, and purple flowers in lateral racemes. He listed *G. apios* as a synonym. For the next 80 years the names *G. apios* and *A. tuberosa* were used about equally in major publications.

Rafinesque (1824) created the binomial *Gonancylis thyrsoidea* to replace *A. americana*. It was not until Rafinesque (1836) discussed the use of equivocal names that are pronounced nearly alike, that an explanation for this nomenclatural change was given. According to Rafinesque, the generic names *Apis*, *Apus*, *Apios*, *Apium*, and *Apion* were poor names because they sound too much alike when pronounced. There was no explanation as to why the specific epiphet was changed from *americana* to *thyrsoidea*.

In an attempt to gain acceptance for the use of duplicate binomials, MacMillan (1892) proposed the tautonym *A. apios*. The source of this combination was from the generic name of *A. tuberosa* and from the specific epiphet of *G. apios*. This combination was occasionally used;

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* email address: mwoods@troy.edu

however, it is an illegitimate name according to article 23 of the Botanical Code (Voss 1983) which states "The specific epiphet may not exactly repeat the generic name with or without the addition of a transcribed symbol (tautonym)."

In the first edition of the Botanical Code (Briquet 1906), *A. americana* Medikus (1787) was chosen as the nomenclatural type in the conservation of *Apios* against *Glycine* (Linnaeus 1753, 1754) (*partim quoad spec 1*). Had the congress, who were evidently unaware, known *A. americana* Fabricius (1759) had been published prior to Medikus' publication, it would likely have been chosen as the nomenclatural type.

Although *A. americana* was chosen as the nomenclatural type (Briquet 1906), Rehder (1934) pointed out that *A. tuberosa* was usually cited as the correct name. The reason for this was two fold: firstly, the rarity of the periodical in which Medikus (1787) published *A. americana* (as Rehder noted, it cannot be found in auy American library); secondly, Taubert (1894) treated *A. americana* and *A. tuberosa* as representing different species.

Robinson (1898) described *A. priceana* and named it in honor of Sadie F. Price, its discoverer. The type location of *A. priceana* in Warren County, Kentucky, has never been relocated and likely has been destroyed by development. Britton transferred *A. priceana* to *G. priceana* (Britton and Brown 1913). This transfer was unjustified as *Apios* had already been conserved against *Glycine* (Briquet 1906). When Robinson (1898) described *A. priceana* he divided the genus into two subgenera. He placed *A. priceana* in subgenus *Tylosemium* and *A. americana* into the subgenus *Euapios* along with the three described Asian species of *Apios*. Subgenus *Tylosemium* was characterized as having a standard with a thick, spongy, knot-like prolongation (stylobus) at its apex and a single, irregularly spheroidal tuber. Subgenus *Euapios* was characterized as having a standard rounded or retuse at the unthickened sumit and the below ground portions, as far as known, fibrous or moniliform-tuberous.

Reproduction

No detailed studies have been conducted on the reproductive and pollination biology of *Apios priceanea* Robinson. The long tailed skipper (*Urbanus proteus* L.), honey bees (*Apis mellifera* L.) and bumble bees (Subfamily *Aspinae*, Tribe *Bombini*) are common visitors and, therefore, possible pollinators (United States Fish and Wildlife Service 1993). However, Connolly et al. (1998) reported that uniformity of banding patterns using electrophoretic analysis suggests that *A. priceanea* may be self-pollinating. Bruneau and Anderson (1988, 1994) reported the reproductive biology of *A. americana* Medikus. In the northern one-half of its range, *Megachile* species (leaf cutter bees) are the only visitors reported to trip the flowers and, therefore, are the only likely pollinators. In the southern part of its range, *Megachile* species are the only insects observed tripping the flowers. Two additional types of bees, honeybees (*Apidae*), and members of the *Halictidae* are frequent visitors but have not been observed tripping the flowers. Based on pollination studies conducted on alfalfa by Free (1970) honeybees tripped 18% of the flowers they visited. Since the number of alfalfa flowers tripped increased from north to south, Bruneau and Anderson (1988) suggested that honeybees may be more effective at tripping flowers of *A. americana* in the southern part of the range and, therefore, would be legitimate pollinators as well.

Crossing experiments and field observations have shown that triploid individuals are sterile and no fruits are produced. Triploid populations consist entirely of clonal individuals that propagate asexually through the production of tubers. Diploid individuals also propagate asexually through tubers but they also produce fruits and viable seeds (Bruneau and Anderson 1988).

Phylogeny, cytology, ethnobotany, conservation biology, and infraspecific taxa are all reasons why a revision of the North American species of *Apios* was needed.

Phylogeny

Apios (Papilionoideae: Phaseoleae) is not phylogenetically related to any other genera in the subtribe Erythrininae, where it has historically been placed. Based on analyses of plastid rbcL (Kajita et al. 2001) and matK gene sequences (Wojciechowski et al., in press) *Apios* is nested in one of two main subclades, the one containing the majority of members of Phaseoleae, that comprise the clade informally know as the Millettioid/Phaseoloid clade (Kajita et al. 2001) or the Millettioids (Wojciechowski et al., in press). Phaseoleae consists of approximately 80 genera and only about 50% of the genetic diversity of the tribe has been sampled. Therefore, the relationships of all of the constituent genera are still uncertain (M.F. Wojciechowski, Arizona State University, pers. comm.).

Cytology

Chromosome counts have been reported for both North American species of *Apios*. Seabrook and Dionne (1976) described diploid ($2n = 2x = 22$) for *A. priceana* Robinson and also for *A. americana* Medikus, in the southern part of its range. However, most *A. americana* populations in the northern part of its range are described as triploid ($3n = 3x = 33$) (Seabrook and Dionne 1976, Bruneau and Anderson 1988). Diploid and triploid individuals are nearly identical morphologically (Bruneau and Anderson 1988).

Ethnobotany

Apios americana Medikus has been considered as a potential commercial root crop (Blackmon 1986) primarily because of its 16.5% dry weight protein content (Walter et al. 1986). Nutritional analyses of *A. priceana* Robinson indicate that its tubers are far less beneficial for human consumption (Connolly et al. 1998). Thus far, cultivation has been unsuccessful (Reynolds et al. 1990). However, recent data shows both *A. priceana* and *A. fortunei* Maximowicz have alleles not present in either diploid or triploid populations of *A. americana*. This indicates that they may have unique characters that could increase the feasibility of developing *A. americana* as a new root crop (Connolly et al. 1998). In addition, the recent isolation of the anticarcinogenic compound genistein from the tubers of *A. americana* should greatly enhance its desirability as a new root crop (Krishnan 1998).

Conservation Biology

Apios priceana Robinson received a global rank of G2 in 1983, meaning it was imperiled globally with only 6–20 known occurrences (United States Fish and Wildlife Service 1990). Woods (1988) recommended that the United States Fish and Wildlife Service list *A. priceana* as endangered throughout its range. At that time, only 10 extant populations were known and 60% of those were in threat of destruction. *Apios priceana* was listed as threatened throughout its entire range in 1990 due to the small number of populations and threats to its habitat (United States Fish and Wildlife Service 1990). When the recovery plan was published in 1993 there were only 24 known populations. The three strategies recommended for recovery of the species are: research on population biology (habitat requirements, vegetative reproduction, pollinations biology, seed dispersal and germination requirements, demography, and the genetic make-up of the populations); search for new populations; and, maintain seeds and plants under artificial conditions so that material will be available for transplanting if natural populations decline or disappear (United States Fish and Wildlife Service 1993).

Infraspecific Taxa

At the time of the last revision of the genus (de Candolle 1825), *Apios americana* Medikus was the only described North American species and none of its six infraspecific taxa had been described. Daniels (1911) described forma *boulderensis* based on a specimen he collected from Boulder, Colorado. Fernald (1934) described forma *cleistogama* as having greenish, minute expanding corollas which scarcely protrude from the calyx while variety *turrigera* (Fernald 1939) is described as having lax, lanceolate or ovoid-attenuate racemes that are prolonged at the apex (Figure 1, number 2). *Apios americana* forma *pilosa* was described by Steyermark (1938) as having spreading hairs on the stems and leaflets. Two color forms of *A. americana*, form *keihneri* and form *mccullougi*, were described by Oswald (1961a, 1961b). Both of these formas are distinguished, based on *Color Standard and Color Nomenclature* (Ridgway 1912). Oswald

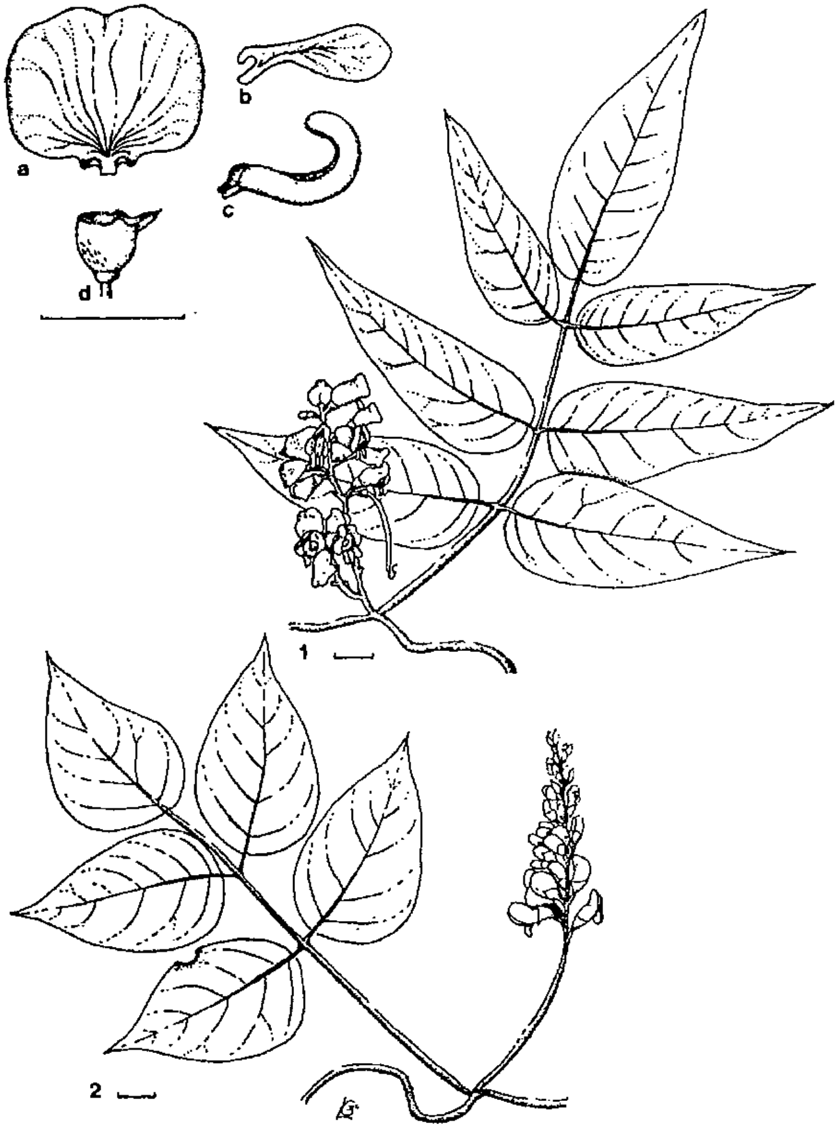

Figure 1. Illustration of *Apios americana*–Number 1: typical raceme habit; a. standard petal; b. wing petal; c. keel petal; d. calyx. Number 2: variation in raceme habit. All scales equal 1.0 cm. *From*: Woods (1988). Illustrated by Linda Gucciardo.

described the corolla color of *A. americana* form *keihneri* as Indian Purple to Dark Corinthian Purple inside and out, except for a small white area in the throat. For *A. americana* form *mcculloughi*, the external color of the standard blends from Pale Vinaceous to Vinaceous, the tip White to Dull Green-yellow. The internal color of the standard is Garnet-brown. Both surfaces of the wings are Oxblood Red to Dark Perilla Purple, while the keel blends from Dark Vinaceous to Pale Dull Green-yellow or White.

METHODS

This revisionary treatment was based on an analysis of reproductive and vegetative organs. The morphological, anatomical, and geographical data were compiled from over 2,100 herbarium specimens, including the types of both *Apios americana* Medikus and *A. priceana* Robinson. Four of the six types of the infraspecific taxa of *A. americana* were also examined.

Herbarium specimens were obtained on loan from the following herbaria: A, APSC, AUA, B, CAL, CHI, E, F, FWM, GH, ILL, ILLS, K, LE, LSUM, MISS, MO, NTSC, NY, P, PE, PH, SIU, SMU, TAI, TENN, TEX, TROY, TTC, UNA, UPS, US, and WNLM. Field studies were conducted throughout most of the geographical range of both species. In addition, seeds and/or tubers from various populations were planted in the greenhouse on the campus of Southern Illinois University at Carbondale and the resultant plants were studied.

Herbarium specimens were initially divided into groups based on overall morphological similarity. Each group was then critically examined and a tentative decision of species was established. Morphological measurements were then made from selective specimens of each group. Specimens were measured using a Bausch & Lomb 0.7X-3.0X stereoscope, a plastic 15 cm ruler graduated in 1.0 mm divisions, and a dial caliper graduated in 0.1 mm divisions. A surfactant and water were used to pre-soak the flowers for dissection and measurements. The terminology used for descriptive analysis followed Radford et al. (1974), Benson (1959) and Stearn (1983).

RESULTS

The genus *Apios* is recognized as consisting of two North American species, both of which are native. Both species, *A. americana* Medikus and *A. priceana* Robinson are distinct based on both floral and vegetative characteristics. Of the sixty structures measured, twenty-eight are useful in delimiting taxa (Table 1). Additionally, none of the six described infraspecific taxa of *A. americana* merit recognition.

Taxonomic Treatments

Apios Fabricius, Enum., Meth. Pl. 176. 1759. *nom. con.*
Glycine Linnaeus, Sp. Pl., ed. 1. 2: 753. 1753.
Apios Boehmer, Ludwig. Def. Gen. Pl. 268. 1760.
Bradlea Adanson, Fam. Pl. 2: 324. 1763.
Apios Cornut *ex* Medikus, Vorles. Chrupfalz. Phys.-ocon. Ges. 2: 354: 1787.
Apios Moench, Meth. 165. 1794.
Gonancylis Rafinesque, First Cat. Bot. Gard. Transylv. Univ. 14. 1824.
Cyrtotropis Wallich, Pl. As. Rar. 49. t.62. 1830.

Perennial, some producing latex, rhizome with or without tubers, if present single or moniliform; roots adventitious, scattered or fibrous-like along the rhizome. Stems herbaceous, occasionally woody at the base, twining, striate, occasionally terete, glabrous to densely tomentose. Leaves alternate, pinnately compound, (3–) 5–7 (–9) foliolate; rachis striate, occasionally terete, glabrous to velutinous; petiole striate, occasionally terete, glabrous to densely tomentose; pulvinus glabrous to densely tomentose to velutinous; stipules 2, persistent or deciduous, linear to narrowly triangular, glabrous to sericeous; leaflets narrowly elliptic to widely ovate, apex acuminate to acute, apiculate to mucronulate, base acuminate to rounded, often asymmetrical, entire, margins glabrous or ciliate, green above, paler beneath, both surfaces glabrous to tomentose, veins anastomosing before reaching the margin; petiolule reduced to a secondary pulvinus, glabrous to sericeous-tomentose; stipels deciduous or persistent, terminal leaflet 2 and lateral leaflets 1 each, lanceolate to narrowly triangular, entire, glabrous to sericeous. Inflorescence a nodose pseudoraceme or flowers paired at the tip of peduncles in the leaf axil, mostly single, occasionally in twos to fours, simple to branched, lax to densely flowered, with 2–70 flowers per inflorescence; bracts 2, early deciduous, lanceolate to ovate, entire, ciliate, glabrous to pubescent. Flowers occasionally single, or in clusters of twos to fours, on tubercles, occasionally paired at the tip of peduncles, yellow-green to deep maroon; pedicels glabrous to velutinous; bracteoles 2, early deciduous, linear to ovate-lanceolate; bractlets 2, early deciduous, lanceolate to linear-acuminate; calyx hemispherical to campanulate, bilobed, glabrous to puberulous, 4-toothed; petals subequal to unequal, keel incurved, narrowly elliptic, petals of the keel united at their apices (slit at their apices, in some species, after tripping), slit at their bases, two-clawed, narrowly linear to oblong, auricle lacking or

Table 1. The twenty-seven characters used to delimit taxa. Range category represents the lowest and highest measurement taken for each character. The top measurement for each character is for *Apios americana* and the lower measurement is for *A. priceana*. All measurements are in mm

Character	Range
Petiole length	20.00–58.00
	70.00–75.00
Pulvinus length	4.70–7.00
	3.00–4.00
Stipule length	4.00–6.50
	7.00–8.60
Pedicel length	2.00–3.00
	4.00–5.00
Calyx height	2.80–3.40
	4.80–5.20
Posterior tooth	0.20–0.30
	0.75–1.00
Lateral teeth	0.20–0.40
	0.90–1.10
Anterior tooth	1.25–1.75
	3.00–4.00
Keel length	12.00–14.00
	18.00–19.00
Keel width	2.00–4.00
	8.00–9.00
Claw length	1.40–1.80
	2.25–2.50
Claw width	0.40–0.60
	0.75–0.85
Wing length	9.50–10.50
	19.00–21.00
Wing width	4.25–4.75
	2.25–2.75
Claw length	1.00–1.40
	1.60–2.00
Claw width	0.40–0.60
	0.75–1.00
Auricle length	0.30–0.60
	1.00–1.40
Auricle width	0.20–0.30
	1.25–1.50
Standard length	10.50–12.50
	23.00–26.00
Auricle length	1.30–1.70
	0.40–0.50
Auricle width	0.75–1.00
	0.40–0.50
Stylohus length	1.50–2.00
	5.80–7.80
Ovary length	5.50–7.00
	13.00–15.00
Fruit length	60.00–120.00
	120.00–180.00
Style length	6.00–7.50

Table 1. Continued

Character	Range
	8.00–11.00
Seed length	5.00–6.00
	7.20–11.00
Hilum length	0.75–1.25
	3.75–4.25
Hilum width	0.30–0.40
	1.00–1.50

reduced to a rounded lobe to broadly rounded; wing petals narrowly elliptic to obovate, falcate, one-clawed, narrowly linear to oblong, auricle almost obsolete or oblong to square; standard elliptic to circular, apex fused into a stylobos, one-clawed, narrowly oblong to square, auricle obovate; stamens 10, diadelphous; anthers filantherous; pistil stipitate with a disk, surrounding and free from the stipe; ovary, glabrous to tomentose, 7–16 ovules, style coiled, glabrous to bearded; stigma capitate with a stigmatic membrane. Fruit a legume, linear to linear-oblong, apex short-aristate to acuminate, glabrous to tomentose when young, glabrous to appressed strigose at maturity, silvery to off-white endocarp. Seeds elliptic to circular-oblate, green when fresh, brown to black when dry, glaucous, glabrous.

KEY TO THE NORTH AMERICAN SPECIES OF *APIOS*

1. Standard oblate, <17 mm long, stylobos <4 mm long; wing petals <15 mm long; keel petal <16 mm long; style glabrous; fruit <12 cm long; seed <6.5 mm long; hilum <2.25 mm long; flower deep maroon to pale maroon and white; 4–12 moniliform tubers in a chain, 2–10 cm in diameter; petiole <65 mm long . . . . 1. *A. americana*

1. Standard widely elliptic, >17 mm long, stylobus >4 mm long; wing petals >15 mm long; keel petal >16 mm long; style bearded; fruit >12 cm long; seed >6.5 mm long; hilum >2.2 mmlong; flower pale green and rose purple; single tuber, 15–20 cm in diameter; petiole >65 mm long. . . 2. *A. priceana*

1. *Apios americana* Medikus, Vorles. Churpfalz. Phys.-ocon. Ges. 2: 354. 1787. *nom. con.* Lectotype: *P. Kalm s.n. s.d.* America. (LINN), photograph at (F!). [Figure 1]

Glycine apios Linnaeus, Sp. Pl. 2: 753. 1753. Type: *P. Kalm s.n. s.d.* America. (LINN), photograph at (F!).

Apios tuberosa Moench, Meth. Pl. 165. 1794.

Gonancylis thyrsoidea Rafinesque, First Cat. Bot. Gard. Trans. Univ. 14. 1824.

Apios apios (Linnaeus) MacMillan, Bull. Torr. Bot. Club 19: 15. 1892.

Apios apios (Linnaeus) MacMillan var. *boulderensis* Daniels, Fl. Boulder Col. 161. 1911. Type: *F. Daniels 799.* 18 August 1906. Boulder, Colorado. (MO!).

Apios americana Medikus forma *cleistogama* Fernald, Rhodora 36: 195. 1934. Holotype: *M.L. Fernald* and *B. Long 17002.* 16 August 1918. Herring River, West Harwich, Barnstable County, Massachusetts. (GH!).

Apios americana Medikus forma *pilosa* Steyermark, Rhodora 40: 179. 1938. Holotype: *J. Steyermark 11390.* 7 July 1936. Two miles northwest of Rombauer, Butler County, Missouri. (MO!).

Apios americana Medikus var. *turrigera* Fernald, Rhodora t.575, fig. 1,2. 41: 547. 1939. Holotype: *M.L. Fernald* and *B. Long 9079.* 23 August 1938. Below Sunken Meadow Beach, Surry County, Virginia. (GH!), Isotype: (GH!, MO!, NY!, PH!).

Apios americana Medikus forma *keihneri* Oswald, Phytologia 8: 47. 1961. Holotype: *F.W. Oswald s.n.* 20 August 1960. Porter, Oxford County, Maine. (H. N. Moldenke).

Apios americana Medikus forma *mccullough*i Oswald, Phytologia 8: 61. 1961. Holotype: *F.W. Oswald s.n.* 22 August 1961. Ten Mile River Scout Camp, Sullivan County, New York. (H. N. Moldenke).

Latex-producing perennial with rhizomes and 4–12 moniliform, fleshy, oblong, oval, or globose tubers. Stems herbaceous, twining, terete, slightly striate, green to brownish green or brown, glabrous to tomentose. Leaves alternate, pinnately compound (3–) 5–7 (–9) foliolate, 10–22 cm long; rachis terete, 10–32 mm between lateral leaflets and terminal leaflet, 16–37 mm long between lateral leaflets, glabrous to slightly velutinous; petiole 20–58 mm long, glabrous to slightly velutinous; pulvinus 4.5–7.0 mm long, glabrous to velutinous; stipules 2, often deciduous, linear-triangular, 4.0–6.5 mm long, 0.25–0.55 mm at the base; leaflets ovate to ovate-lanceolate, apex acuminate to acute, apiculate, base rounded, often asymmetrical, entire, 47–70 (–90) mm long, 21–42 mm wide, leaflets of rameal branches often smaller, 30–45 mm long, 12–20 mm wide, abaxial surface subglabrous to tomentose, usually denser on the major veins, adaxial surface glabrous to puberulous, usually denser on the major veins; petiolule reduced to a secondary pulvinus, (1.50–) 2.75–4.00 mm long, slightly pubescent to velutinous; stipels often deciduous, terminal leaflet 2 and lateral leaflets 1 each, linear triangular, entire, 0.5–1.0 mm long, 0.1–0.3 mm wide at the base, scattered trichomes to sericeous. Inflorescence a nodose pseudoraceme in the leaf axil, mostly single, occasionally in twos or threes, densely flowered, with 40–60 flowers per inflorescence, 3.0–14.0 cm long; bracts 2, often deciduous, lanceolate, 2.00–2.75 mm long. Flowers in clusters of twos or threes on inflated tubercles, deep maroon to pale maroon and white; pedicels 2–3 mm long, glabrous to velutinous; bracteoles 2, early deciduous, ovate-lanceolate, 2–3 mm long, 0.25–0.50 mm wide at the base; bractlets 2, early deciduous, lanceolate-acute, 1.5–2.0 mm long, 0.2–0.3 mm wide at the base; calyx (Figure 1d) hemispherical to campanulate, 2.8–3.4 mm high, green, red and green, or pink-red, glabrous to puberulous, apparently 4-toothed, the posterior tooth almost obsolete to broadly rounded with an acute, triangular apex, 0.2–0.3 mm long, 0.1–0.2 mm wide at the base; the lateral teeth triangular to shallowly triangular, 0.2–0.4 mm long, 0.7–0.9 mm wide at the base; the anterior tooth lanceolate to narrowly triangular, 1.25–1.75 mm long, 0.4–0.6 mm wide at the base; petals subequal, keel (Figure 1c) strongly incurved, narrowly elliptic, petals of the keel united at their apices (slit at their apices after tripping for 2.0–3.5 mm), slit at their bases for 2–3 mm, 12–14 mm long, 2–4 mm wide, two-clawed, narrowly oblong, acuminate, 1.1–1.8 mm long; 0.4–0.6 mm wide; wing petals (Figure 1b) obovate, falcate, 9.5–10.5 mm long, 4.25–4.75 mm wide, one-clawed, the auricle oblong, 0.3–0.6 mm long, 0.30–0.35 mm wide; standard (Figure 1a) oblate, 10.5–12.5 mm long, 14–16 mm wide, apex fused 1.5–2.0 mm into a stylobos; stamens 10, diadelphous, 1 free, 15.5–17.0 mm long, the fused portion of the filaments 0.7–0.9 mm wide, the outer 2 filaments free the upper 1.5–3.0 mm, the remaining 7 filaments free, 0.5–1.5 mm, increasing in length from the inside toward the outside; anthers filantherous, 0.5–0.6 mm long, 0.20–0.25 mm wide; pistil stipitate with a disk, 0.9–1.2 mm long, surrounding and free from the stipe; ovary 5.5–7.0 mm long, 0.4–0.6 mm wide, glabrous to slightly pubescent along the sutures, 6–11 ovules, the style coiled, 6.0–7.5 mm long, glabrous; stigma capitate with a stigmatic membrane, 0.4–0.5 mm long and wide. Fruit a legume, linear-oblong, apex aristate to acuminate, base acute, 6–10 (–12) cm long, 6–7 mm wide, olive green to tannish brown, glabrous, white endocarp surrounding the seeds. Seeds 6–11 per legume, elliptic to widely oblong, 5–6 mm long, 3.5–4.5 mm wide, olive green when fresh, brown to reddish brown when dry, glabrous; hilum 0.75–2.00 mm long, 0.3–0.4 mm wide.

Habitat and distribution: primarily in wet soil along creeks, rivers and lakes, often in dense colonies; eastern North America from southern Florida to Nova Scotia west through southern Canada to southeastern Manitoba, southwest to eastern Colorado and south to southern Texas (Figure 2).

Specimens examined. CANADA. NEW BRUNSWICK: Sunbury County: *Scoggan 12866*, 14 August 1955 (WNLM). NOVA SCOTIA: Queens County: *Graves, Long & Linder 21735*, 16 August 1920 (A). ONTARIO: Carleton County: *Calder, Frankton & Gillett 1606*, 20 August 1947 (MO). QUEBEC: Brome County: *Marie-Victorin, Rolland-Germain, Raymond & Rousseau 56225*, 9 August 1942 (E). UNITED STATES. ALABAMA: Baldwin County: *Wofford 10526*, 7 August 1970 (TENN). ARKANSAS: Clark County: *Demaree 62247*, 22 June 1970 (SMU). COLORADO: Boulder County: *Weber 4211*, 1 July 1948 (TEX). CONNECTICUT: New London County: *Hill 9356*, 13 August 1980 (A, NY). DELAWARE: Kent County: *Proctor 1100*, 1 August

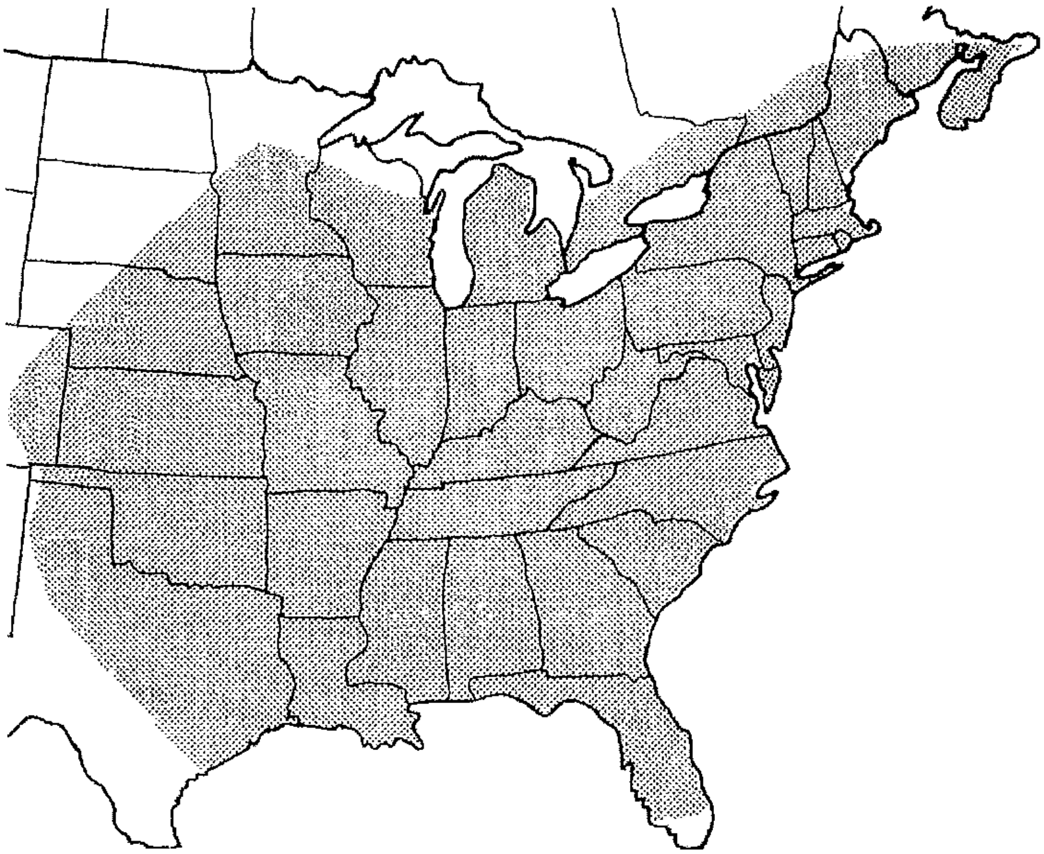

Figure 2. Map showing distribution of *Apios americana*. *From*: Woods (1988).

1944 (SMU). DISTRICT OF COLUMBIA: *Freeman 9252,* 22 August 1934 (US). FLORIDA: Dixie County: *Godfrey 56032,* 5 September 1957 (A). GEORGIA: White County: *Rodgers* & *Mullens 74458,* 3 September 1974 (MO). INDIANA: Elkhart County: *Demaree 40414,* 19 August 1958 (SMU). ILLINOIS: Jackson County: *Heineke 1169,* 15 August 1976 (SIU). IOWA: Winneshiek County: *Hayden 387,* 31 August 1933 (MO, NY). KANSAS: Meade County: *Horr* & *McGregor 4037,* 3 September 1951 (NY, US). KENTUCKY: Bell County: *Hinkle 49410,* 8 July 1974 (TENN). LOUISIANA: East Baton Rouge Parish: *Pias* & *Leibforth 4592,* 16 September 1979 (LSUM). MAINE: York County: *Moldenke* & *Moldenke 6312,* 28 August 1931 (G, NY). MICHIGAN: Kalamazoo County: *Gillis 12664,* 27 July 1975 (GH). MISSISSIPPI: Desoto County: *Pullen 70863,* 7 August 1970 (MISS). MISSOURI: Camden County: *Steyermark 7194,* 22 September 1938 (F). NEBRASKA: Cuming County: *Stephens 36401,* 4 September 1969 (NY). NEW HAMPSHIRE: Merrimack County: *Rousseau 1887,* 17 August 1972 (MO). NEW JERSEY: Cape May County: *Gershoy 389,* 30 August 1917 (GH). NEW YORK: Oneida County: *House 23090,* 29 August 1935 (MO). NORTH CAROLINA: Nash County: *Godfrey 5170,* 18 July 1938 (GH). OHIO: Delaware County: *Crane 3107,* 29 August 1928 (NY). OKLAHOMA: Marshall County: *Burgess 86,* 28 June 1965 (FWM). PENNSYLVANIA: Indiana County: *Wahl 2868A,* 19 August 1947 (A). RHODE ISLAND: Newport County: *Fernald, Long* & *Torrey 9761,* 13 September 1913 (A). SOUTH CAROLINA: Colleton County: *Bell 4552,* 4 September 1956 (TEX). TENNESSEE: Benton County: *Shanks* & *Sharp 5984,* 10 August 1947 (TENN). Bledsoe County: *Wofford* & *Collins 8396,* 19 August 1983 (TENN). TEXAS: Bowie County: *Correll 33371,* 13 August 1966 (NY, TEX). VIRGINIA: Alexandria County: *Chase 2672,* 21 September 1904 (F, SIU). VERNONT: Franklin County: *Blake 3198,* 28 August 1911 (TEX). WEST VIRGINIA: Jefferson County: *Core 3823,* 20 August 1931 (NY). WISCONSIN: Lincoln County: *Seymour* & *Schilising 15825,* 14 July 1954 (SMU).

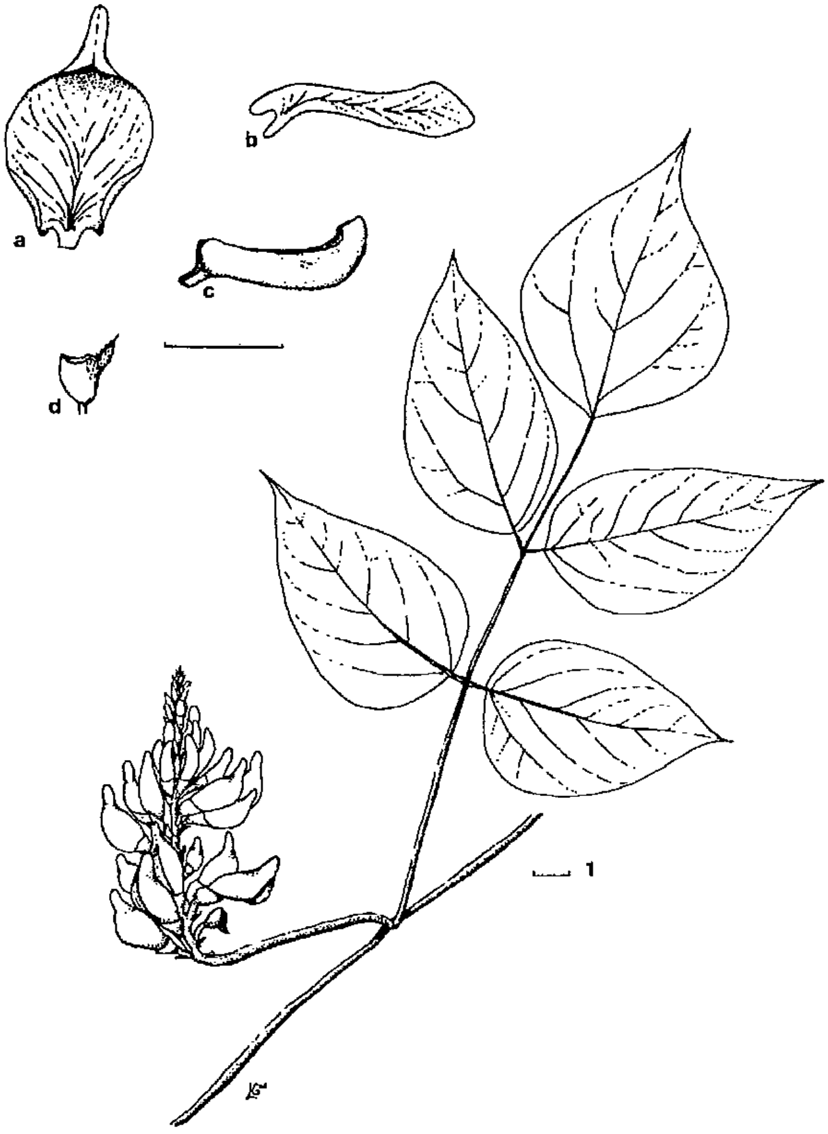

Figure 3. Illustration of *Apios priceana*–a. standard petal; b. wing petal; c. keel petal; d. calyx. All scales equal 1.0 cm. *From*: Woods (1988). Illustrated by Linda Gucciardo.

2. *Apios priceana* Robinson, Bot. Gaz. 25: 450. 1898.

Lectotype: *Sadie F. Price s.n.* July–September 1896. Near Bowling Green, Warren County, Kentucky. (GH!), Isolectotype: three at (GH!), Paratype: *s.n.* 12 July 1896. (GH!), *s.n.* July 1896. drawing at (GH!), *s.n.* 1895, drawing at (GH!), Topotype: *Sadie F. Price s.n.* August 1897. (GH!, NY!). [Figure 3]

Glycine priceana (Robinson) Britton, Il. Fl. edition 2, 2: 418. 1913.

Latex producing perennial with a single oblate spheroidal tuber, 15–20 cm in diameter. Stems herbaceous, twining, terete, slightly striate, brownish green, glabrous to reflexed pubescence. Leaves alternate, pinnately compound, (3–) 5–7 (–9) foliolate, 18–27 cm long; rachis 30–37 mm long between the lateral leaflets and terminal leaflet, 34–52 mm long between the lateral leaflets, glabrous to slightly pubescent; petiole 70–75 mm long, glabrous to slightly pubescent; pulvinus 3–4 mm long, glabrous to scattered pubescence; stipules 2, early deciduous, linear-triangular, 7.0–8.6 mm long, 0.5–0.7 mm wide at the base; leaflets ovate to ovate-lanceolate, apex caudate, apiculate, base obtuse or rounded, entire, 5.1–10.3 cm long, terminal- 3.1–6.8 cm wide, glabrous to strigose, primarily along the major veins; petiolule reduced to a secondary pulvinus, 3.5–4.0 mm long, slightly pubescent to tomentose; stipels early deciduous, terminal leaflet 2 and lateral leaflets 1 each, narrowly triangular, entire, 0.3–0.4 mm long, 0.1–0.2 mm wide at the base, sericeous. Inflorescence a nodose pseudoraceme in the leaf axil, mostly single, occasionally in twos, densely flowered, with 55–70 flowers per inflorescence, 12–16 cm long; bracts 2, early deciduous, lanceolate, 2.50–3.25 mm long. Flowers in clusters of twos or threes on small tubercles, pale green and rose-purple; pedicel 4–5 mm long, glabrous to sparsely pubescent; bracteoles 2, early deciduous, ovate-lanceolate, 5.0–6.5 mm long, 1.00–1.75 mm wide at the base; bractlets 2, early deciduous, lanceolate-acuminate, 4–6 mm long, 0.75–1.25 mm wide at the base; calyx (Figure 3d) hemispherical, 4.75–5.25 mm high, green, glabrous to sericeous, apparently 4-toothed, the posterior tooth almost obsolete, shallowly triangular, 0.75–1.00 mm long, 1.90–2.25 mm wide at the base; the lateral teeth shallowly triangular, 0.9–1.1 mm long, 2.0–2.25 mm wide at the base; the anterior tooth, lanceolate-acuminate, 3–4 mm long, 1.9–2.1 mm wide at the base; petals subequal, keel (Figure 3c) incurved, narrowly elliptic, petals of the keel united at their apices, slit at their bases for 4.5–5.5 mm, 18–19 mm long, 8–9 mm wide, a triangular pouch present at the mid-point, two-clawed, narrowly oblong, 2.25–2.50 mm long, 0.75–0.85 mm wide; wing petals (Figure 3b) narrowly elliptic, falcate, 19–21 mm long, 2.25–2.75 mm wide at the middle, 4.5–5.0 mm wide at the apex, the auricle square, 1.0–1.4 mm long, 1.25–1.50 mm wide; standard (Figure 3a) widely elliptic, 23–26 mm long, 15–20 mm wide, apex fused 5.8–7.8 mm into a stylobos; stamens 10, diadelphous, 1 free, 20–24 mm long, the fused portion of the filaments 2.75–3.25 mm wide, the outer 2 filaments free the upper 2.5–3.3 mm, the remaining 7 filaments free 1.0–2.3, increasing in length from the inside toward the outside; anthers filantherous, 0.8–1.0 mm long, 0.2–0.4 mm wide; pistil stipitate with a disk, 0.75–1.00 mm long, surrounding and free from the stipe; ovary 13–15 mm long, 0.9–1.1 mm wide, glabrous to slightly pubescent, primarily along the sutures, 8–12 ovules, the style coiled, 8–11 mm long, bearded with simple trichomes, 0.6–1.0 mm long; stigma capitate with a stigmatic membrane, 0.4–0.6 mm long, 0.1–0.2 mm wide. Fruit a legume, linear-oblong, apex acuminate, base attenuate, 12–15 (–18) cm long, 6–10 mm wide, brownish red with tan lines when dry, glabrous, silvery white endocarp surrounding the seeds. Seeds 8–12 per legume, elliptic to oblong, 7.2–11.0 mm long, 4.5–5.5 mm wide, olive green when fresh, brown, glaucous, when dry, glabrous; hilum 3.3–4.5 mm long, 1.4–1.6 mm wide.

Habitat and distribution: in rocky, open woods and forest borders, usually associated with mixed oak woods, limestone and a drainage area; southeastern United States from central Alabama west to western Mississippi and north through central Tennessee and western Kentucky to southwestern Illinois (Figure 4).

Specimens examined. ALABAMA: Autauga County: *Gunn 945*, 15 July 1982 (AUA). Marshall County: *Patrick 1065*, 29 July 1979 (TENN); *Partick & Perkins 1068*, 4 September 1979 (TENN). ILLINOIS: Union County: *Fuller 664*, 8 September 1941 (ILL). KENTUCKY: Livingston County: *Athey 1164*, 2 August 1970 (A, NY). Lyon County: *Athey 771*, 11 July 1969 (A); *Athey s.n.*, 19 September 1969 (SIU); *Schwegman 1334*, 30 July 1967 (ILLS). Trigg County: *Ellis 772*, 5 August 1965 (APSC); *Ellis 2383*, 16 August 1966 (APSC). Warren County: *Price s.n.*, July–September (A); *Price s.n.*, July–September 1896 (A); *Price s.n.* 1895 (A); *Price s.n.*, July 1896 (A); *Price s.n.*, 12 July 1896 (A); *Price s.n.*, August 1897 (A, NY); *Price s.n., s.d.* (MO, NY). MISSISSIPPI: Clay County: *Thomas 1797*, 9 September 1968 (UNA). Oktibbeha County: *Ray 6728*, 9 July 1956 (A). Davidson County: *Svenson 7325*, 24 July 1935 (TENN). TENNESSEE: Marion County: *Patrick 1529*, 9 November 1980 (TENN); *Simmers s.n.*, 28 July 1978 (TENN). Montgomery County: *Chester 4130*, 21 July 1979 (APSC, TENN); *F.H.N. et al. 16303*, 19 August 1951 (TENN); *Silva & Clebsch 510*, 15 July 1949 (APSC).

Excluded Names

Apios frutescens Pursh, Fl. Am. Sept. 474. 1814.

=*Wisteria frutescens* (Linnaeus) Poiret in Lamarck, Tabl. Encycl. Meth. Bot. 3: 674. 1823. Basionym: *Glycine frutescens* L.

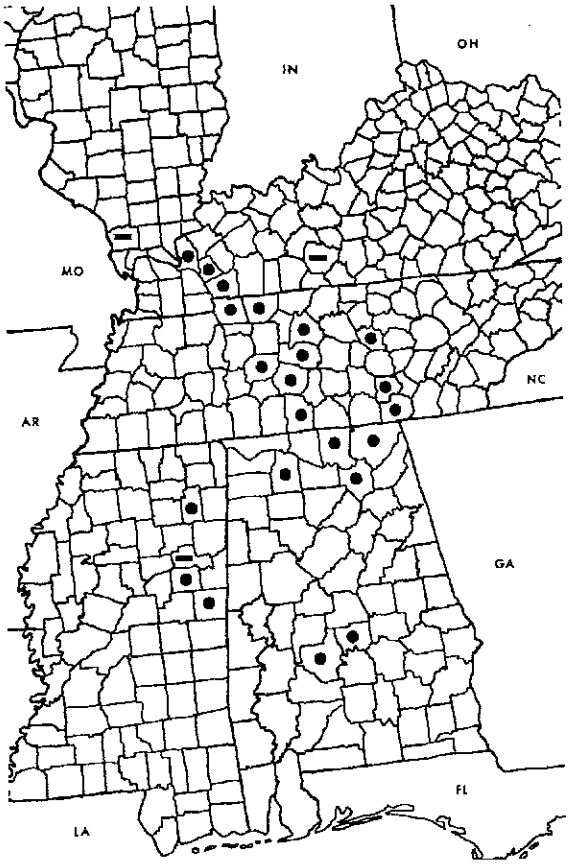

Figure 4. Map showing distribution of *Apios priceana*. Symbols: • = extant populations, — = extinct populations.

Pursh (1814) transferred *Glycine frutescens* to *Apios frutescens* and described the species as having nine leaflets, coriaceous legumes, terminal racemes, and purplish blue flowers. These characters did not coincide with Fabricius' 1759 description of *Apios*. Therefore, Poiret (1823) correctly transferred *G. frutescens* to Nuttall's (1818) genus *Wisteria* (*nom. con.*).

DISCUSSION

Both *Apios americana* Medikus and *A. priceana* Robinson form a natural group and the two subgenera, *Tylosemium* and *Euapios*, proposed by Robinson (1898) are not justified. The stylobi of *A. priceana* (subgenus *Tylosemium*) is spongy and larger (5.8–7.8 mm long) than the stylobi of *A. americana* and the three Asian species (subgenus *Euapios*), which range from 1.5–5.5 mm long. However, the basic structure and function of the stylobi of all five species are the same. Additionally, the single, irregularly spheroidal tuber Robinson recognized as a characteristic of subgenus *Tylosemium* does not separate the species into natural groups. Although *A. americana* has rhizomes with 4–12 moniliform, fleshy, oblong, oval, or globose tubers, the three Asian species exhibit a considerable amount of variation in the below the ground portion of the plants. Some specimens of *A. fortunei* Maximowicz have a single tuber while others have moniliform tubers. Both *A. carnea* (Wallich) Bentham *ex* Baker and *A. delavayi* Franchet have a rhizome but do not produce tubers.

Of the twenty-eight characteristics useful in delimiting taxa, three are vegetative parts and twenty-five are reproductive parts (Table 1). Vegetative characteristics, both within and between the two species, exhibit a significant amount of variation. The three vegetative characteristics that are of taxonomic significance include petiole length, pulvinus length and stipule length. Floral characteristics are fairly consistent within a species but most vary significantly between species. The size (length and width) of the various flora parts are most useful in separating the two species.

Both species are latex producing, herbaceous perennial with a tuber, or tubers, and adventitious roots. *Apios americana* produces 4–12 moniliform, fleshy, oblong, oval, or globose tubers, 2–10 cm in diameter at 3–10 cm intervals along the rhizome. *Apios priceana* produces a single oblate spheroidal tuber, 15–20 cm in diameter.

The leaves are alternate, pinnately compound. With the exception of petiole length, pulvinus length and stipule length, the other leaf characteristics overlap between the two species. Although these characteristics (leaf and leaflet length and width, rachis, secondary pulvinus and stipel lengths) tend to be larger in *A. priceana*, there is always overlap between the upper measurements of *A. americana* and the lower measurements of *A. priceana*. The base of the leaflets of *A. americana* is commonly asymmetrical. Some specimens, however, have leaflets with both asymmetrical and symmetrical bases, while other specimens have leaflets which are all symmetrical at the base. All three base types (asymmetrical, combination and symmetrical) are scattered throughout the geographical range of the species. The leaflet bases of all specimens of *A. priceana* examined during this study were symmetrical.

The inflorescences of both species are a nodose pseudoraceme in the leaf axil. Although the inflorescences are primarily unbranched and occur mostly single or in twos, the inflorescences of some specimens of *A. americana* are branched and may occur in threes. The keel of *A. priceana* does not coil after tripping, instead, it bends sharply backwards at the mid-point. This bending is allowed by a thin triangular pouch located at the mid-point of the keel. Seabrook (1973) proposed the name “articulum” for this specalized pouch.

The androecium consists of 10 diadelphous stamens. In *A. americana*, the single free stamen is 15.5–17.0 mm long. Of the 9 fused filaments, the outer 2 are free the upper 1.5–3.0 mm. The remaining 7 filaments are free the upper 0.5–1.5 mm, increasing in length from the inside toward the outside. The anthers are filantherous, 0.5–0.6 mm long. *Apios priceana* has a single free stamen 20–24 mm long. Of the 9 fused filaments, the outer 2 are free the upper 2.5–3.3 mm. The remaining 7 filaments free 1.0–2.3 mm, increasing in length from the inside toward the outside. The anthers are filantherous, 0.8–1.0 mm long.

The gynoecium consists of a single pistil that is stipitate on a disk. The ovary is 5.5–7.0 mm long with 6–11 ovules in *A. americana*. In *A. priceana*, the ovary is 13–15 mm long with 8–12 ovules. The style of *A. americana* is smooth and glabrous, whereas, the style of *A. priceana* is grooved along the outer surface and is bearded with simple trichomes.

The fruits and seeds of both species are olive green when fresh. In *A. americana*, mature fruits are tannish brown and the seeds are brown to reddish brown when dry. Mature fruits of *A. priceana* are brownish red with tan lines and the seeds are brown and glaucous when dry.

The highly variable characters of *A. americana* are so overlapping that no definite lines of demarcation can adequately separate the infraspecific taxa. This conservative species concept allows for the expected morphological phenotypic variation of a species within its overall distributional range. The primary reason Daniels (1911) described forma *boulderensis* was because of its disjunct distribution (it was previously unknown west of eastern Kansas) and its larger, thinner, long-acuminate leaflets and smaller brownish to deep-violet flowers. Although Boulder County, Colorado represents the western range of *A. americana*, it is no longer disjunct, as it has been documented from seven counties in central and western Kansas and two additional counties in Colorado (Denver and Yuma). The leaflet size and shape, and, flower color all fall within the range of variability for typical *A. americana*. The type of forma *cleistogama* appears to be an immature specimen of typical *A. americana*. The floral parts, when compared to immature flowers from other plants, are equivalent in size and shape. In addition, there is no evidence of fruit development on the type specimen. Fernald (1939) described the typical variety of *A. americana* as having compact and thick racemes that are strongly rounded at the summit (Figure 1, number 1). He described variety *turrigera* as having lax, lanceolate or ovoid-attenuate racemes that are prolonged at the apex (Figure 1, number 2). Wilbur (1963) did not consider this infraspecific taxon worthy of recognition, because he had examined specimens with both typical and *turrigera* type racemes on the same plant. Seabrook (1973) reported that racemes on plants in the northern part of the range were short and truncate, while racemes on plants from the southern part of the range are usually longer and pointed at the apex. She suggested the shorter photoperiod in the north caused the apex of the racemes to senesce and fall off. In addition, the author has observed plants from the southern part of the range with elongated racemes on the upper portion of the plants but more compact, truncate racemes toward the base where they are more shaded. This suggests that photodensity, along with photoperiod, is an important factor in determining raceme shape. There is so much variation in pubescence that forma *pilosa* cannot be recognized as a distinct taxon. Results from this treatment show a wide variety of pubescent patterns and numerous intermediate combinations on specimens in the field and grown in the greenhouse. Some specimens are pubescent on the main stems while rameal stems are glabrous. On other specimens, the upper portions of the plants are pubescent while the lower portions are glabrous. Tubers from different populations, grown in the greenhouse, reveal that some plants are pubescent when young but became glabrous with age. The types of the two color forms of *A. americana*, forma *keihneri* and forma *mccullougħi*, could not be located, and therefore were not studied during this revision. However, the variation in flower color (yellow-green to deep maroon) and the requirements for correct identification described by Oswald (1961a, 1961b) justify not recognizing these two infraspecific taxa as distinct. Oswald instructs for correct identification that *Color Standard and Color Nomenclature* (Ridgway 1912) should be used and the standard, wings, and keel should to be matched separately to prevent the creation of a false tone. In addition, only freshly opened flowers should be used and the color test should be conducted out of the sun, but in bright open shade, and only during the late morning or early afternoon hours.

Apios priceana was designated as threatened throughout its entire range in 1990 due to the small number of populations and the threats to its habitats (United States Fish and Wildlife Service 1990). At the time it was listed as threatened it was known from only 11 populations in 11 counties and four states (Alabama, Kentucky, Mississippi, and Tennessee). Presently, there are 47 populations from 22 counties in the same four states (Figure 4). There are 12 populations from 6 counties in Alabama (Al Scholz, Alabama Natural Heritage Program, pers. comm.), 7 populations from 3 counties in Kentucky (Deborah White, Kentucky State Nature Preserves Commission, pers. comm.), 4 populations from 3 counties in Mississippi (Ronald Wieland, The Mississippi Natural Heritage Program, pers. comm.) and, 24 populations from 10 counties in Tennessee (Claude J. Bailey, Tennessee Department of Environment and Conservation, Natural Heritage Program, pers. comm., Estes 2004).

Both species display a rather narrow ecological amplitude. *Apios americana* occurs in eastern North American primarily in wet soil along creeks, rivers and lakes (Figure 2). *Apios priceana* occurs in the southeastern United States in rocky, open woods and forest borders, usually associated with mixed oak woods, limestone and a drainage area (Figure 4).

Diploid and triploid populations of *A. americana* are almost entirely restricted to different sections of the overall geographical range. Triploid individuals are primarily located in the section of eastern North American that was covered by ice during the Wisconsinan glaciation 18,000 years ago. This includes the areas north of Pennsylvania, central Ohio, southern Indiana, central Wisconsin, and central Iowa. The diploid individuals also occur in the Wisconsinan glaciation area but are more abundant outside of the area in the southern part of the range. Triploidy is considered to have evolved several times as four different clones have been described. Clones east of the Appalachian Mountains have light-colored flowers and very little stem pubescence, whereas the western clones have dark-colored flowers and heavy stem pubescence (Joly and Bruneau 2004).

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APPENDIX H

KEMPER COUNTY IGCC PROJECT WILDLIFE SPECIES DOCUMENTED IN MINE STUDY AREA

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Wildlife Species Documented Within the Study Area

Common Name	Scientific Name	Evidence of Utilization
Amphibians		
Southern Toad	*Bufo Terrestris*	Visual Observation
Cricket Frog	*Acris sp.*	Calls
Bronze Frog	*Rana clamitans clamitans*	Calls
Reptiles		
Green Anole	*Anolis carolinensis*	Visual Observation
Eastern Box Turtle	*Terrapene carolina*	Visual Observation
Florida Cottonmouth	*Agkistrodon piscivorus conanti*	Visual Observation
Eastern Ribbonsnake	*Thamnophis sauritus*	Visual Observation
Timber Rattlesnake	*Crotalus horridus*	Visual Observation
Mammals		
Nine-banded Armadillo	*Dasypus novemcinctus*	Burrow
Virginia Opossum	*Didelphis virginiana*	Dead on Road.
Eastern Gray Squirrel	*Sciurus carolinensis*	Visual Observation
American Beaver	*Castor canadensis*	Visual Observation
Bobcat	*Lynx rufus*	Visual Observation
Coyote	*Canis latrans*	Scat
Wild Boar	*Sus scrofa*	Tracks
Raccoon	*Procyon lotor*	Tracks, Dead on Road
White-tailed Deer	*Odocoileus virginianus*	Visual Observation
Eastern Cottontail	*Sylvilagus floridanus*	Visual Observation
Birds		
Wild Turkey	*Meleagris gallopavo*	Visual Observation
Northern Bobwhite	*Colinus virginianus*	Calls, Visual Observation
Black Vulture	*Coragyps atratus*	Visual Observation
Turkey Vulture	*Cathartes aura*	Visual Observation
Red-shouldered Hawk	*Buteo lineatus*	Calls, Visual Observation
Eurasian Collared-Dove	*Streptopelia decaocto*	Visual Observation
Mourning Dove	*Zenaida macroura*	Calls, Visual Observation
Common Ground-Dove	*Columbina passerina*	Calls, Visual Observation
Yellow-billed Cuckoo	*Coccyzus americanus*	Calls, Visual Observation
Barred Owl	*Strix varia*	Dead on Road
Red-bellied Woodpecker	*Melanerpes carolinus*	Calls

Continued

Downy Woodpecker	*Picoides pubescens*	Calls
Hairy Woodpecker	*Picoides villosus*	Calls
Northern Flicker	*Colaptes auratus*	Calls, Visual Observation
Eastern Wood-Pewee	*Contopus virens*	Calls, Visual Observation
Eastern Phoebe	*Sayornis phoebe*	Calls, Visual Observation
Loggerhead Shrike	*Lanius ludovicianus*	Visual Observation
White-eyed Vireo	*Vireo griseus*	Calls, Visual Observation
Yellow-throated Vireo	*Vireo flavifrons*	Calls, Visual Observation
Red-eyed Vireo	*Vireo olivaceus*	Calls, Visual Observation
Blue Jay	*Cyanocitta cristala*	Calls, Visual Observation
American Crow	*Corvus brachyrhynchos*	Calls, Visual Observation
Barn Swallow	*Hirundo rustica*	Used Nest
Carolina Chickadee	*Poecile carolinensis*	Calls
Tufted Titmouse	*Baeolophus bicolor*	Calls, Visual Observation
Brown-headed Nuthatch	*Sitta pusilla*	Visual Observation
Carolina Wren	*Thyrothorus ludovicianus*	Calls, Visual Observation
House Wren	*Troglodytes aedon*	Visual Observation
Blue-gray Gnatcatcher	*Polioptila caerulea*	Visual Observation
Eastern Bluebird	*Sialia sialis*	Visual Observation
Gray Catbird	*Dumetella carolinensis*	Visual Observation
Northern Mockinbird	*Mimus polyglottos*	Calls, Visual Observation
Brown Thrasher	*Toxostoma rufum*	Calls, Visual Observation
Pine Warbler	*Dendroica pinus*	Visual Observation
Summer Tanager	*Piranga rubra*	Calls, Visual Observation
Eastern Towhee	*Pipilo erythrophthalmus*	Visual Observation
Northern Cardinal	*Cardinalis cardinalis*	Calls, Visual Observation
Blue Grosbeak	*Passerina caerulea*	Visual Observation
Indigo Bunting	*Passerina cyanea*	Visual Observation
Brown-headed Cowbird	*Molothrus ater*	Visual Observation

APPENDIX I

STREAM ASSESSMENT REPORT FOR THE PROPOSED LIBERTY FUELS MINE AND THE EXISTING RED HILLS MINE

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STREAM ASSESSMENT REPORT FOR THE PROPOSED LIBERTY FUELS LIGNITE MINE AND THE EXISTING RED HILLS LIGNITE MINE

Prepared for:

NORTH AMERICAN COAL CORPORATION
P.O. BOX 399
JOURDANTON, TEXAS 78026

Prepared by:

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

October, 2009

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KEMPER COUNTY POWER PLANT SITE AND MINE AREA

INTRODUCTION

In June, 2008 Barry A. Vittor & Associates, Inc. completed stream Rapid Bioassessment (RBA) studies at 8 sites in Kemper County, Mississippi. This work was performed on behalf of North American Coal and was designed to provide quantitative information necessary to characterize aquatic biological resources in the proposed lignite mine study area. Figure 1 depicts the locations of the stream study sites.

MATERIALS AND METHODS

Station Location Descriptions

Station locations are shown in Figure 1 (GPS locations given in Table 1). The 8 sampling stations are located within the 31,000 acre proposed lignite mine area in Kemper County, Mississippi.

Stream Habitat Quality and Biota

Physical/Chemical Conditions

Water quality (temperature, dissolved oxygen, pH, and conductivity) was measured with a YSI Model 6600 multiparameter sonde unit equipped with a 650 datalogger. The substrate type at each station was based on Wolman pebble count data.

Habitat Assessments

The Kemper County stream sampling sites can be roughly grouped based on their habitat assessment scores (HAS). Habitat assessments are used to characterize the quality of habitats found in a particular stream reach. The information obtained from a habitat assessment is necessary for the proper interpretation of water quality and benthic macroinvertebrate studies because the kinds of organisms present are dependent on the type of habitat available, as well as the quality of the water in a stream. The information used in obtaining a habitat assessment score for a particular stream reach includes epifaunal substrate/available cover, pool substrate characterization, pool variability, degree and type(s) of channel alteration, sediment deposition, channel sinuosity, channel flow status, bank vegetative protection, bank stability, and riparian vegetation zone width. The habitat assessments were conducted according to the Mississippi

Department of Environmental Quality (MDEQ) and U.S. Environmental Protection Agency's (EPA) Rapid Bioassessment (RBA) protocols (MDEQ 2001, Barbour *et al*. 1989). The HAS is derived from the MDEQ Surface Water Habitat Assessment Field Data Sheet. A higher HAS indicates a stream reach with more available biological habitat, little instream disturbance, and an undisturbed riparian zone.

Rapid Bioassessment and Benthic Communities

Macroinvertebrate sampling was conducted using the MDEQ's bioassessment protocols. D-frame dip nets were used to collect a composite macroinvertebrate sample from representative habitats in each reach. Each reach, approximately 100 meters (m) in length, was divided into discrete habitat types (*e.g.* gravel/rock/cobble, snags/leaf packs/detritus, vegetated banks, submerged macrophytes, sand/silt). The extent of each habitat type in each reach was estimated (*e.g.* 40% snags, 40% sand/silt, 20% vegetated banks). Twenty dip net sweeps were collected from each reach with the total number being apportioned among the representative habitat types with the exception that 5 jabs were taken from sand/silt for all stations. Material from the 20 sweeps was composited, preserved in 10% buffered formalin and returned to the laboratory for further processing. Composite samples were inventoried in the laboratory, rinsed gently through a 0.5 millimeter (mm) mesh sieve to remove preservatives and sediment, stained with Rose Bengal, and stored in a 70% isopropanol solution for processing. Each composite sample was randomly subsampled to a targeted level of 200 (± 20%) organisms according to MDEQ (2001) and Barbour *et al*. (1989). All macroinvertebrates were identified to the lowest practical identification level (LPIL), which in most cases was to species unless the specimen was a juvenile or damaged.

Fish Communities

Fish were collected at the sampling stations primarily with the use of a back-pack style electroshocker, although a seine net was used in combination with the shocker at some sites, as well.

RESULTS AND DISCUSSION

Stream Habitat Quality and Biota

Physical/Chemical Conditions

Physical/chemical data and Habitat Assessment Scores (HAS) for the eight sites are given in Table 1. Physical/chemical parameters were generally similar for the sampling sites. However, the three sites with the lowest HAS (Tompeat Creek, Dry Creek Tributary, and Penders Creek South) also had the lowest dissolved oxygen measurements at the time of sampling, with Tompeat Creek having, by far, the lowest measurement (1.37 mg/L, 16.4% saturation). Water temperature ranged from 22.6°C (Penders Creek South) to 25.8°C (Okatibbee Creek). Conductivity ranged from 22- µmhos/cm (Chickasawhay Headwaters) to 68- µmhos/cm (Dry Creek Tributary). Stream ph ranged from 6.71 (Tompeat Creek) to 7.82 (Penders Creek South). The substrate type was characterized as sand at six of the eight sampling sites. The Chickasawhay Plant site had a substrate characterized as sandy silt, and the Tompeat Creek site had a substrate characterized as silt/clay.

Habitat Assessments

Table 2 shows the habitat assessment scores (broken down by habitat parameter) for the North American Coal, Kemper County sampling sites. The maximum possible HAS for a stream site is 200 (Table 3). Five of the sites (Chickasawhay South, Chickasawhay Plant, Okatibbee Creek, Chickasawhay Headwaters, and Penders Creek North) earned scores of 94 or higher (with the highest score being 115 for the Chickasawhay South site), while the remaining 3 sites (Dry Creek Tributary, Tompeat Creek, and Penders Creek South) earned scores of 66 or lower (with the lowest score being 56 for the Penders Creek South site). Despite the variability in scores, bottom substrate/available cover scores (which measure the availability of actual substrates as refugia for aquatic organisms) were generally similar for all 8 sampling sites (ranging from a low score of 3, at the Chickasawhay Headwaters, Tompeat Creek, and Penders Creek South sites, to a high score of 7 at the Penders Creek North Site). These scores are relatively low, when compared to a maximum bottom substrate/available cover score of 20 (Table 2). The high and low assessment scores for these sites were primarily driven by parameters such as riparian vegetation zone width, bank stability and vegetative protection, pool substrate characterization, and channel sinuosity, and not by the availability of suitable bottom substrate or available cover.

Streams in the study area were generally diminished in habitat quality due primarily to a lack of legitimate riparian zones and the presence of steeply incised stream banks. These factors are likely the result of human interaction, primarily historic agricultural practices in those areas.

Rapid Bioassessment and Benthic Communities

A cluster analysis for the North American Coal sampling sites was performed using several metrics, including total number of taxa (taxa richness), percent dominant taxon (percentage of total individuals represented by the dominant taxon), number of Chironomidae taxa, percent Chironomidae, percent Tanytarasini Chrionomid taxa, number of EPT (Ephemeroptera + Plecoptera + Trichoptera) taxa, percent EPT taxa, EPT/Chironomidae taxa ratio, Shannon taxa diversity index (H’), and habitat assessment score. The metric data for each site are given in Table 3 and the cluster analysis is presented in Figure 2. The raw taxonomic data for each of the eight sites is archived at Barry A. Vittor & Assoc., Inc..

No unionid mussels were encountered at any of the eight sampling stations. The only bivalves observed during sampling were common fingernail clams (Family Sphaeriidae). Likewise, no crayfish species were observed during sampling at any of the eight monitoring stations.

Taxa richness data for the eight sampling sites are given in Table 3. Taxa richness typically declines with increasing stream perturbations. Taxa richness was lowest at the Tompeat Creek site, with 31 unique taxa identified at that site. All other sampling sites had higher numbers of taxa, with the highest number, 45, occurring at the Chickasawhay South site.

The numbers of Chironomidae taxa (midge larvae) for the eight sites are given in Table 3. The number of Chironomidae taxa typically declines with increasing stream perturbations. The number of Chrionomidae taxa was lowest at the Tompeat Creek site, with 12 taxa being collected. The highest numbers of Chironomidae taxa were collected at the Chickasawhay South and Chickasawhay Plant sites, with 21 taxa being collected at both sites. The percent dominance of chironomids typically increases with stream perturbations and ranged from 36% (Tompeat Creek) to 83% (Penders Creek South).

The percentage of chironomids in the Tribe Tanytarsini is given in Table 3. Tanytarsini chironomids are small midge larvae that are variously filter-feeders or collector-gatherers. Typically the number of Tanytarsini chironomids declines with perturbations to a stream habitat. The percentage of Tanytarsini chironomids was extremely variable with the lowest percentage collected at the Tompeat Creek site (2%) and the highest percentage collected at the Okatibbee Creek site (55%).

The number of EPT taxa and the percent of the assemblage represented by EPT taxa are given in Table 3. EPT taxa are composed of Ephemeroptera (mayfly larvae), Plecoptera (stonefly larvae), and Trichoptera (caddisfly larvae). EPT taxa are typically sensitive to stream perturbations and numbers decline with increasing disturbance. No EPT taxa were collected from the Dry Creek Tributary site. The highest number and percentage of EPT taxa was collected from the Okatibbee Creek site (8 taxa, 25% of the assemblage).

The EPT taxa/Chironomidae taxa ratio for each site is given in Table 3. Typically the relative abundance of EPT taxa to Chironomidae taxa decreases with increasing stream perturbation. The EPT/Chironomidae ratio was 0 for the Dry Creek Tributary (due to the lack of EPT taxa). The highest ratio, 24, was found at the Chickasawhay Plant site.

The percent dominant taxon data are given in Table 3. The percent dominance of a single taxon increases with increasing stream perturbation. The dominance of a single taxon was lowest at the Chickasawhay South site (11%), while a single taxon made up 47% of the assemblage at the Okatibbee Creek site. Taxa diversity (H') data are given in Table 3. Taxa diversity within a given assemblage is dependent upon the number of taxa present (taxa richness) and the distribution of all individuals among those taxa (equitability or evenness). Taxa diversity typically declines with increasing stream perturbation. Diversity was lowest at the Okatibbee Creek site (2.20) and highest (3.31) at the Chickasawhay South site. Habitat assessment scores ranged from 56 (Penders Creek South) to 115 (Chickasawhay South).

Based on HAS and RBA metrics it appears that the Tompeat Creek and Dry Creek Tributary sites are the most impacted sites, exhibiting those characteristics indicative of historic human interaction (i.e. lack of legitimate riparian zone, and steeply incised stream banks). Cluster analysis was performed by calculating the Bray-Curtis similarity coefficient for all pairs of sampling stations utilizing the biological metrics (Clarke and Gorley 2003). Clusters were formed using the group-average linkage method between similarities. Cluster analysis is a multivariate technique that attempts to determine natural groupings (or clusters) of sites based on the biological metrics. Cluster analysis for the eight sampling sites shows separation of the Tompeat Creek and Dry Creek Tributary sites based primarily on a very low percentage of sensitive organisms (Tompeat Creek) or the lack of EPT taxa collected (Dry Creek Tributary) along with low HAS at both sites. Based on a high HAS, a high percentage of sensitive organisms, and a high number of EPT taxa, Okatibbee Creek appears to be the least impacted site. All other sites were generally similar with respect to the RBA metrics.

Available habitat for aquatic organisms varied little between these other sites, and was either generally low quality, or lacking in overall area of available habitat, illustrating the importance of taking into account overall RBA metrics as well as HAS when drawing conclusions concerning overall habitat quality in a given study area.

Fish Communities

Fish community data for the eight sampling sites are given in Table 4. Numbers of fish taxa, as well as numbers of individuals varied greatly between stations. However, the three sites with the highest HAS (Chickasawhay South, Chickasawhay Plant, and Okatibbee Creek) also had the highest numbers of taxa and individuals, with the Chickasawhay South site having the highest numbers (5 taxa, 28 individuals). Of these 28 individuals, the majority (20) was made up of two species of shiner. The dominant species at this site was Weed Shiner (*Notropis texanus*, 13 individuals) and Blacktail Shiner (*Cyprinella venusta*, 7 individuals). Other species collected at the Chickasawhay South site included Spotted Bass (*Micropterus punctulatus*, 4 individuals), Bluegill (*Lepomis macrochirus*, 3 individuals) and Clear Chub (*Notropis winchelli*, 1 individual).

Weed Shiner and Blacktail Shiner also dominated the fish community collected at the Chickasawhay Plant site with 16 and 6 individuals collected, respectively. The other species collected at this site was Bluegill (two individuals). The Okatibbee Creek fish community was also dominated by Weed Shiner and Blacktail Shiner with 5 and 4 individuals collected, respectively. Other species collected at the Okatibbee Creek site included Blackspotted Top Minnow (*Fundulus olivaceus*, one individual) and Longnose Shiner (*Notropis longirostris*, one individual).

Very few fish were collected from the other sampling sites: 5 Bluegill were collected from the Penders Creek North site; 2 Bluegill and one Spotted Bass were collected from the Tompeat Creek Site; and 3 Western Mosquitofish (Gambusia affinis) were collected from the Penders Creek South site. One Week Shiner was collected from the Dry Creek Tributary site, and one Blacktail Shiner was collected from the Chickasawhay Headwaters site.

The number of fish collected can be a function of the amount of available cover at a particular site. However, fish collections are largely qualitative in nature and correlations between fish community data and stream condition should not be assumed.

STATION SPECIFIC SUMMARY

The following section summarizes the data obtained at each station during the field surveys. Stations were ranked by habitat assessment score and are described below in order from highest to lowest score.

Chickasawhay South

Habitat Assessment

Chickasawhay South was sampled on June 3, 2008 and scored a habitat assessment score (HAS) of 115. This station was distinguished by high scores on riparian vegetation zone widths for right and left banks, channel alteration, and channel flow status. The score for bottom substrate/available cover was relatively low.

Rapid Bioassessment/Benthos

Forty-five taxa were collected at this site during sampling. Twenty-one of these taxa, 70% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 27%

were from the taxonomic tribe, Tanytarsini, an important indicator group due to their sensitivity to environmental impacts. Four of the total taxa collected (9%) were Ephemeroptera, Plecoptera, or Tricoptera (EPT) taxa. This site had a taxa diversity (H') of 3.31.

Physical/Chemical Data

Chickasawhay South had a stream width of approximately 5 meters in the sampling area, with an average stream depth of 0.5 meters. Water temperature at the time of sampling was 24.4°C. Conductivity and pH were 47 µmhos/cm and 7.3, respectively. Dissolved oxygen at this site was 5.67 mg/L (68% saturation) at the time of sampling. The substrate type (based on pebble count data) was sand.

Fish Collection

Five fish taxa (28 individuals) were collected at the Chickasawhay South site. The most numerous of these (13 individuals; 46% of total individuals) was Weed Shiner (*Notropis texanus*). Other taxa collected included Blacktail Shiner (*Cyprinella venusta*, 7 individuals), Spotted Bass (*Micropterus punctulatus*, 4 individuals), Bluegill (*Lepomis macrochirus*, 3 individuals) and Clear Chub (*Notropis winchelli*, 1 individual).

Chickasawhay Plant

Habitat Assessment

Chickasawhay Plant was sampled on June 4, 2008 and scored a HAS of 112. This station was distinguished by high scores on riparian vegetation zone width on the right bank, channel alteration, channel sinuosity, and channel flow status. The score for bottom substrate/available cover was relatively low.

Rapid Bioassessment/Benthos

Forty-one taxa were collected at this site during sampling. Twenty-one of these taxa, 66% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 18% were from the taxonomic tribe, Tanytarsini. Five of the total taxa collected (12%) were EPT taxa. This site had a taxa diversity (H') of 3.13.

Physical/Chemical Data

Chickasawhay Plant had a stream width of approximately 5 meters in the sampling area, with an average stream depth of 0.5 meters. Water temperature at the time of sampling was 23.9°C. Conductivity and pH were 42 µmhos/cm and 7.17, respectively. Dissolved oxygen at this site was 5.9 mg/L (69.8% saturation) at the time of sampling. The substrate type (based on pebble count data) was sandy silt.

Fish Collection

Three fish taxa (24 individuals) were collected at the Chickasawhay Plant site. The most numerous of these (16 individuals; 67% of total individuals) was Weed Shiner (*Notropis texanus*). Other taxa collected included Blacktail Shiner (*Cyprinella venusta*, 6 individuals), and Bluegill (*Lepomis macrochirus*, 2 individuals).

Okatibbee Creek

Habitat Assessment

Okatibbee Creek was sampled on June 4, 2008 and scored a HAS of 100. This station was distinguished by high scores on riparian vegetation zone width for right and left banks, channel alteration, and channel flow status. This site received a lower HAS than previous sites based primarily on lower scores for bank stability and bank vegetative protection. The score for bottom substrate/available cover was relatively low, and similar to previous sites.

Rapid Bioassessment/Benthos

Thirty-two taxa were collected at this site during sampling. Sixteen of these taxa, 76% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 55% were from the taxonomic tribe, Tanytarsini. Eight of the total taxa collected (25%) were EPT taxa. This site had a taxa diversity (H’) of 2.20.

Physical/Chemical Data

Okatibbee Creek had a stream width of approximately 10 meters in the sampling area, with an average stream depth of 3 meters. Water temperature at the time of sampling was 25.8°C. Conductivity and pH were 46 µmhos/cm and 7.23, respectively. Dissolved oxygen at this site was 6.71 mg/L (82.3% saturation) at the time of sampling. The substrate type (based on pebble count data) was sand.

Fish Collection

Four fish taxa (11 individuals) were collected at the Okatibbee Creek site. The most numerous of these (5 individuals; 45% of total individuals) was Weed Shiner (*Notropis texanus*). Other taxa collected included Blacktail Shiner (*Cyprinella venusta*, 4 individuals), Blackspotted topminnow (Fundulus olivaceus, 1 individual), and Longnose Shiner (*Notropis longirostris*, 1 individual).

Chickasawhay Headwaters

Habitat Assessment

The Chickasawhay Headwaters site was sampled on June 3, 2008 and scored a HAS of 98. This station was distinguished by high scores on riparian vegetation zone width for right and left banks, sediment deposition, and channel flow status. This site received a lower HAS than previous sites based primarily on low scores for pool substrate characterization and pool variability. The score for bottom substrate/available cover was relatively low, and similar to previous sites.

Rapid Bioassessment/Benthos

Thirty-eight taxa were collected at this site during sampling. Eighteen of these taxa, 80% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 23% were from the taxonomic tribe, Tanytarsini. Five of the total taxa collected (13%) were EPT taxa. This site had a taxa diversity (H’) of 2.78.

Physical/Chemical Data

The Chickasawhay Headwaters site had a stream width of approximately 2 meters in the sampling area, with an average stream depth of 0.2 meters. Water temperature at the time of sampling was 24.9°C. Conductivity and pH were 22 µmhos/cm and 7.08, respectively. Dissolved oxygen at this site was 7.78 mg/L (93.9% saturation) at the time of sampling. The substrate type (based on pebble count data) was sand.

Fish Collection

One fish taxon (1 individual) was collected at the Chickasawhay Headwaters site. This individual was a Blacktail Shiner (*Cyprinella venusta*).

Penders Creek North

Habitat Assessment

Penders Creek North was sampled on June 3, 2008 and scored a HAS of 94. This station was distinguished by high scores on riparian vegetation zone width for right and left banks, channel alteration, and channel flow status. This site received a lower HAS than previous sites based primarily on a low score for channel sinuosity. The score for bottom substrate/available cover was relatively low, and similar to previous sites.

Rapid Bioassessment/Benthos

Forty-two taxa were collected at this site during sampling. Eighteen of these taxa, 79% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 15% were from the taxonomic tribe, Tanytarsini. Five of the total taxa collected (12%) were EPT taxa. This site had a taxa diversity (H') of 2.42.

Physical/Chemical Data

Penders Creek North had a stream width of approximately 5 meters in the sampling area, with an average stream depth of 0.75 meters. Water temperature at the time of sampling was 22.7°C. Conductivity and pH were 37 µmhos/cm and 7.82, respectively. Dissolved oxygen at this site was 7.04 mg/L (81.9% saturation) at the time of sampling. The substrate type (based on pebble count data) was sand.

Fish Collection

One fish taxon (5 individuals) was collected at the Penders Creek North site. These individuals were Bluegill (*Lepomis Macrochirus*).

Dry Creek Tributary

Habitat Assessment

Dry Creek Tributary was sampled on June 4, 2008 and scored a HAS of 66. This station was distinguished by high scores on riparian vegetation zone width for the left bank, and channel flow status. This site received a considerably lower HAS than previous sites based primarily on a low scores for right bank riparian vegetation zone width, channel sinuosity, bank vegetative protection, and bank stability. The score for bottom substrate/available cover was relatively low, and similar to previous sites.

Rapid Bioassessment/Benthos

Thirty-four taxa were collected at this site during sampling. Eighteen of these taxa, 57% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 29% were from the taxonomic tribe, Tanytarsini. No EPT taxa were collected from this site, which had a taxa diversity (H’) of 2.67.

Physical/Chemical Data

Dry Creek Tributary had a stream width of approximately 3 meters in the sampling area, with an average stream depth of 0.2 meters. Water temperature at the time of sampling was 23.4°C. Conductivity and pH were 68 µmhos/cm and 7.01, respectively. Dissolved oxygen at this site was 4.02 mg/L (47% saturation) at the time of sampling. The substrate type (based on pebble count data) was sand.

Fish Collection

One fish taxon (1 individual) was collected at the Dry Creek Tributary site. This individual was a Weed Shiner (*Notropis texanus*).

Tompeat Creek

Habitat Assessment

Tompeat Creek was sampled on June 4, 2008 and scored a HAS of 64. This station was distinguished by high scores on bank vegetative protection, and channel flow status. This site received a similar HAS to the Dry Creek Tributary site, and a considerably lower HAS than the other sites. The lower HAS at this site was based primarily on a low scores for riparian vegetation zone width, channel sinuosity, pool substrate characterization, pool variability, channel alteration, and sediment deposition. The score for bottom substrate/available cover was relatively low, and similar to previous sites.

Rapid Bioassessment/Benthos

Thirty-one taxa were collected at this site during sampling. Twelve of these taxa, 36% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 2% were from the taxonomic tribe, Tanytarsini. Two of the total taxa collected (6%) were EPT taxa. This site had a taxa diversity (H') of 2.52.

Physical/Chemical Data

Tompeat Creek had a stream width of approximately 1 meter in the sampling area, with an average stream depth of 0.2 meters. Water temperature at the time of sampling was 24.1°C. Conductivity and pH were 49 µmhos/cm and 6.71, respectively. Dissolved oxygen at this site was 1.37 mg/L (16.4% saturation) at the time of sampling. The substrate type (based on pebble count data) was silt/clay.

Fish Collection

Two fish taxa (3 individuals) were collected at the Tompeat Creek site. 2 of these individuals were Bluegill (*Lepomis macrochirus*) and the other was a Spotted Bass (*Micropterus punctulatus*).

Penders Creek South

Habitat Assessment

Penders Creek South was sampled on June 3, 2008 and scored a HAS of 56. This station was distinguished by a high score only on channel flow status. This site received a similar HAS to the Dry Creek Tributary and Tompeat Creek sites, and a considerably lower HAS than the other sites. The lower HAS at this site was based primarily on a low scores for riparian vegetation zone width, bank stability, bank vegetative protection, and channel sinuosity. The score for bottom substrate/available cover was relatively low, and similar to previous sites.

Rapid Bioassessment/Benthos

Thirty-two taxa were collected at this site during sampling. Twenty of these taxa, 83% of the total individuals collected, were from the family Chironomidae. Of the Chironomidae, 26% were from the taxonomic tribe, Tanytarsini. Three of the total taxa collected (9%) were EPT taxa. This site had a taxa diversity (H') of 2.80.

Physical/Chemical Data

Penders Creek South had a stream width of approximately 2.5 meters in the sampling area, with an average stream depth of 0.25 meters. Water temperature at the time of sampling was 22.6°C. Conductivity and pH were 50 µmhos/cm and 7.38, respectively. Dissolved oxygen at this site was 4.05 mg/L (45.6% saturation) at the time of sampling. The substrate type (based on pebble count data) was sand.

Fish Collection

One fish taxon (3 individuals) was collected at the Penders Creek South site. These individuals were Western Mosquitofish (*Gambusia affinis*).

RED HILLS MINE AREA

INTRODUCTION

In October, 2008 Barry A. Vittor & Associates, Inc. completed stream Rapid Bioassessment (RBA) studies at four sites at North American Coal's Red Hills Mine site in Choctaw County, Mississippi. This work was performed on behalf of North American Coal and was designed to provide quantitative information necessary to characterize aquatic biological resources at that site. RBA data from "natural" stream sections, as well as sections of stream diverted as a part of mining activity was used to gain a greater understanding of possible impacts of mining activities on streams near the proposed lignite mine area in Kemper County, Mississippi.

MATERIALS AND METHODS

Station Location Descriptions

Two "natural" stream sites were studied near the Red Hills Mine site. The R1 Headwaters site was located upstream of the mine area, while the Little Bywy station was located just downstream of the mine site, below the sediment retention basin at the north side of the mine. The other two sampling locations were located in areas that had been diverted due to mining activity. These two stations (Diversion 1 and Diversion 2) were located between the R1 Headwaters and Little Bywy stations. Figure 3 shows a map of the sampling locations.

Stream Habitat Quality and Biota

Physical/Chemical Conditions

Water quality (temperature, dissolved oxygen, pH, and conductivity) was measured with a YSI Model 6600 multiparameter sonde unit equipped with a 650 datalogger. The substrate type at each station was based on Wolman pebble count data.

Habitat Assessments

Habitat assessments are used to characterize the quality of habitats found in a particular stream reach. The information obtained from a habitat assessment is necessary for the proper interpretation of water quality and benthic macroinvertebrate studies because the kinds of organisms present are dependent on the type of habitat available, as well as the quality of the water in a stream. The information used in obtaining a habitat assessment score for a particular stream reach includes epifaunal substrate/available cover, pool substrate characterization, pool variability, degree and type(s) of channel alteration, sediment deposition, channel sinuosity, channel flow status, bank vegetative protection, bank stability, and riparian vegetation zone width. The habitat assessments were conducted according to the Mississippi Department of Environmental Quality (MDEQ) and U.S. Environmental Protection Agency's (EPA) Rapid Bioassessment (RBA) protocols (MDEQ 2001, Barbour *et al*. 1989). The habitat assessment score (HAS) is derived from the MDEQ Surface Water Habitat Assessment Field Data Sheet. A higher HAS indicates a stream reach with more available biological habitat, little instream disturbance, and an undisturbed riparian zone.

Rapid Bioassessment and Benthic Communities

Macroinvertebrate sampling was conducted using the MDEQ's bioassessment protocols. D-frame dip nets were used to collect a composite macroinvertebrate sample from representative habitats in each reach. Each reach, approximately 100 meters (m) in length, was divided into discrete habitat types (*e.g.* gravel/rock/cobble, snags/leaf packs/detritus, vegetated banks, submerged macrophytes, sand/silt). The extent of each habitat type in each reach was estimated (*e.g.* 40% snags, 40% sand/silt, 20% vegetated banks). Twenty dip net sweeps were collected from each reach with the total number being apportioned among the representative habitat types with the exception that 5 jabs were taken from sand/silt for all stations. Material from the 20 sweeps was composited, preserved in 10% buffered formalin and returned to the laboratory for further processing. Composite samples were inventoried in the laboratory, rinsed gently through a 0.5 millimeter (mm) mesh sieve to remove preservatives and sediment, stained with Rose Bengal, and stored in a 70% isopropanol solution for processing. Each composite sample was randomly subsampled to a targeted level of 200 (± 20%) organisms according to MDEQ (2001) and Barbour *et al*. (1989). All macroinvertebrates were identified to the lowest practical identification level (LPIL), which in most cases was to species unless the specimen was a juvenile or damaged.

Fish Communities

Fish were collected at the sampling stations primarily with the use of a back-pack style electroshocker, although a seine net was used in combination with the shocker at some sites, as well.

RESULTS AND DISCUSSION

Stream Habitat Quality and Biota

Physical/Chemical Conditions

Water quality data for the Red Hills Mine stations are given in Table 5. Physical/chemical parameters were generally similar among the stations sampled at the Red Hills Mine. Dissolved oxygen ranged from 2.75 mg/L (26.7% saturation) at the Diversion 1 station to 8.73 mg/L (86.6% saturation) at the Little Bywy station. Water temperature ranged from 14.86°C (Diversion 1) to 17.0°C (R1 Headwaters). Conductivity ranged from 37- µmhos/cm (R1 Headwaters) to 61- µmhos/cm (Little Bywy). Stream pH ranged form 7.27 (Diversion 2) to 9.92 (R1 Headwaters). The substrate type was characterized as sand at the R1 Headwaters site, silt at Diversion 1, and silty/sand at both Diversion 2 and Little Bywy. Physical/chemical parameters observed at Red Hills were comparable to physical/chemical data obtained at the Kemper County sites. Some data (especially temperature) differed due to the difference in season that the sampling was completed (Red Hills was sampled in October, Kemper County in June).

Habitat Assessments

Scores for the Red Hills stations are given in Table 6. Scores were all similar at the Red Hills stations and ranged from 98 at Diversion 2 to 128 at Little Bywy. Each of the remaining stations (Diversion 1 and R1 Headwaters) received habitat assessment scores of 113. The lower HAS at the Diversion 2 station was primarily a function of lack of riparian zone vegetation at that station. HAS for the Red Hills sampling stations were generally similar to scores observed at the Kemper County sites (which ranged from 56 to 115). HAS for the two diverted sections of stream suggest that the diversion of these sections has been completed in a manner which retains relatively similar habitat quality to natural stream sections in the sampling area, as well as to stream sites located near the proposed Kemper County site.

Rapid Bioassessment and Benthic Communities

The biological metrics data for each of the Red Hills sampling stations are given in Table 7. For the purposes of comparison, the metrics data for the Kemper County stations are also presented in Table 7. The rapid bioassessment metrics vary among the Red Hills sampling stations. In general, the metrics for the Diversion 1 station were similar to the metrics observed at the R1 Headwaters station, while the Diversion 2 and Little Bywy sampling stations were highly variable. Based on the metrics data, it appears that benthic communities, while variable, did not experience significant impact as a result of mining activities (i.e. diversion of the natural stream system) in that area.

When compared to the metrics data for the Kemper County sampling stations, the four Red Hills stations exhibit similar metrics values, as well as similarly high variability as the Kemper County sampling stations.

For the purposes of comparison, MDEQ guidelines were followed to develop a multi-metric bioassessment score for the Red Hills Mine sampling sites as well as the Kemper County sampling stations (MDEQ 2001). Selected benthic macroinvertebrate metrics were used to calculate this bioassessment score. Results for each sampling site are given in Table 8. Bioassessment scores varied among sites at both the Red Hills and Kemper County sampling areas. Scores for the two diverted sections of stream varied from each other, but were generally similar to natural stream sections at both the Red Hills and Kemper County sampling areas.

A cluster analysis for the North American Coal sampling sites (Red Hills and Kemper County) was performed using several metrics, including total number of taxa (taxa richness), percent dominant taxon (percentage of total individuals represented by the dominant taxon), number of Chironomidae taxa, percent Chironomidae, percent Tanytarasini Chrionomid taxa, number of EPT (Ephemeroptera + Plecoptera + Trichoptera) taxa, percent EPT taxa, EPT/Chironomidae taxa ratio, Shannon taxa diversity index (H'), and habitat assessment score. The cluster analysis is presented in Figure 4. The cluster analysis shows all sites (Red Hills and Kemper County sites) grouped at greater than a 70% level of similarity. This cluster analysis further documents the conclusion that the diversion of natural stream sections by mining activity at the Red Hills site has been completed in a manner which retains relatively similar habitat quality and benthic macroinvertebrate communities to natural stream sections in the same sampling area, as well as to stream sites located near the proposed Kemper County site.

Fish Communities

Fish collections at the Red Hills stations were similar to those at the Kemper County sites. The highest numbers and species diversity were collected from the two diversion sites at Red Hills. Sampling for fish communities at the R1 Headwaters and Little Bywy sites was logistically more difficult than at the diversion sites. Lack of fish species collected at these sites does not reflect poor conditions, but rather difficulty in sampling fish at those sites. Regardless, the number and diversity of the fish caught at Diversion 1 and 2 reflects a generally high degree of suitable habitat (i.e. submerged vegetation and rocky substrates) in the diverted area. Fish collection data for the Red Hills sampling stations are given in Table 9. No fish were collected at the R1 Headwaters site, reflecting the very narrow, shallow nature of this stream section. The most numerous fish species collected at the remaining stations were members of the genus *Lepomis* (sunfishes). Diversion 1 also contained *Gambusia affinis* (western mosquitofish) and *Fundulus olivaceus* (blackspotted topminnow). Diversion 2 contained *Notropis taxanus* (weed shiner), *F. olivaceus*, and *Erimyzon oblongus* (creek chubsucker) along with the various *Lepomis* species.

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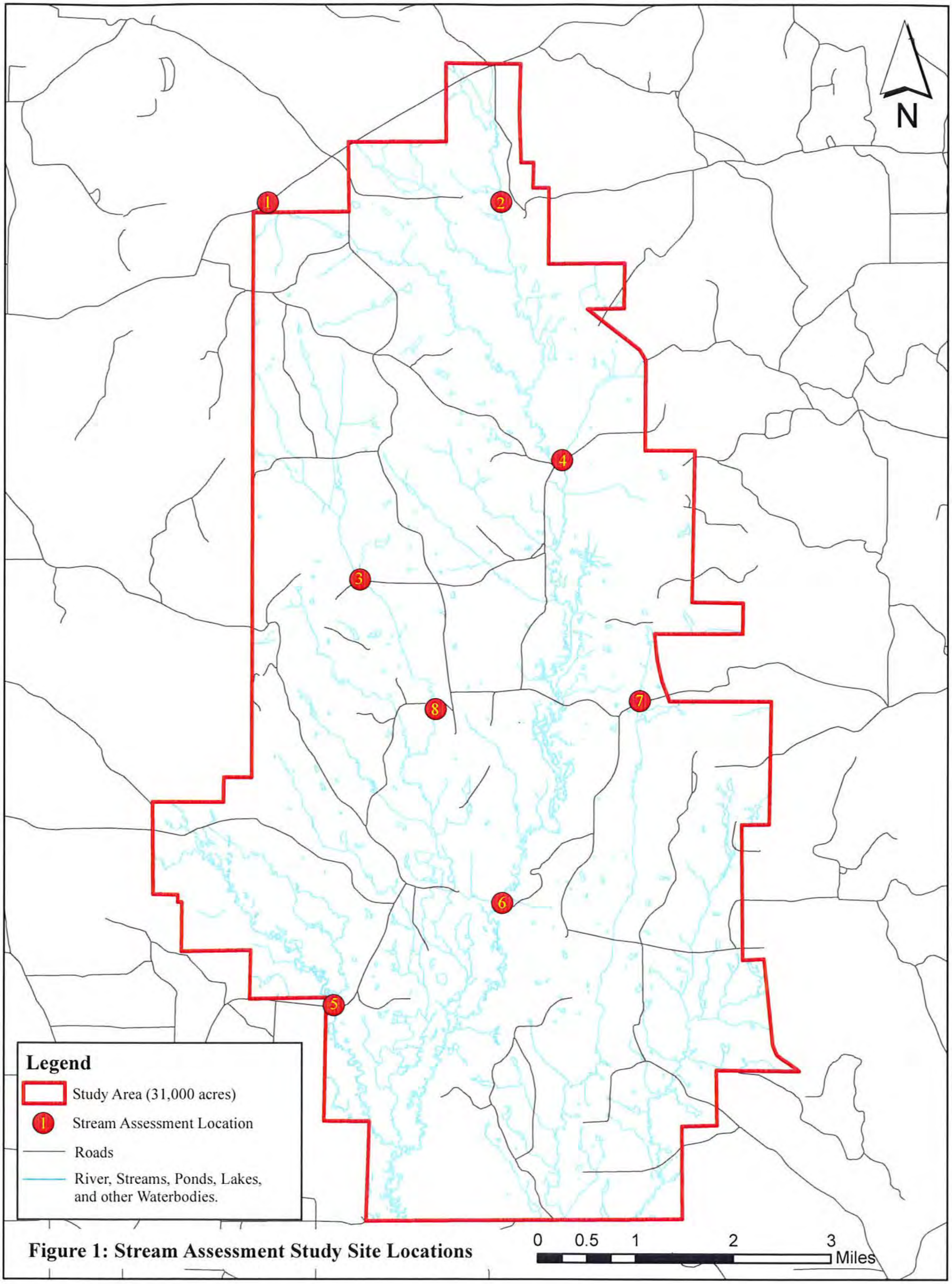
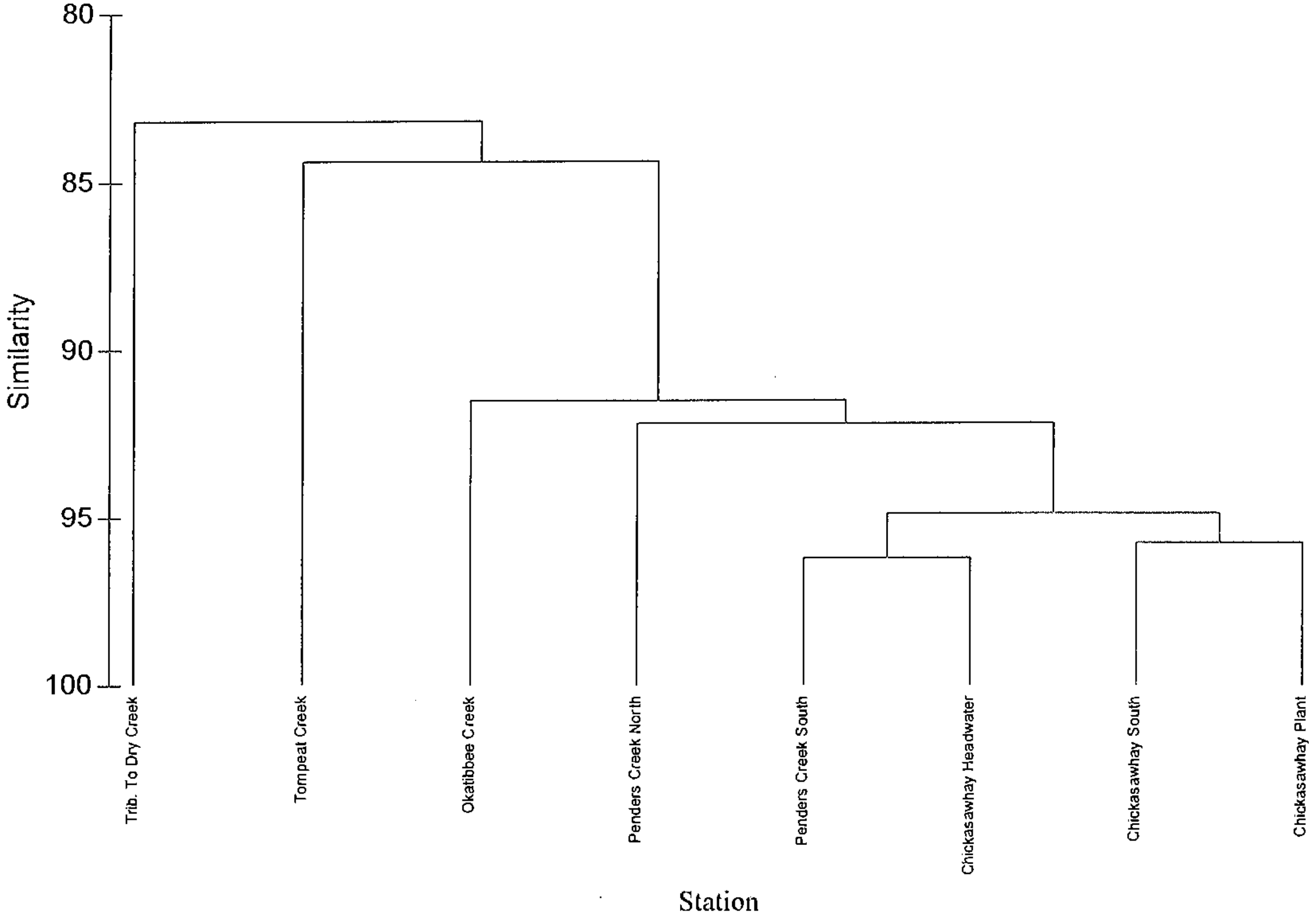


Figure 1: Stream Assessment Study Site Locations

Figure 2. Cluster analysis for the North American Coal Kemper County RBA sampling sites.



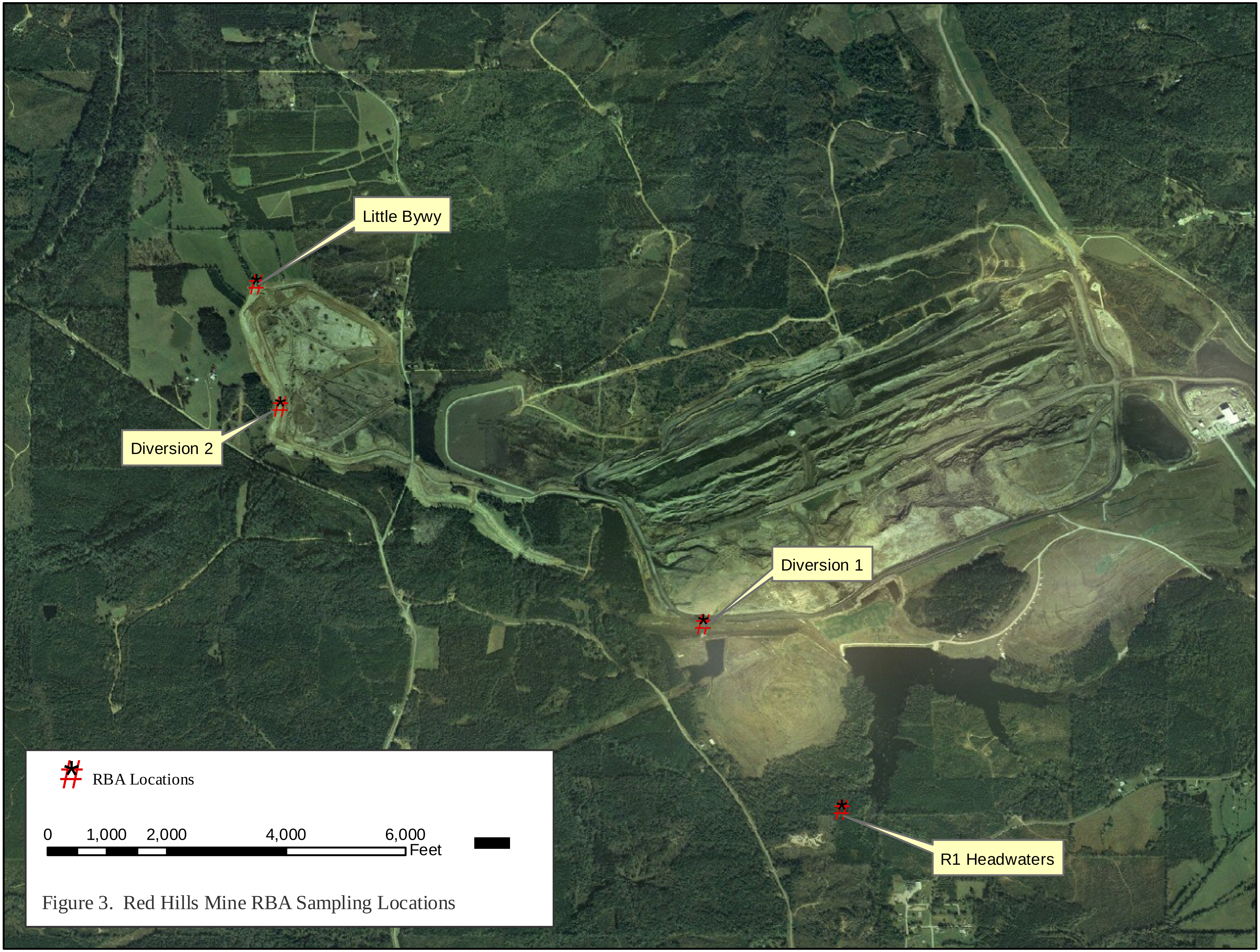


Figure 3. Red Hills Mine RBA Sampling Locations

Figure 4. Cluster analysis for the North American Coal Kemper County and Red Hills Mine RBA sampling sites.

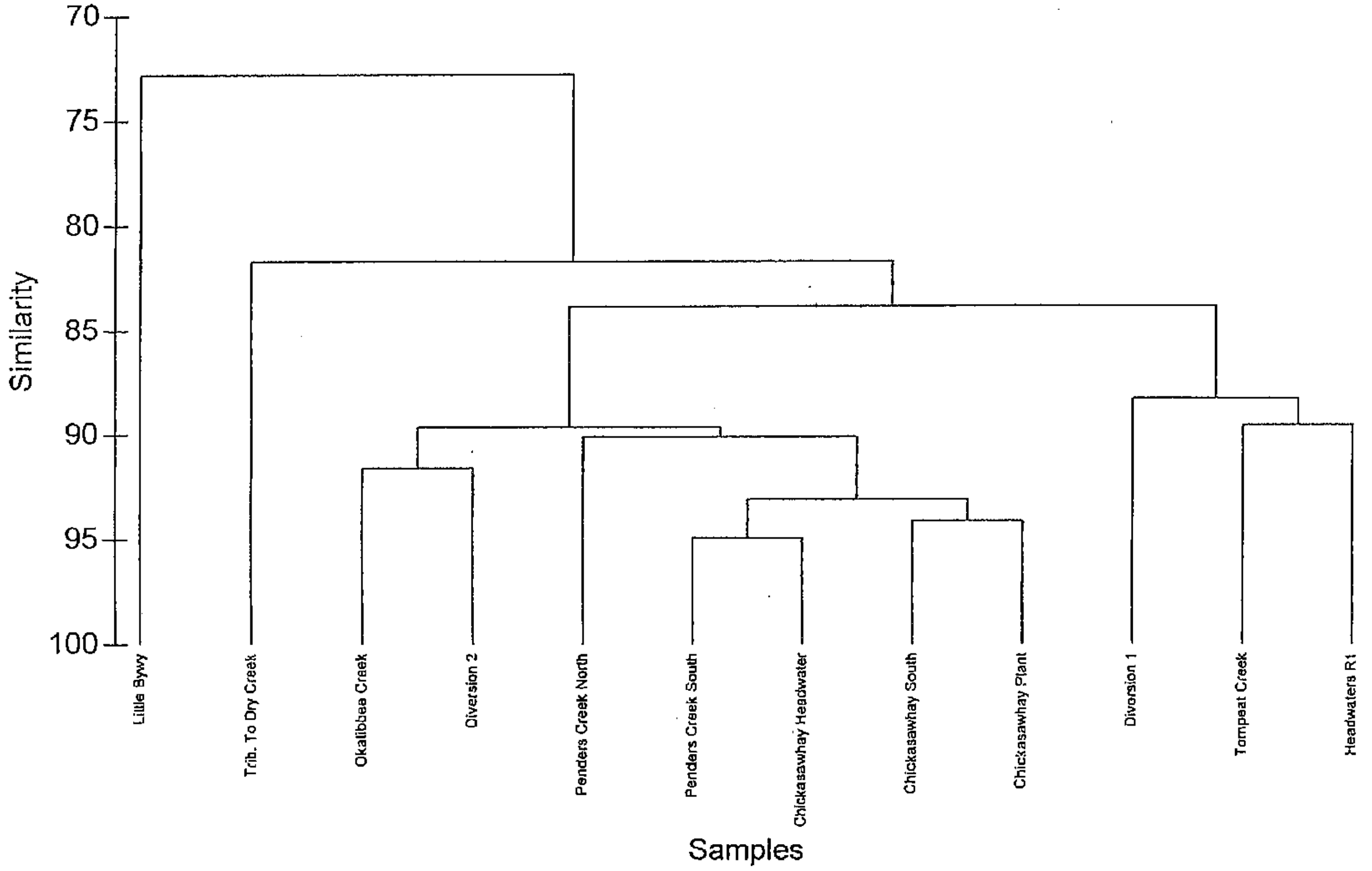


Table 1. Physical/chemical and water quality data for the North American Coal, Kemper County sampling sites.

Station	Station Description	Date Sampled	Station Location Latitude	Station Location Longitude	Stream Width (m)	Avg. Stream Depth (m)	Water Temp (°C)	Conductivity µmhos/cm	pH	DO mg/l	DO %Saturation	*Substrate Type	Habitat Assessment Score
CHH	Chickasawhay Headwaters	3-Jun	32°41'43"N	88°49'32"W	2	0.2	24.9	22	7.08	7.78	93.9	sand	98
CHP	Chickasawhay Plant	4-Jun	32°39'24"N	88°46'28"W	5	0.5	23.9	42	7.17	5.9	69.8	sandy silt	112
CHS	Chickasawhay South	3-Jun	32°35'28"N	88°47'06"W	5	0.5	24.4	47	7.3	5.67	68	sand	115
PCN	Penders Creek North	3-Jun	32°38'30"N	88°48'35"W	5	0.75	22.7	37	7.82	7.04	81.9	sand	94
PCS	Penders Creek South	3-Jun	32°37'07"N	88°47'48"W	2.5	0.25	22.6	50	7.38	4.05	45.6	sand	56
TPC	Tompeat Creek	4-Jun	32°37'16"N	88°45'39"W	1	0.2	24.1	49	6.71	1.37	16.4	silt/clay	64
DCT	Dry Creek Tributary	4-Jun	32°41'43"N	88°47'06"W	3	0.2	23.4	68	7.01	4.02	47	sand	66
OKC	Okatibbee Creek	4-Jun	32°34'33"N	88°41'51"W	10	3	25.8	46	7.23	6.71	82.3	sand	100

*Pebble Count Summary

Table 2. Habitat assessment scores for the North American Coal, Kemper County sampling sites, June, 2008.

Habitat Parameter	Max Score	Chickasawhay South	Chickasawhay Plant Site	Okatibbee Creek	Chickasawhay Headwaters	Penders Creek North	Dry Creek Tributary	Tompeat Creek	Penders Creek South
Bottom Substrate/ Available Cover	20	5	4	6	3	7	6	3	3
Pool Substrate Characterization	20	9	6	7	3	4	7	1	7
Pool Variability	20	6	6	7	1	6	7	2	6
Channel Alteration	20	14	16	15	5	14	6	3	5
Sediment Deposition	20	11	11	11	16	14	6	3	11
Channel Sinuosity	20	10	16	9	12	0	0	0	0
Channel Flow Status	20	18	18	18	18	18	16	16	16
Bank Vegetative Protection (Left Bank)	10	6	6	2	5	3	2	9	2
Bank Vegetative Protection (Right Bank)	10	6	6	2	5	3	2	9	2
Bank Stability (Left Bank)	10	5	5	3	5	4	2	7	2
Bank Stability (Right Bank)	10	5	5	3	5	4	2	7	2
Riparian Vegetation Zone Width (Left Bank)	10	10	3	10	10	7	10	2	0
Riparian Vegetation Zone Width (Right Bank)	10	10	10	7	10	10	0	2	0
Total	200	115	112	100	98	94	66	64	56

Table 3. Biological metrics data for the North American Coal, Kemper County sampling sites.

Site Description	No. of Taxa	% Dominant Taxon	No. Chironomidae Taxa	% Chironomidae	% Tanytarsini	% Filterer	% Clingers	No. EPT Taxa	% EPT Taxa	EPT/Chiro	H'
Penders Creek South	32	19	20	83	26	27	27	3	9	0.05	2.80
Penders Creek North	42	43	18	79	15	14	2	5	12	0.05	2.42
Chickasawhay South	45	11	21	70	27	30	8	4	9	0.13	3.31
Chickasawhay Headwater	38	23	18	80	23	27	16	5	13	0.07	2.78
Chickasawhay Plant	41	15	21	66	18	26	24	5	12	0.24	3.13
Tompeat Creek	31	31	12	36	2	2	8	2	6	0.03	2.52
Okatibbee Creek	32	47	16	76	55	60	13	8	25	0.23	2.20
Trib. To Dry Creek	34	24	18	57	29	40	3	0	0	0	2.67

Table 4. Fish data summary for the North American Coal Kemper County sampling sites, June, 2008.

Station	Taxa	Common Name	SL	TL	Weight
Penders Creek South	*Gambusia affinis*	Western mosquito fish	20	26	0.0816
	Gambusia affinis	Western mosquito fish	22	29	0.1391
	Gambusia affinis	Western mosquito fish	32	40	0.3933
Penders Creek North	*Lepomis macrochirus*	Bluegill	Identified and released in the field		
	Lepomis macrochirus	Bluegill	Identified and released in the field		
	Lepomis macrochirus	Bluegill	Identified and released in the field		
	Lepomis macrochirus	Bluegill	Identified and released in the field		
	Lepomis macrochirus	Bluegill	Identified and released in the field		
Okatibbee Creek	*Cyprinella venusta*	Blacktail shiner	51	65	1.8434
	Cyprinella venusta	Blacktail shiner	74	90	4.4854
	Cyprinella venusta	Blacktail shiner	37	50	0.6375
	Cyprinella venusta	Blacktail shiner	49	60	1.3866
	Fundulus olivaceus	Blackspotted top minnow	46	62	1.5153
	Notropis longirostris	Longnose shiner	40	50	0.6965
	Notropis texanus	Weed shiner	56	67	2.5952
	Notropis texanus	Weed shiner	43	53	0.736
	Notropis texanus	Weed shiner	40	49	0.5949
	Notropis texanus	Weed shiner	45	55	1.1079
	Notropis texanus	Weed shiner	42	49	0.6028
Dry Creek Tributary	*Notropis texanus*	Weed Shiner	51	62	1.5243
Chickasawhay South	*Micropterus punctulatus*	Spotted Bass	39	48	1.1443
	Micropterus punctulatus	Spotted Bass	45	55	1.445
	Micropterus punctulatus	Spotted Bass	43	53	1.4616
	Micropterus punctulatus	Spotted Bass	50	61	2.1077
	Lepomis macrochirus	Bluegill	34	43	1.0542
	Lepomis macrochirus	Bluegill	27	32	0.4459
	Lepomis macrochirus	Bluegill	21	27	0.2147
	Cyprinella venusta	Blacktail Shiner	37	47	0.6528
	Cyprinella venusta	Blacktail Shiner	60	72	2.4385
	Cyprinella venusta	Blacktail Shiner	47	57	1.3816
	Cyprinella venusta	Blacktail Shiner	53	66	1.9035
	Cyprinella venusta	Blacktail Shiner	55	68	2.2459
	Cyprinella venusta	Blacktail Shiner	32	47	0.6235
	Cyprinella venusta	Blacktail Shiner	39	48	0.7683
	Notropis texanus	Weed Shiner	49	61	1.6309
	Notropis texanus	Weed Shiner	43	53	0.95
	Notropis texanus	Weed Shiner	42	51	0.65901
	Notropis texanus	Weed Shiner	36	44	0.5171
	Notropis texanus	Weed Shiner	41	50	0.6074
	Notropis texanus	Weed Shiner	53	66	1.5201
	Notropis texanus	Weed Shiner	77	95	5.092
	Notropis texanus	Weed Shiner	42	53	0.6951
	Notropis texanus	Weed Shiner	42	50	0.6953
	Notropis texanus	Weed Shiner	46	55	0.8252
	Notropis texanus	Weed Shiner	41	52	0.7572
	Notropis texanus	Weed Shiner	40	52	0.7314
	Notropis texanus	Weed Shiner	55	71	1.9721
	Notropis winchelli	Clear Chub	47	58	1.2257

Table 4. Continued

Chickasawhay Plant	*Lepomis macrochirus*	Bluegill	33	45	1.166
	Lepomis macrochirus	Bluegill	39	46	1.305
	Cyprinella venusta	Blacktail Shiner	65	83	3.57
	Cyprinella venusta	Blacktail Shiner	72	90	4.9084
	Cyprinella venusta	Blacktail Shiner	50	61	1.443
	Cyprinella venusta	Blacktail Shiner	43	52	1.0019
	Cyprinella venusta	Blacktail Shiner	48	60	1.3595
	Cyprinella venusta	Blacktail Shiner	40	51	0.7535
	Notropis texanus	Weed Shiner	40	51	0.746
	Notropis texanus	Weed Shiner	37	47	0.59
	Notropis texanus	Weed Shiner	35	44	0.5337
	Notropis texanus	Weed Shiner	37	45	0.5338
	Notropis texanus	Weed Shiner	56	71	2.2774
	Notropis texanus	Weed Shiner	37	45	0.554
	Notropis texanus	Weed Shiner	40	52	0.8174
	Notropis texanus	Weed Shiner	50	60	1.5675
	Notropis texanus	Weed Shiner	44	55	0.8072
	Notropis texanus	Weed Shiner	40	50	0.695
	Notropis texanus	Weed Shiner	47	59	1.1594
	Notropis texanus	Weed Shiner	43	52	0.895
	Notropis texanus	Weed Shiner	35	45	0.5041
	Notropis texanus	Weed Shiner	39	49	0.7124
	Notropis texanus	Weed Shiner	35	45	0.5445
	Notropis texanus	Weed Shiner	34	44	0.4179
Chickasawhay Headwaters	*Cyprinella venusta*	Blacktail Shiner	100	120	12.045
Tompeat Creek	*Lepomis macrochirus*	Bluegill	Identified and released in the field		
	Lepomis macrochirus	Bluegill	Identified and released in the field		
	Micropterus punctulatus	Spotted Bass	Identified and released in the field		

Table 5. Physical/chemical and water quality data for the North American Coal, Red Hills Mine sampling sites.

Station Description	Date Sampled	Station Location		Stream Width (m)	Avg. Stream Depth (m)	Water Temp (°C)	Conductivity µmhos/cm	pH	DO mg/l	DO %Saturation	*Substrate Type
		Latitude	Longitude								
R1 Headwaters	23-Oct	33.36409°	89.24241°	1	0.1	17.00	37	9.92	7.17	74.2	sand
Diversion 1	24-Oct	33.37256°	89.24873°	3	0.75	14.86	57	7.82	2.75	26.7	silt
Diversion 2	24-Oct	33.38257°	89.26816°	5	1.0	16.04	58	7.27	8.28	83.9	silty sand
Little Bywy	24-Oct	33.38815°	89.26925°	4	0.75	15.23	61	7.46	8.73	86.6	silty sand

*Pebble Count Summary

Table 6. Habitat assessment scores for the North American Coal, Red Hills Mine sampling sites, October, 2008.

Habitat Parameter	Max Score	R1 Headwaters	Diversion 1	Diversion 2	Little Bywy
Bottom Substrate/ Available Cover	20	5	5	7	7
Pool Substrate Characterization	20	7	13	7	7
Pool Variability	20	5	11	11	13
Channel Alteration	20	18	6	6	16
Sediment Deposition	20	6	11	14	11
Channel Sinuosity	20	19	6	6	18
Channel Flow Status	20	11	10	15	16
Bank Vegetative Protection (Left Bank)	10	6	9	5	7
Bank Vegetative Protection (Right Bank)	10	6	9	5	7
Bank Stability (Left Bank)	10	5	9	9	8
Bank Stability (Right Bank)	10	5	9	9	8
Riparian Vegetation Zone Width (Left Bank)	10	10	5	2	5
Riparian Vegetation Zone Width (Right Bank)	10	10	10	2	5
Total	200	113	113	98	128

Table 7. Biological metrics data for the North American Coal, Red Hills Mine sampling sites (October, 2008).

Site Description	No. of Taxa	% Dominant Taxon	No. Chironomidae Taxa	% Chironomidae	% Tanytarsini	% Filterer	% Clingers	No. EPT Taxa	% EPT Taxa	EPT/Chiro	H'
R1 Headwaters	24	25.2	11	50	<1	5	15	2	8	0.25	2.49
Diversion 1	20	27	7	68	3	3	6	1	5	0.007	2.05
Diversion 2	35	20	14	47	27	27	1	6	17	0.24	2.79
Little Bywy	51	28	13	15	<1	<1	2	6	12	2.42	3.06

Biological metrics data for the North American Coal, Kemper County sampling sites (June, 2008).

Site Description	No. of Taxa	% Dominant Taxon	No. Chironomidae Taxa	% Chironomidae	% Tanytarsini	% Filterer	% Clingers	No. EPT Taxa	% EPT Taxa	EPT/Chiro	H'
Penders Creek South	32	19	20	83	26	27	27	3	9	0.05	2.80
Penders Creek North	42	43	18	79	15	14	2	5	12	0.05	2.42
Chickasawhay South	45	11	21	70	27	30	8	4	9	0.13	3.31
Chickasawhay Headwater	38	23	18	80	23	27	16	5	13	0.07	2.78
Chickasawhay Plant	41	15	21	66	18	26	24	5	12	0.24	3.13
Tompeat Creek	31	31	12	36	2	2	8	2	6	0.03	2.52
Okatibbee Creek	32	47	16	76	55	60	13	8	25	0.23	2.20
Dry Creek Tributary	34	24	18	57	29	40	3	0	0	0	2.67

Table 8. Multi-metric bioassessment scores for the Red Hills Mine and Kemper County sampling sites.

Station	Bioassessment Score
Red Hills	
R1 Headwaters	13
Diversion 1	13
Diversion 2	25
Little Bywy	23
Kemper County	
Penders Creek South	21
Penders Creek North	25
Chickasawhay South	25
Chickasawhay Headwaters	25
Chickasawhay Plant	25
Tompeat Creek	17
Okatibbee Creek	27
Dry Creek Tributary	17

Table 9. Fish data summary for the North American Coal Red Hills Mine sampling sites, October, 2008

Station	**Taxa**	**Common Name**	**SL(mm)**	**TL(mm)**	**Weight(g)**
R1 Headwaters	No Fish Collected				
Diversion 1	*Lepomis cyanellus*	Green Sunfish	70.1	87.2	10.2103
	Lepomis macrochirus	Bluegill	53.4	66.8	4.7637
	Lepomis macrochirus	Bluegill	47.7	58.7	2.6130
	Lepomis macrochirus	Bluegill	36.3	48.2	1.3262
	Gambusia affinis	Western Mosquitofish	23.4	29.1	0.2435
	Gambusia affinis	Western Mosquitofish	21.0	25.3	0.1358
	Fundulus olivaceus	Blackspotted Topminnow	46.5	55.7	1.3069
Diversion 2	*Lepomis humilis*	Orangespotted Sunfish	56.6	70.0	5.9227
	Lepomis humilis	Orangespotted Sunfish	45.2	56.0	3.0583
	Lepomis humilis	Orangespotted Sunfish	40.1	50.0	2.2385
	Lepomis megalotis	Longear Sunfish	90.8	109.1	28.8230
	Lepomis macrochirus	Bluegill	73.5	98.8	14.1703
	Lepomis macrochirus	Bluegill	61.3	79.8	7.5383
	Lepomis macrochirus	Bluegill	61.4	77.1	7.3434
	Lepomis macrochirus	Bluegill	66.3	83.5	9.0242
	Lepomis macrochirus	Bluegill	60.5	75.3	6.4975
	Lepomis macrochirus	Bluegill	48.8	63.7	2.9960
	Lepomis macrochirus	Bluegill	49.6	65.5	3.3556
	Lepomis macrochirus	Bluegill	58.0	73.5	6.5410
	Lepomis macrochirus	Bluegill	46.9	58.5	3.0704
	Lepomis macrochirus	Bluegill	57.6	73.0	6.1933
	Lepomis macrochirus	Bluegill	40.9	51.0	1.9590
	Lepomis macrochirus	Bluegill	29.5	37.4	0.7717
	Lepomis macrochirus	Bluegill	28.0	35.5	0.6695
	Lepomis macrochirus	Bluegill	45.5	59.1	2.8547
	Lepomis macrochirus	Bluegill	33.5	41.7	1.2020
	Lepomis macrochirus	Bluegill	44.0	58.2	2.7099
	Lepomis macrochirus	Bluegill	46.9	59.4	2.9031
	Lepomis macrochirus	Bluegill	55.0	72.7	5.4218
	Lepomis macrochirus	Bluegill	57.5	74.3	6.2599
	Lepomis macrochirus	Bluegill	55.4	70.5	5.2579
	Lepomis macrochirus	Bluegill	48.1	62.9	3.8568
	Lepomis macrochirus	Bluegill	55.1	69.2	5.0936
	Lepomis macrochirus	Bluegill	39.7	53.1	2.3158
	Lepomis macrochirus	Bluegill	54.0	69.8	5.1648
	Lepomis macrochirus	Bluegill	47.8	61.1	3.2555
	Lepomis macrochirus	Bluegill	43.8	56.0	2.5205
	Lepomis macrochirus	Bluegill	31.3	39.5	1.0501
	Lepomis macrochirus	Bluegill	29.1	35.6	0.7481
	Lepomis macrochirus	Bluegill	26.9	32.5	0.6244
	Lepomis macrochirus	Bluegill	38.6	48.1	1.9569
	Lepomis macrochirus	Bluegill	28.8	36.0	0.7592

Table 9. Continued

Station	Taxa	Common Name	SL(mm)	TL(mm)	Weight(g)
Diversion 2 (continued)	*Lepomis macrochirus*	Bluegill	26.4	32.6	0.5135
	Lepomis macrochirus	Bluegill	23.6	30.5	0.3942
	Lepomis macrochirus	Bluegill	46.9	58.4	2.8202
	Lepomis macrochirus	Bluegill	43.0	55.5	2.1567
	Lepomis macrochirus	Bluegill	49.2	61.5	2.9261
	Lepomis macrochirus	Bluegill	28.8	36.0	0.8203
	Lepomis macrochirus	Bluegill	26.2	32.9	0.5215
	Lepomis macrochirus	Bluegill	31.2	39.7	1.0542
	Lepomis macrochirus	Bluegill	36.4	46.5	1.4673
	Lepomis macrochirus	Bluegill	28.9	36.1	0.6853
	Lepomis macrochirus	Bluegill	27.3	34.4	0.6501
	Lepomis macrochirus	Bluegill	39.6	49.2	1.9582
	Notropis texanus	Weed Shiner	32.5	39.5	0.5687
	Notropis texanus	Weed Shiner	35.4	40.1	0.6536
	Notropis texanus	Weed Shiner	31.5	39.0	0.4990
	Notropis texanus	Weed Shiner	36.9	44.2	0.7176
	Notropis texanus	Weed Shiner	44.3	53.2	1.5416
	Notropis texanus	Weed Shiner	37.9	46.8	0.9242
	Notropis texanus	Weed Shiner	43.9	52.2	1.5195
	Fundulus olivaceus	Blackspotted Topminnow	45.1	53.2	1.3287
	Fundulus olivaceus	Blackspotted Topminnow	40.6	49.6	1.0655
	Fundulus olivaceus	Blackspotted Topminnow	36.8	44.1	0.8009
	Erimyzon oblongus	Creek Chubsucker	60.5	72.9	4.4587
Little Bywy	*Lepomis cyanellus*	Green Sunfish	40.0	50.2	1.6155
	Lepomis macrochirus	Bluegill	101.0	131.8	37.9508
	Lepomis macrochirus	Bluegill	55.8	71.6	5.0952

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APPENDIX J

KEMPER COUNTY IGCC PROJECT MINE STUDY AREA AQUATIC TAXONOMY DATA

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Raw Data

Station	Station ID	Phylum	Class	Order	Family	Taxon Name	Rep 1
Penders Creek South	1	Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae (LPIL)	1
	1	Annelida	Oligochaeta	Tubificida	Enchytraeidae	Enchytraeidae (LPIL)	2
	1	Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogonidae (LPIL)	3
	1	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	33
	1	Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia mallochi	5
	1	Arthropoda	Insecta	Diptera	Chironomidae	Chironomus (LPIL)	7
	1	Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus (LPIL)	4
	1	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	18
	1	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum scalaenum grou	3
	1	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum aviceps	24
	1	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum flavum	10
	1	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum (LPIL)	4
	1	Arthropoda	Insecta	Diptera	Chironomidae	Procladius (LPIL)	2
	1	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	42
	1	Arthropoda	Insecta	Diptera	Chironomidae	Cladotanytarsus (LPIL)	7
	1	Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes (LPIL)	7
	1	Arthropoda	Insecta	Diptera	Chironomidae	Psectrocladius elatus	1
	1	Arthropoda	Insecta	Diptera	Chironomidae	Labrundinia (LPIL)	2
	1	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos fuscicorne	1
	1	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	8
	1	Arthropoda	Insecta	Diptera	Chironomidae	Rheocricotopus robacki	1
	1	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladius (LPIL)	1
	1	Arthropoda	Insecta	Diptera	Chironomidae	Paraphaenocladius (LPIL)	3
	1	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	2
	1	Arthropoda	Insecta	Diptera	Psychodidae	Pericoma (LPIL)	1
	1	Arthropoda	Insecta	Odonata		Odonata (LPIL)	1
	1	Arthropoda	Insecta	Coleoptera	Dytiscidae	Neoporus (LPIL)	2
	1	Arthropoda	Insecta	Coleoptera	Scirtidae	Scirtes (LPIL)	1
	1	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	7
	1	Arthropoda	Insecta	Trichoptera		Trichoptera (LPIL)	1
	1	Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptila (LPIL)	1
	1	Arthropoda	Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca	16

Penders Creek North	2	Arthropoda	Arachnida	Acari	Mideopsidae	Mideopsis (LPIL)	1
	2	Arthropoda	Insecta	Diptera		Diptera (LPIL)	2
	2	Arthropoda	Insecta	Diptera	Ceratopogonida	Ceratopogonidae (LPIL)	2
	2	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	30
	2	Arthropoda	Insecta	Diptera	Chironomidae	Chironomus (LPIL)	2
	2	Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus (LPIL)	1
	2	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	3
	2	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum fallax	2
	2	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum tritum	1
	2	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum aviceps	1
	2	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	32
	2	Arthropoda	Insecta	Diptera	Chironomidae	Cladotanytarsus (LPIL)	12
	2	Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes (LPIL)	4
	2	Arthropoda	Insecta	Diptera	Chironomidae	Labrundinia (LPIL)	1
	2	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos fuscicorne	9
	2	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	1
	2	Arthropoda	Insecta	Diptera	Chironomidae	Microtendipes pedellus	158
	2	Arthropoda	Insecta	Diptera	Chironomidae	Natarsia (LPIL)	5
	2	Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella (LPIL)	8
	2	Arthropoda	Insecta	Diptera	Chironomidae	Parametriocnemus (LPIL)	2
	2	Arthropoda	Insecta	Diptera	Chironomidae	Stictochironomus (LPIL)	16
	2	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	4
	2	Arthropoda	Insecta	Diptera	Dixidae	Dixella (LPIL)	14
	2	Arthropoda	Insecta	Diptera	Culicidae	Anopheles (LPIL)	1
	2	Arthropoda	Insecta	Diptera	Tipulidae	Tipula (LPIL)	1
	2	Arthropoda	Insecta	Odonata		Odonata (LPIL)	1
	2	Arthropoda	Insecta	Coleoptera	Dytiscidae	Neoporus (LPIL)	8
	2	Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis (LPIL)	1
	2	Arthropoda	Insecta	Collembola		Collembola (LPIL)	2
	2	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	6
	2	Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis (LPIL)	3
	2	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae (LPIL)	2
	2	Arthropoda	Insecta	Megaloptera	Sialidae	Sialis (LPIL)	2
	2	Arthropoda	Insecta	Plecoptera	Perlidae	Acroneuria (LPIL)	1
	2	Arthropoda	Insecta	Trichoptera		Trichoptera (LPIL)	1
	2	Arthropoda	Malacostraca	Amphipoda	Crangonyctidae	Synurella bifurca	2
	2	Arthropoda	Malacostraca	Amphipoda	Crangonyctidae	Synurella (LPIL)	1
	2	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae (LPIL)	13
	2	Mollusca	Gastropoda			Gastropoda (LPIL)	1
	2	Mollusca	Gastropoda	Basommatophora	Ancylidae	Ancylidae (LPIL)	1
	2	Mollusca	Gastropoda	Basommatophora	Planorbidae	Planorbidae (LPIL)	4
	2	Mollusca	Gastropoda	Basommatophora	Planorbidae	Menetus (LPIL)	2

Chickasawhay South	3	Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae (LPIL)	4
	3	Arthropoda	Arachnida	Acari		Acari (LPIL)	2
	3	Arthropoda	Arachnida	Acari	Lebertiidae	Lebertia (LPIL)	1
	3	Arthropoda	Arachnida	Acari	Mideopsidae	Mideopsis (LPIL)	1
	3	Arthropoda	Arachnida	Acari	Unionicolidae	Unionicola (LPIL)	1
	3	Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogonidae (LPIL)	2
	3	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	24
	3	Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia mallochi	5
	3	Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia (LPIL)	1
	3	Arthropoda	Insecta	Diptera	Chironomidae	Chironomus (LPIL)	7
	3	Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus (LPIL)	3
	3	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	4
	3	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum scalaenum grou	1
	3	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum halterale group	6
	3	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum flavum	4
	3	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum (LPIL)	1
	3	Arthropoda	Insecta	Diptera	Chironomidae	Procladius (LPIL)	5
	3	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	16
	3	Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes (LPIL)	2
	3	Arthropoda	Insecta	Diptera	Chironomidae	Stenochironomus (LPIL)	1
	3	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos jucundum	13
	3	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos fuscicorne	4
	3	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos (LPIL)	8
	3	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus pellucidus	21
	3	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	18
	3	Arthropoda	Insecta	Diptera	Chironomidae	Rheocricotopus robacki	2
	3	Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella (LPIL)	1
	3	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	2
	3	Arthropoda	Insecta	Diptera	Tabanidae	Tabanidae (LPIL)	2
	3	Arthropoda	Insecta	Odonata		Odonata (LPIL)	2
	3	Arthropoda	Insecta	Odonata	Gomphidae	Dromogomphus (LPIL)	2
	3	Arthropoda	Insecta	Odonata	Aeshnidae	Boyeria vinosa	2
	3	Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis (LPIL)	1
	3	Arthropoda	Insecta	Coleoptera	Elmidae	Dubiraphia (LPIL)	3
	3	Arthropoda	Insecta	Coleoptera	Elmidae	Ancyronyx variegatus	2
	3	Arthropoda	Insecta	Coleoptera	Elmidae	Macronychus (LPIL)	5
	3	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	2
	3	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae (LPIL)	12
	3	Arthropoda	Insecta	Megaloptera	Sialidae	Sialis (LPIL)	1
	3	Arthropoda	Insecta	Trichoptera		Trichoptera (LPIL)	4
	3	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche (LPIL)	1
	3	Arthropoda	Malacostraca	Isopoda	Asellidae	Caecidotea (LPIL)	1
	3	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae (LPIL)	5
	3	Mollusca	Gastropoda			Gastropoda (LPIL)	1
	3	Mollusca	Gastropoda	Basommatophora	Ancylidae	Ancylidae (LPIL)	4

Chickasawhay Headwate	4	Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae (LPIL)	1
	4	Arthropoda	Arachnida	Acari		Acari (LPIL)	7
	4	Arthropoda	Arachnida	Acari	Arrenuridae	Arrenurus (LPIL)	1
	4	Arthropoda	Arachnida	Acari	Hygrobatidae	Hygrobates (LPIL)	1
	4	Arthropoda	Insecta	Diptera	Ceratopogonida	Ceratopogonidae (LPIL)	1
	4	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	53
	4	Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia mallochi	1
	4	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	3
	4	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum scalaenum grou	5
	4	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum aviceps	24
	4	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum flavum	3
	4	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum (LPIL)	2
	4	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	36
	4	Arthropoda	Insecta	Diptera	Chironomidae	Labrundinia (LPIL)	1
	4	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus robacki	2
	4	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus pellucidus	9
	4	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	4
	4	Arthropoda	Insecta	Diptera	Chironomidae	Corynoneura (LPIL)	2
	4	Arthropoda	Insecta	Diptera	Chironomidae	Rheocricotopus (LPIL)	1
	4	Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella (LPIL)	3
	4	Arthropoda	Insecta	Diptera	Chironomidae	Parametriocnemus (LPIL)	21
	4	Arthropoda	Insecta	Diptera	Chironomidae	Limnophyes (LPIL)	13
	4	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladius crictopus grou	2
	4	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	9
	4	Arthropoda	Insecta	Diptera	Empididae	Hemerodromia (LPIL)	1
	4	Arthropoda	Insecta	Diptera	Dixidae	Dixella (LPIL)	2
	4	Arthropoda	Insecta	Diptera	Tipulidae	Limnophila (LPIL)	1
	4	Arthropoda	Insecta	Diptera	Tipulidae	Pseudolimnophila (LPIL)	1
	4	Arthropoda	Insecta	Odonata	Gomphidae	Gomphidae (LPIL)	1
	4	Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis (LPIL)	1
	4	Arthropoda	Insecta	Coleoptera	Elmidae	Macronychus (LPIL)	2
	4	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	3
	4	Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis diminuta	2
	4	Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis (LPIL)	5
	4	Arthropoda	Insecta	Hemiptera	Veliidae	Veliidae (LPIL)	2
	4	Arthropoda	Insecta	Plecoptera	Perlidae	Acroneuria (LPIL)	2
	4	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae (LPIL)	1
	4	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae (LPIL)	2

Chickasawhay Plant	5	Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae (LPIL)	5
	5	Arthropoda	Arachnida	Acari		Acari (LPIL)	1
	5	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	29
	5	Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia mallochi	2
	5	Arthropoda	Insecta	Diptera	Chironomidae	Chironomus (LPIL)	2
	5	Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus (LPIL)	5
	5	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	14
	5	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum scalaenum grou	5
	5	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum halterale group	4
	5	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum aviceps	22
	5	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum flavum	4
	5	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum (LPIL)	1
	5	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	2
	5	Arthropoda	Insecta	Diptera	Chironomidae	Cladotanytarsus (LPIL)	3
	5	Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes (LPIL)	1
	5	Arthropoda	Insecta	Diptera	Chironomidae	Paralauterborniella (LPIL)	3
	5	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos fuscicorne	3
	5	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus pellucidus	32
	5	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	1
	5	Arthropoda	Insecta	Diptera	Chironomidae	Microtendipes pedellus	2
	5	Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella (LPIL)	1
	5	Arthropoda	Insecta	Diptera	Chironomidae	Parametriocnemus (LPIL)	2
	5	Arthropoda	Insecta	Diptera	Chironomidae	Brillia (LPIL)	2
	5	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	4
	5	Arthropoda	Insecta	Odonata	Gomphidae	Dromogomphus (LPIL)	1
	5	Arthropoda	Insecta	Odonata	Aeshnidae	Boyeria vinosa	1
	5	Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis (LPIL)	1
	5	Arthropoda	Insecta	Coleoptera	Elmidae	Dubiraphia (LPIL)	4
	5	Arthropoda	Insecta	Coleoptera	Elmidae	Ancyronyx variegatus	3
	5	Arthropoda	Insecta	Coleoptera	Elmidae	Macronychus (LPIL)	2
	5	Arthropoda	Insecta	Coleoptera	Elmidae	Microcylloepus (LPIL)	1
	5	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	13
	5	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae (LPIL)	6
	5	Arthropoda	Insecta	Hemiptera	Corixidae	Corixidae (LPIL)	2
	5	Arthropoda	Insecta	Trichoptera		Trichoptera (LPIL)	6
	5	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae (LPIL)	7
	5	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche (LPIL)	2
	5	Arthropoda	Malacostraca	Isopoda	Asellidae	Lirceus (LPIL)	3
	5	Arthropoda	Malacostraca	Isopoda	Asellidae	Caecidotea (LPIL)	1
	5	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae (LPIL)	7
	5	Mollusca	Gastropoda	Basommatophor	Ancylidae	Ancylidae (LPIL)	2

Tompeat Creek	6	Annelida	Oligochaeta	Tubificida	Naididae	Naididae (LPIL)	1
	6	Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae (LPIL)	24
	6	Annelida	Oligochaeta	Tubificida	Tubificidae	Limnodrilus hoffmeisteri	2
	6	Arthropoda	Arachnida	Acari	Pionidae	Piona (LPIL)	1
	6	Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogonidae (LPIL)	15
	6	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	24
	6	Arthropoda	Insecta	Diptera	Chironomidae	Chironomus (LPIL)	13
	6	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	4
	6	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum tritum	9
	6	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum trigonus	1
	6	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum (LPIL)	2
	6	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	5
	6	Arthropoda	Insecta	Diptera	Chironomidae	Cryptotendipes (LPIL)	1
	6	Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes (LPIL)	2
	6	Arthropoda	Insecta	Diptera	Chironomidae	Tribelos fuscicorne	8
	6	Arthropoda	Insecta	Diptera	Chironomidae	Natarsia (LPIL)	2
	6	Arthropoda	Insecta	Diptera	Chironomidae	Parametriocnemus (LPIL)	2
	6	Arthropoda	Insecta	Diptera	Tabanidae	Tabanidae (LPIL)	1
	6	Arthropoda	Insecta	Diptera	Chaoboridae	Chaoborus (LPIL)	1
	6	Arthropoda	Insecta	Diptera	Tipulidae	Pseudolimnophila (LPIL)	1
	6	Arthropoda	Insecta	Odonata		Odonata (LPIL)	6
	6	Arthropoda	Insecta	Odonata	Coenagrionidae	Enallagma (LPIL)	6
	6	Arthropoda	Insecta	Coleoptera	Dytiscidae	Dytiscidae (LPIL)	1
	6	Arthropoda	Insecta	Collembola		Collembola (LPIL)	1
	6	Arthropoda	Insecta	Collembola	Isotomidae	Isotomurus (LPIL)	3
	6	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	1
	6	Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis diminuta	1
	6	Arthropoda	Insecta	Hemiptera	Corixidae	Corixidae (LPIL)	1
	6	Arthropoda	Malacostraca	Amphipoda	Crangonyctidae	Crangonyx (LPIL)	64
	6	Arthropoda	Ostracoda	Podocopida	Cyprididae	Cyprididae (LPIL)	1
	6	Mollusca	Gastropoda	Basommatophora	Physidae	Physidae (LPIL)	1

Okatibbee Creek	7	Arthropoda	Arachnida	Acari	Hygrobatidae	Hygrobates (LPIL)	3
	7	Arthropoda	Arachnida	Acari	Lebertiidae	Lebertia (LPIL)	1
	7	Arthropoda	Insecta	Diptera	Ceratopogonida	Ceratopogonidae (LPIL)	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	6
	7	Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus (LPIL)	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum scalaenum grou	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum halterale group	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum aviceps	6
	7	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum flavum	20
	7	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	7
	7	Arthropoda	Insecta	Diptera	Chironomidae	Stenochironomus (LPIL)	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus pellucidus	104
	7	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	10
	7	Arthropoda	Insecta	Diptera	Chironomidae	Corynoneura (LPIL)	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Nilotanypus fimbriatus	2
	7	Arthropoda	Insecta	Diptera	Chironomidae	Rheocricotopus robacki	6
	7	Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella (LPIL)	1
	7	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladius (LPIL)	2
	7	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	5
	7	Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis (LPIL)	1
	7	Arthropoda	Insecta	Coleoptera	Curculionidae	Bagous planatus	1
	7	Arthropoda	Insecta	Ephemeroptera		Ephemeroptera (LPIL)	22
	7	Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis (LPIL)	1
	7	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis (LPIL)	1
	7	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae (LPIL)	1
	7	Arthropoda	Insecta	Trichoptera		Trichoptera (LPIL)	1
	7	Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptila (LPIL)	6
	7	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae (LPIL)	6
	7	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche (LPIL)	1
	7	Arthropoda	Malacostraca	Decapoda	Cambaridae	Cambaridae (LPIL)	1
	7	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae (LPIL)	1

Dry Creek Tributary	8	Annelida	Oligochaeta	Tubificida	Naididae	Naididae (LPIL)	1
	8	Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae (LPIL)	18
	8	Annelida	Oligochaeta	Tubificida	Lumbriculidae	Lumbriculidae (LPIL)	2
	8	Arthropoda	Arachnida	Acari	Lebertiidae	Lebertia (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	25
	8	Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia mallochi	2
	8	Arthropoda	Insecta	Diptera	Chironomidae	Chironomus (LPIL)	14
	8	Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus (LPIL)	3
	8	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum illinoense grou	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum scalaenum grou	2
	8	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum halterale group	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum aviceps	2
	8	Arthropoda	Insecta	Diptera	Chironomidae	Procladius (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus (LPIL)	48
	8	Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Paralauterborniella (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus pellucidus	5
	8	Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus (LPIL)	5
	8	Arthropoda	Insecta	Diptera	Chironomidae	Rheocricotopus robacki	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Natarsia (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladius lignicola	1
	8	Arthropoda	Insecta	Diptera	Simuliidae	Simulium (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Psychodidae	Pericoma (LPIL)	1
	8	Arthropoda	Insecta	Diptera	Culicidae	Culex (LPIL)	3
	8	Arthropoda	Insecta	Diptera	Tipulidae	Limnophila (LPIL)	1
	8	Arthropoda	Insecta	Odonata	Coenagrionidae	Enallagma (LPIL)	1
	8	Arthropoda	Insecta	Coleoptera	Dytiscidae	Dytiscidae (LPIL)	4
	8	Arthropoda	Insecta	Collembola	Sminthuridae	Sminthurides (LPIL)	1
	8	Arthropoda	Insecta	Megaloptera	Sialidae	Sialis (LPIL)	2
	8	Arthropoda	Malacostraca	Amphipoda	Crangonyctidae	Crangonyx (LPIL)	18
	8	Arthropoda	Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca	10
	8	Arthropoda	Ostracoda	Podocopida		Podocopida (LPIL)	1
	8	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae (LPIL)	22

APPENDIX K

WETLAND HABITAT QUALITY ASSESSMENT DATA SHEETS FOR THE PROPOSED LIBERTY FUELS MINE

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WETLAND HABITAT QUALITY ASSESSMENT
DATA SHEETS

Prepared for:

NORTH AMERICAN COAL CORPORATION
P.O. BOX 399
JOURDANTON, TEXAS 78026

Prepared by:

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

October, 2009

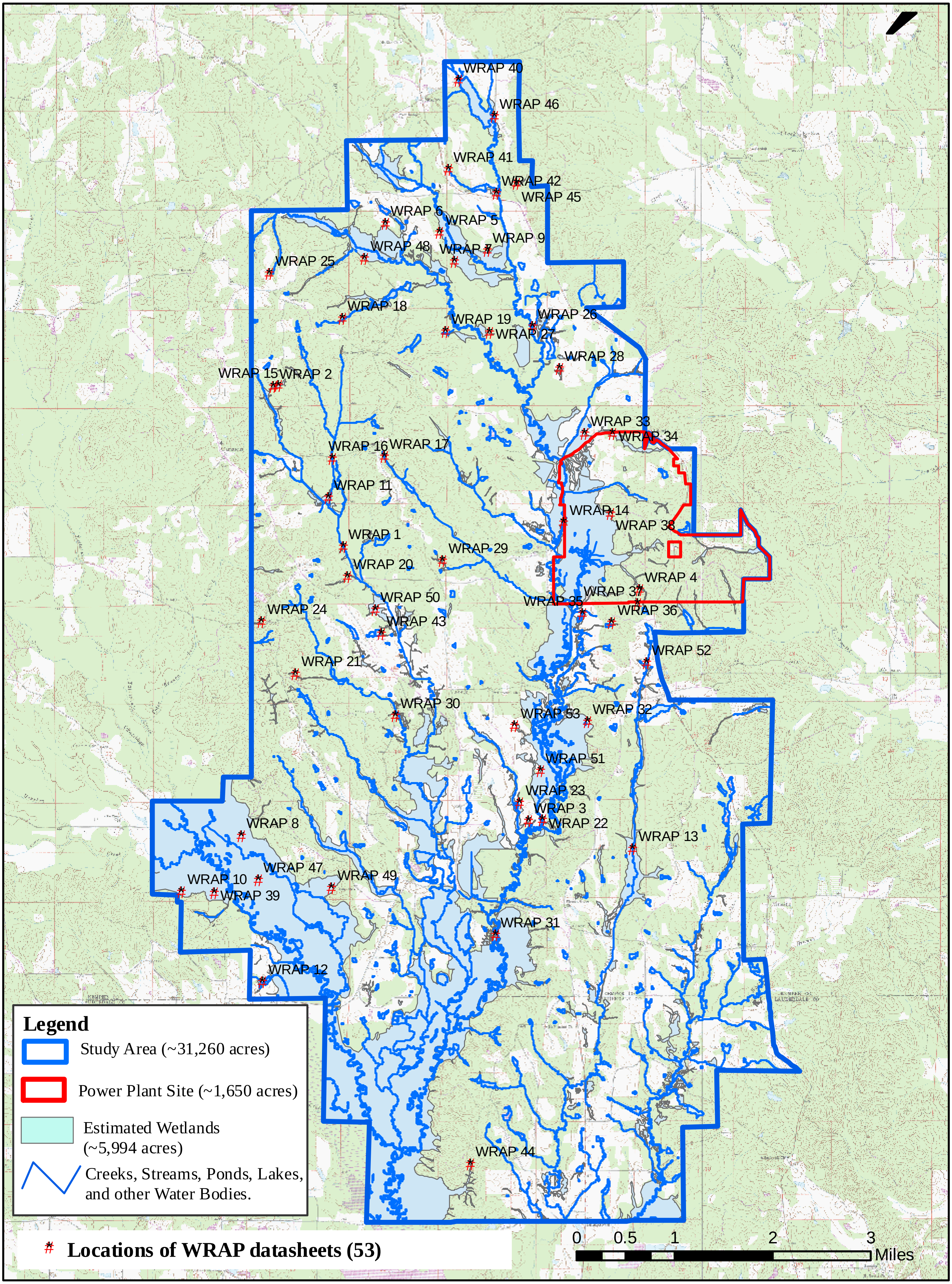
Barry A. Vittor & Associates, Inc. conducted wetland surveys of the study area between the months of June and October, 2008. Vittor & Associates biologists documented the quality of wetland habitat at 53 individual locations within the study area. Due to the limited access to private lands during wetland surveys, the location of WRAP points were arbitrarily selected in the field and do not represent a true random sample.

The quality of each wetland habitat was evaluated using the Wetland Rapid Assessment Procedure (WRAP). The WRAP is a rating index that was developed by the South Florida Water Management District to assist in the regulatory evaluation of mitigation sites. In 2007, the Mobile, Alabama District Corps of Engineers (COE) began using the WRAP to evaluate the habitat quality of jurisdictional wetlands as defined by the 1987 Corps of Engineers Wetland Delineation Manual. The objectives of the WRAP are: 1. to establish an accurate, consistent, and timely regulatory tool; 2. to track trends over time (land use vs. wetland impacts); and 3. to offer guidance for environmental site plan development.

When determining wetland quality using the WRAP methodology the following 6 variables are assessed: Wildlife Utilization, Wetland Overstory/Shrub Canopy, Wetland Vegetative Ground Cover, Adjacent Upland Support/Wetland Buffer, Field Indicators of Wetland Hydrology, and Water Quality Input and Treatment Systems. For each wetland evaluated a score between 0 and 3 is assigned to each of the 6 parameters. A score of 3 indicates the evaluated parameter meets all the criteria required for a system to be classified as 100% functional, and a score of 0 represents no functionality. The evaluator has the option to score each parameter in half (0.5) increments; half increments are utilized on the point scale from 0.5 through 2.5. This allows the evaluator to assess the value of the system more accurately. After assigning a value to each of the 6 parameters the sum of all scores is then divided by 18 (the maximum combined score) to obtain a final rating, which is expressed numerically by a number between 0 and 1. A final rating score of 1 indicates that a wetland is functioning at 100% of its capacity; whereas, a final score of 0 indicates a wetland has no functional value. The Mobile District COE uses the final WRAP score to determine overall quality of a wetland. For the purpose of assessing ratios for mitigation banking and mitigating wetland impacts the Mobile District COE uses the following range of WRAP scores to describe overall quality of a wetland: high quality (0.75-1), medium quality (0.50-0.74), and low quality (0-0.49). Calculations of wetland quality were derived in the office after fieldwork was completed.

BVA categorized each of the 53 evaluated wetlands as one of the following vegetation/land use types: planted pine (PP), hardwood forest (H), pine-hardwood forest (PH), hardwood-pine forest (HP), bottomland forest (BF), shrub land (S), and fields (F). Wetlands that were classified as vegetation types PP, H, PH, HP, and BF are forested wetlands. Wetlands that possess vegetative cover dominated by herbaceous plant species were classified as fields (pastures, hay fields, “deer plots”, or any area cleared of forest cover and maintained in an herbaceous state), and scrub-shrub wetlands were designated as shrub land under the vegetation/land use types. The most common forested wetlands evaluated by BVA were Planted Pine and Bottomland Forest. Wetlands were frequently documented in fields during the survey due to the common occurrence of maintained pastureland in floodplains. Only two shrub land wetlands were evaluated during the WRAP surveys. Shrub land wetlands are uncommon inside the study area.

Wrap locations are depicted in the attached study area wetland map, and data sheets are attached.


WRAP 40
WRAP 46
WRAP 41
WRAP 42
WRAP 45
WRAP 6
WRAP 5
WRAP 9
WRAP 48
WRAP 7
WRAP 25
WRAP 18
WRAP 19
WRAP 26
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WRAP 30
WRAP 53
WRAP 32
WRAP 51
WRAP 23
WRAP 3
WRAP 22
WRAP 8
WRAP 13
WRAP 47
WRAP 49
WRAP 10
WRAP 39
WRAP 31
WRAP 12
WRAP 44
Legend
Study Area (~31,260 acres)
Power Plant Site (~1,650 acres)
Estimated Wetlands
(~5,994 acres)
Creeks, Streams, Ponds, Lakes,
and other Water Bodies.
Locations of WRAP datasheets (53)
0
0.5
1
2
3
Miles

Wetland Rapid Assessment Procedure

WRAP #1

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number:

Project Name: North American Coal

Date: 06/23/08

Evaluator: Matt Stowe

Wetland Type: Bottomland Forest

Land Use: Forest Management

FLUCCS Code: Description:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 2.5

Wetland Ground Cover (GC): 1.5

Field Hydrology (HYD): 2

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average, consisting of >75% nuisance species	1	100	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Planted Pine	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	1.5	100	1.5
Pine Plantation			

PT TOTAL: 1.5

WRAP Score: 0.58

Wildlife Utilization (WU) 2	Evidence of wildlife utilization by large mammals. Adequate upland food sources and habitat.
Wetland Canopy (O/S) 2.5	*evidence of natural recruitment. *healthy canopy *no exotic species present *less than 10% invasive species composition.
Wetland Ground Cover (GC) 1.5	<20% vegetated ground cover with <10% exotic species. Siltation occurring in the wetland. Canopy appeared healthy.
Habitat Support/Buffer 1.0	* >300′ Buffer with > 75% nuisance species * Connected to offsite corridor
Field Hydrology (HYD) 2	Hydroperiod adequate enough to support a viable wetland. Plants appear to be healthy. Some areas exhibited evidence of siltation.
WQ Input & Treatment (WQ) 1.5	(LU) -Pine Plantation. (PT) –Undeveloped Pine Plantation.

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

WRAP #2

Application Number:

Project Name: North American Coal

Date: 06/24/08

Evaluator: Matt Stowe

Wetland Type: Hardwood-Pine Forest

Land Use: Forest Management

FLUCCS Code: ☐ Description:

Wildlife Utilization (WU): 1

Wetland Canopy (O/S): 1.5

Wetland Ground Cover (GC): 2

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average, consisting of >75% nuisance species.	1.0	100	1.0

TOTAL 1.0

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Und Pine Plantation	1.5	100	1.5

PT TOTAL 1.5

WRAP Score: 0.53

Wildlife Utilization (WU)	Minimal evidence of utilization by wildlife. Wetland newly planted with *Pinus taeda* (loblolly). Minimal habitat or food source.
Wetland Canopy (O/S)	- Less than 25% undesirable species. - Canopy provides habitat - Soil subsidence has adversely impacted the canopy species
Wetland Ground Cover (GC)	<25% undesirable species composition, no recorded exotic species. Siltation occurring around edges of wetlands.
Habitat Support/Buffer	>300′ but dominated by >75% nuisance species (*Pinus taeda*). Connected to offsite corridor.
Field Hydrology (HYD)	High levels of soil subsidence occur at the wetland boundary. Hydroperiod adequate to support viable wetland.
WQ Input & Treatment (WQ)	LU - Monoculture Pine Plantation – 100% PT - Undeveloped Land/Planted Pine – 100%

Wetland Rapid Assessment Procedure

WRAP #3

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	06/26/08	Matt Stowe	Planted Pine

Land Use: Forest Management

FLUCCS Code:

Wildlife Utilization (WU): 1.5

Wetland Canopy (O/S): 1.5

Wetland Ground Cover (GC): 1.0

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300', consisting of >75% nuisance species.	1.0	100	1.0

TOTAL: 1.0

Field Hydrology (HYD): 2.0

WQ Input & Treatment (WQ)*: 1.9

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Natural Undeveloped	2.5	40%	1
Pine Plantation	1.5	60%	0.9

(LU) TOTAL: 1.9

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Natural Undeveloped	2.5	40	1.0
Pine Plantation	1.5	60	0.6

PT TOTAL: 1.9

WRAP Score: 0.49

Wildlife Utilization (WU) 1.5

Tracks and visual observation provide evidence of utilization of the wetland and adjacent uplands by white-tailed deer and songbirds. Frequent human disturbance. Limited adjacent upland habitat.

Wetland Canopy (O/S) 1.5

* <25 % undesirable cover
* no exotics present
* minimal evidence of recruitment of native species

Wetland Ground Cover (GC) 1.0

~50 % undesirable cover. Cover slightly impacted by humans. Frequent human activity (recreation).

Habitat Support/Buffer 1.0

>300' buffer; however, buffer consists of >75% nuisance species (*Pinus taeda*). Connected to offsite wildlife corridor.

Field Hydrology (HYD) 2.0

Wetland hydrology is adequate, but ditches are present and adversely affect hydrology. Little evidence of soil subsidence.

WQ Input & Treatment (WQ) 1.9

(LU) 60% Monocultured Pine Plantation 40% Natural undeveloped
(PT) 40% Natural Undeveloped 60% Planted Pine

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 4

Application Number:
Project Name: North American Coal
Date: 7/9/2008
Evaluator: D.K.
Wetland Type: Planted Pine

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2
Wetland Canopy (O/S): 1
Wetland Ground Cover: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.75

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>30<300'	1	100	1
& consisting			
of >75%			
nuisance sp.			

Total 1

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	75	1.125
Nat Undevelop	2.5	25	0.625

LU Total 1.75

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	75	1.125
Nat Undevelop	2.5	25	0.625

PT Total 1.75

WRAP Score

0.49

Field Notes:

Wildlife Utilization (WU)

Utilized by mammals, birds, macroinvertebrates, amphibians and reptiles. Adequate adjacent upland food sources. Minimal human intervention. Adequate cover and habitat.

Wetland Canopy (O/S)

~50% undesirable species.

Wetland Ground Cover

~50% undesirable species. Chinese privet present in the understory, cover significantly impacted by humans.

Habitat Support/Buffer

Upland buffer has been recently clear-cut and provides little food or cover. Wetland buffer is connected to off-site corridors.

Field Hydrology (HYD)

Adequate hydroperiod. Plants healthy. Berms present in places. Erosion evident at the edge of clearcuts.

WQ Input & Treatment

Surrounding land use can best be described as a mix between natural undeveloped land and silvicultural practices. Pre-treatment of water is a mix between natural undeveloped lands and run-off from pine plantation.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 5

Application Number:

Project Name: North American Coal

Date: 7/10/2008

Evaluator: D.K.

Wetland Type: Bottomland Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 2

Wetland Ground Cover: 2

Habitat Support Buffer

Buffer Type	(Score)	X (% of area)=	Sub Totals
>30<300', ~50 undesirable species	1.5	100	1.5

Total: 1.5

Field Hydrology (HYD): 2

WQ Input & Treatment *: 2.25

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score)	X (% of area)=	Sub Totals
Planted Pine	1.5	50	0.75
Natural	2.5	50	1.25
Undeveloped			
		LU Total	2.00

Pretreatment Category (PT)

PT Category	(Score)	X (% of area)=	Sub Totals
Berms	2.5	50	1.25
Natural	2.5	50	1.25
Undeveloped			
		PT Total	2.5

WRAP Score: 0.65

Field Notes:

Wildlife Utilization (WU)

Utilized by mammals, birds, macroinvertebrates, amphibians and reptiles. Adequate adjacent upland food sources. Moderate human intervention. Adequate cover and habitat.

Wetland Canopy (O/S)

<25% Undesirable cover. Evidence of natural recruitment. Healthy canopy with no sign of disease. Few snags.

Wetland Ground Cover

<25% Undesirable species. Cover impacted by recent clear-cut.

Habitat Support/Buffer

Upland buffers consist of forested hardwoods and planted pine, ~50% of the buffer consists of undesirable loblolly pine.

Field Hydrology (HYD)

Adequate hydroperiod. Plants healthy. Berms present in places. Erosion evident at the edges of wetlands.

WQ Input & Treatment

Surrounding land use can best be described as ongoing silvicultural operations. Pre-treatment of water is a mix between undeveloped bottomland hardwood forest and berms that minimize erosion.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location: WRAP 6

Application Number:

Project Name: North American Coal

Date: 7/10/2008

Evaluator: D.K.

Wetland Type: Planted Pine

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 1

Wetland Ground Cover: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.38

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300' w/ 75%	1	100	1
nuisance species			

Total: 1

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	75	1.125
Improved			
pasture	1	25	0.25
		LU Total	1.38

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	75	1.125
grass swales	1	25	0.25
		PT Total	1.38

WRAP Score: 0.47

Field Notes:

Wildlife Utilization (WU)

Utilized by mammals, birds, macroinvertebrates, amphibians and reptiles. Adequate adjacent upland food sources. Minimal human intervention. Adequate cover and habitat.

Wetland Canopy (O/S)

~50% Undesirable cover. Minimal signs of natural recruitment. Healthy canopy with no sign of disease.

Wetland Ground Cover

~50% undesirable species. Cover significantly impacted by humans.

Habitat Support/Buffer

Upland buffers consist of improved pasture and planted pine.

Field Hydrology (HYD)

Adequate hydroperiod. Plants healthy. Berms present in places. Erosion evident at the edges of wetlands.

WQ Input & Treatment

Surrounding land use can best be described as a mix between improved pasture and silvicultural practices. Pre-treatment of water is a mix between grass swales and berms that minimize erosion.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 7

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	7/10/2008	D.K.	Bottomland Forest

Land Use	Description	Wetland Acreage

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover
2.5	3	3

Field Hydrology (HYD): 2.5

WQ Input & Treatment *: 2.26

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2.5	75	1.88
>300' w/ >75% nuisance species	1	25	0.25

Total 2.13

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	25	0.375
Natural Undev	2.5	75	1.88

LU Total 2.26

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	25	0.375
Natural Undev	2.5	75	1.88

PT Total 2.26

WRAP Score
0.85

Field Notes:

Wildlife Utilization (WU)

Utilized by mammals, birds, macroinvertebrates, amphibians and reptiles. Adequate adjacent upland food sources. Minimal human intervention. Adequate cover and habitat.

Wetland Canopy (O/S)

<10% invasive canopy with no exotics. Strong evidence of natural recruitment. Healthy canopy with no sign of disease. Few snags.

Wetland Ground Cover

<10% Undesirable species with no exotics. Good habitat, minimal disturbance to ground cover.

Habitat Support/Buffer

Upland buffers consist of forested hardwoods and planted pine.

Field Hydrology (HYD)

Exhibits natural hydroperiod. Plants healthy. Berms present in some places. No subsidence.

WQ Input & Treatment

Surrounding land use can best be described as a natural undeveloped land and infrequent silvicultural practices. Pre-treatment of water is through natural undeveloped land and forested swales.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 8

Application Number:

Project Name: North American Coal

Date: 7/21/2008

Evaluator: D.K.

Wetland Type: Planted Pine

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 1

Wetland Ground Cover: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300' & >75%	1	100	1
nuisance			
Species			

Total 1

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Pine	1.5	100	1.5
Plantation			
		LU Total	1.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Undeveloped	1.5	100	1.5
Planted			
Pine			
		PT Total	1.5

WRAP Score
0.47

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, and a small number of songbirds. Cover is adequate, but poor upland food sources exist adjacent to the wetland.

Wetland Canopy (O/S)

>50% Undesirable species exist in the pine dominated canopy. There are hydrology problems associated with the rowed pine trees.

Wetland Ground Cover

~50% Undesirable species in the ground cover component. Maintained as a pine plantation, limited diversity of ground cover species.

Habitat Support/Buffer

>300' buffer, but has a >75% nuisance species composition (pine plantation).

Field Hydrology (HYD)

Hydroperiod adequate, but rowed swales associated with the planted pine trees has an adverse affect on hydrology.

WQ Input & Treatment

(LU) - Surrounding land use is primarily planted pine monoculture. (PT) - Undeveloped planted pine.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 9

Application Number:
Project Name: North American Coal
Date: 7/25/2008
Evaluator: D.K.
Wetland Type: Bottomland Forest

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2
Wetland Canopy (O/S): 2.5
Wetland Ground Cover: 2

Field Hydrology (HYD): 2

WQ Input & Treatment *: 2.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2	100	2

Total 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Nat Undevelop	2.5	100	2.5
		LU Total	2.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Nat Undevelop	2.5	100	2.5
		PT Total	2.5

WRAP Score
0.72

Field Notes:

Wildlife Utilization (WU)
Utilized by small and large mammals, songbirds and reptiles. Cover and adjacent upland food sources are adequate and human intervention is minimal.

Wetland Canopy (O/S)
<10% Invasive canopy species are present. The canopy is healthy and there is strong evidence of natural recruitment. Canopy provides habitat.

Wetland Ground Cover
<25% Undesirable species composition in the herbaceous layer. Cover is slightly impacted by human activities.

Habitat Support/Buffer
>300' buffer on average. There is a <10% exotic species component in the adjacent land. Site is connected to wildlife corridors.

Field Hydrology (HYD)
Hydroperiod adequate, but swales and adjacent roads may have an adverse affect on hydrology.

WQ Input & Treatment
(LU) - Natural Undeveloped Land (PT) - Natural Undeveloped Land

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 10

Application Number:

Project Name: North American Coal

Date: 7/22/2008

Evaluator: D.K.

Wetland Type: Planted Pine

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 1.5

Wetland Canopy (O/S): 1

Wetland Ground Cover: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2	100	2

Total 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Pine Plantation	1.5	100	1.5

LU Total 1.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Pine Plantation	1.5	100	1.5

PT Total 1.5

WRAP Score
0.50

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals. No sign of reptiles or amphibians were observed. Limited adjacent upland food source.

Wetland Canopy (O/S)

>50% Undesirable species composition. Minimal sign of recruitment, intensively maintained as pine monoculture.

Wetland Ground Cover

~50% Undesirable species. Routinely managed as pine monoculture, low species diversity.

Habitat Support/Buffer

>300' buffer on average. Contains some desirable species. Site is connected to wildlife corridors.

Field Hydrology (HYD)

Hydroperiod adequate, plants appear healthy and disease free. Some subsidence was observed.

WQ Input & Treatment

(LU) - Pine Plantation (PT) - Undeveloped Pine Plantation

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 11

Application Number:
Project Name: North American Coal
Date: 7/23/2008
Evaluator: D.K.
Wetland Type: Planted Pine

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 1.5
Wetland Canopy (O/S): 1
Wetland Ground Cover: 1

Field Hydrology (HYD): 2
WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>30<300'	1.5	100	1.5

Total 1.5

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Pine Plantation	1.5	100	1.5

LU Total 1.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Pine Plantation	1.5	100	1.5

PT Total 1.5

WRAP Score
0.47

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, aquatic fishes, amphibians, reptiles. Limited upland food source.

Wetland Canopy (O/S)

>50% Undesirable species composition. Limited sign of recruitment was observed. Intensively maintained as pine monoculture.

Wetland Ground Cover

~50% Undesirable cover. Routinely managed as pine monoculture, low species diversity and biomass.

Habitat Support/Buffer

<30>300' buffer on average. Provides cover, limited food source.

Field Hydrology (HYD)

Hydroperiod adequate, plants appear healthy and disease free. Soil subsidence observed, adversely affecting hydrology.

WQ Input & Treatment

(LU) - Pine Plantation (PT) - Undeveloped Pine Plantation

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location: WRAP 12

Application Number:

Project Name: North American Coal

Date: 6/12/2008

Evaluator: David Knowles

Wetland Type: Bottomland Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 2

Wetland Ground Cover: 1.5

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>30<300'	1.5	100	1.5

Total: 1.5

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Livestock	1	100	1
Pasture			

LU Total: 1.00

Pretreatment Category (PT)

PT Category	(Score)	X (% of area)=	Sub Totals
Wet detention w/			
grass swales	2		2

PT Total: 2

WRAP Score: 0.58

Field Notes:

Wildlife Utilization (WU)

Evidence of use by mammals, birds, macroinvertebrates, amphibians and reptiles. Adequate adjacent upland food sources. Frequent human intervention. Adequate protective cover.

Wetland Canopy (O/S)

<10% invasive cover. Minimal recruitment of native species. Canopy provides good cover and habitat. Few snags, healthy canopy.

Wetland Ground Cover

<10% invasive species. Cover significantly impacted by livestock.

Habitat Support/Buffer

Upland buffer provides little cover. Wetland buffer does provide adequate cover. Portions of wetland are connected to off-site corridor.

Field Hydrology (HYD)

Wetland hydroperiod adequate but has swales, ponds and reduced drainage.

WQ Input & Treatment

The water entering the system is directly effected by livestock pasture and cattle ponds. A natural wetland drain was previously altered and now feeds two cattle ponds before entering the Okatibbee floodplain.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 13

Application Number:

Project Name: North American Coal

Date: 6/24/2008

Evaluator: D.K. and D.N.

Wetland Type: Hardwood Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.5

Wetland Ground Cover: 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300' average	2.5	50	1.25
>300' w/ ~50% undesirable species.	1.5	50	0.75

Total: 2

Field Hydrology (HYD): 2

WQ Input & Treatment *: 2

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	50	0.75
Nat Undevelop	2.5	50	1.25

LU Total: 2.00

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	50	0.75
Nat Undevelop	2.5	50	1.25

PT Total: 2

WRAP Score: 0.72

Field Notes:

Wildlife Utilization (WU)

Abundant sign of mammals, birds, macroinvertebrates, amphibians and reptiles. Adequate adjacent upland food sources. Minimal human intervention. Adequate cover and habitat within wetland and adjacent upland buffer.

Wetland Canopy (O/S)

<10% invasive cover. Good habitat, strong evidence of natural recruitment. Healthy canopy with no sign of disease.

Wetland Ground Cover

<25% invasive species. Chinese privet present in the understory, cover slightly impacted by humans.

Habitat Support/Buffer

Wetland buffer >300' on average, 50% of buffer consists of ~50% undesirable plant species(loblolly pine). Upland buffer provides good cover and adequate food source. Wetland buffer is connected to off-site corridors and supports large mammals.

Field Hydrology (HYD)

Adequate hydroperiod. Silvicultural practices have produced some rutting in places and a significant amount of ditching has taken place and affected hydrology.

WQ Input & Treatment

Surrounding land use can best be described as a mix between natural undeveloped land and silvicultural practices. Pre-treatment of water is mostly natural undeveloped lands.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 14

Application Number:
Project Name: North American Coal
Date: 6/24/2008
Evaluator: D.K. and D.N.
Wetland Type: Bottomland Forest

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2.75
Wetland Canopy (O/S): 3
Wetland Ground Cover: 2.5

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300' average	2.5	50	1.25
>300' w/ >75% exotic species.	1	50	0.5

Total 1.75

Field Hydrology (HYD): 2.5

WQ Input & Treatment *: 2.25

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	50	0.75
Nat Undevelop	3	50	1.5

LU Total 2.25

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Planted Pine	1.5	50	0.75
Nat Undevelop	3	50	1.5

PT Total 2.25

WRAP Score
0.82

Field Notes:

Wildlife Utilization (WU)

Abundant mammals, birds, macroinvertebrates, amphibians and reptiles. Abundant adjacent upland food sources. Negligible human intervention. Abundant cover and habitat within wetland and adjacent upland buffer.

Wetland Canopy (O/S)

<10% invasive cover. Good habitat, strong evidence of natural recruitment. Healthy canopy with no sign of disease.

Wetland Ground Cover

<10% invasive species. Chinese privet present in the understory, cover slightly impacted by humans.

Habitat Support/Buffer

Upland buffer provides good cover and adequate food source. Wetland buffer is connected to off-site corridors and supports large mammals. >300' width on average, 50% of buffer contains>75% exotic species.

Field Hydrology (HYD)

Healthy non-stressed plants, wetland exhibits a natural hydroperiod. Silviculture practices have produced some rutting in places and a small number of ditches are found throughout the Chickasawhay Creek floodplain.

WQ Input & Treatment

Surrounding land use can best be described as a mix between natural undeveloped land and silvicultural practices. Pre-treatment of water is mostly natural undeveloped lands.

Wetland Rapid Assessment Procedure

WRAP 15

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number:

Project Name: North American Coal

Date: 10/07/08

Evaluator: Everett/Stowe

Wetland Type: Hardwood-Pine Forest

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 1.5

Wetland Canopy (O/S): 2

Wetland Ground Cover (GC): 2.5

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average, consisting of >75% nuisance species	1	100	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped Pine Plantation	1.5	100	1.5

PT TOTAL: 1.5

WRAP Score: 0.61

Wildlife Utilization (WU) 1.5	-Evidence of large and small mammals; medium and small reptiles -Adequate upland forage. -Minimal upland shelter
Wetland Canopy (O/S) 2	- Mature but somewhat sparse canopy - Adequate roosting - Desirable species present - ≈30% deadfall or snags
Wetland Ground Cover (GC) 2.5	- No exotic species observed - ≈25% nuisance species present - Desirable wetland vegetation in area
Habitat Support/Buffer 1	- 2 yr – 3 yr old planted loblolly pine plantations which occupy 100% of the upland buffer
Field Hydrology (HYD) 2.5	- System is still able to maintain hydroperiod
WQ Input & Treatment (WQ 1.5	- Land use = 100% loblolly pine plantation - Pretreatment = 100% undeveloped loblolly pine plantation

Wetland Rapid Assessment Procedure

WRAP 16

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/07/08	Everett/Stowe	Bottomland Forest

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover (GC)
2.5	2.5	2

Field Hydrology (HYD): 2

WQ Input & Treatment (WQ)*: 2.25

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300’	3	50%	1.5
>300’, >75% nuisance species composition.	1	50%	0. 5

TOTAL: 2

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Nat.Undeveloped	3	50%	1.5
Pine Plantation	1.5	50%	0. 75

(LU) TOTAL: 2.25

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Nat. Undeveloped	3	50	1.5
Pine Plantation	1.5	50	0. 75

PT TOTAL: 2.25

WRAP Score: 0.74

Wildlife Utilization (WU) 2.5	-Abundant food shelter and roosting -Evidence of mammals, reptiles and aquatic life. -Desirable species -Minimal human disturbance
Wetland Canopy (O/S) 2.5	-Desirable mature canopy -Abundant roosting available -Dense understory
Wetland Ground Cover (GC) 2	- ≈ 50% ground cover - desirable species - siltation
Habitat Support/Buffer 2	- 50% >300’ - 50% >300’, >75% undesirable species composition
Field Hydrology (HYD) 2	Large stream is channelized
WQ Input & Treatment (WQ 2.25	- Land use = 50% natural undeveloped & 50% pine plantation - Pretreatment = 50% natural undeveloped & 50% pine plantation

Wetland Rapid Assessment Procedure

WRAP 17

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/07/08	Everett/Stowe	Bottomland Forest

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.5

Wetland Ground Cover (GC): 2.5

Field Hydrology (HYD): 2

WQ Input & Treatment (WQ)*: 2.25

Buffer type	Habitat Support/Buffer (Score) X	(% of area)	=Sub Totals
>300'	3	75%	2.25
>300', <75% undesirable species composition	2	25%	0.5
		TOTAL	2.75

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Rangeland	2.0	100%	2.0
		(LU) TOTAL	2.0

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Wet detention	2.5	50%	1.25
Undeveloped	2.0	50%	1.25
Rangeland			
		PT TOTAL	2.5

WRAP Score: 0.81

Wildlife Utilization (WU) 2.5	-Abundant forage, habitat, and roosting available. -Desirable species -Diversity of species -Minimal human disturbance
Wetland Canopy (O/S) 2.5	Mature canopy with ≈ 25% exotic species Good habitat for roosting Desirable species for forage
Wetland Ground Cover (GC) 2.5	70% wetland coverage with ≈ 25% exotic species present
Habitat Support/Buffer 2.75	- 75% >300' natural undeveloped - 25% >300' rangeland
Field Hydrology (HYD) 2	Man made pond adversely affects hydrology.
WQ Input & Treatment (WQ 2.25	- Land use = 100% Rangeland - Pretreatment = 50% wet detention & 50% rangeland

WRAP 18

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/08/08	Everett/Stowe	Bottomland Forest

Land Use	FLUCCS Code	Description:	

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover (GC)
2	2	2

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300’, >75% nuisance species composition	1.0	100%	1.0

TOTAL 1.0

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

PT TOTAL 1.5

WRAP Score: 0.61

Wildlife Utilization (WU)	-Evidence of wildlife utilization -Adequate habitat for roosting and forage
Wetland Canopy (O/S)	-Mature canopy with desirable species -Sparse in areas due to timber harvest -Adequate roosting available
Wetland Ground Cover (GC)	<25% exotic ground cover in wetland area
Habitat Support/Buffer	>300’, >75% nuisance species composition
Field Hydrology (HYD)	-Some siltation occurring in small areas due to recent clear cut -System still able to maintain hydrologic regime
WQ Input & Treatment (WQ)	- Land use = 100% loblolly pine plantation - Pretreatment = 100% loblolly pine plantation

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

WRAP 19

Application Number:

Project Name: North American Coal

Date: 10/08/08

Evaluator: Everett/Stowe

Wetland Type: Bottomland Forest

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2

Wetland Ground Cover (GC): 2.0

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average, consisting of >75% nuisance species	1	100	1

TOTAL: 1

Field Hydrology (HYD): 3

WQ Input & Treatment (WQ)*: 1.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undev. Pine Planta.	1.5	100	1.5

PT TOTAL: 1.5

WRAP Score: 0.67

Wildlife Utilization (WU) 2.5	-Evidence of diversity of wildlife including aquatic life -Abundant wildlife forage -Abundant roosting in canopy
Wetland Canopy (O/S) 2	-50% of canopy is immature but has potential -50% of canopy is mature and healthy with ≈ 25% of understory contains exotic species
Wetland Ground Cover (GC) 2	≈ 30% Coverage with no exotics
Habitat Support/Buffer 1.0	>300' average, consisting of >75% nuisance species
Field Hydrology (HYD) 3	Hydrology is unaltered.
WQ Input & Treatment (WQ 1.5	LU – Pine Plantation PT – Undeveloped Planted Pine

Wetland Rapid Assessment Procedure

WRAP 20

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/08/08	Everett/Stowe	Planted Pine

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover (GC)
1.0	1.5	1

Field Hydrology (HYD): 2.0

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300′, consisting of >75% nuisance species	1	100	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1	100%	1.5

PT TOTAL: 1.5

WRAP Score: 0.45

Wildlife Utilization (WU)	- Little habitat for birds and reptiles, deer tracks were observed in the wetland. - Limited adjacent upland food source.
Wetland Canopy (O/S)	<25 % undesirable cover. Minimal sign of recruitment of native species.
Wetland Ground Cover (GC)	~50% undesirable cover.
Habitat Support/Buffer	>300′, consisting of >75% nuisance species.
Field Hydrology (HYD)	-System is culverted upstream under an old logging road. -Hydroperiod is adequate enough to maintain system.
WQ Input & Treatment (WQ)	- Land use = 100% pine plantation - W.Q. Pretreatment = 100% pine plantation

Wetland Rapid Assessment Procedure

WRAP 21

☐ Check one
☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/08/08	Everett/Stowe	Hardwood-Pine Forest

Land Use	FLUCCS Code	Description:	

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover (GC)
2.5	2.5	2.5

Field Hydrology (HYD): 3

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>30<300', >75% undesirable species composition	1	100%	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	1.5	100%	1.5
Pine Plantation			

PT TOTAL: 1.5

WRAP Score: 0.72

Wildlife Utilization (WU) 2.5	-Adequate roosting and forage -Negligible evidence of human disturbance -Uplands consist of ≈ 2 yr old planted pine
Wetland Canopy (O/S) 2.5	-Mature canopy -Adequate roosting and shelter
Wetland Ground Cover (GC) 2.5	<25% Undesirable species present
Habitat Support/Buffer 1	>30<300'Buffer consists of >75% undesirable species composition
Field Hydrology (HYD) 3.0	Non altered hydrology
WQ Input & Treatment (WQ) 1.5	(LU) pine plantation (PT) undeveloped pine plantation

Wetland Rapid Assessment Procedure

WRAP 22

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/08/08	Everett/Stowe	Bottomland Forest

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.5

Wetland Ground Cover (GC): 2.5

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 2.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300′ Pine Plantation	1.0	50%	0. 5
>300′ Hardwood	3	50%	1.5

TOTAL: 2.0

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Nat Undevelop.	2.5	100%	2.5

(LU) TOTAL: 2.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Nat Undevelop.	2.5	100%	2.5

PT TOTAL: 2.5

WRAP Score: 0.81

Wildlife Utilization (WU) 2.5

-Connected to wildlife corridor
-Abundant shelter, forage, and roosting

Wetland Canopy (O/S) 2.5

<10% Invasive canopy, Evidence of recruitment of native species present.

Wetland Ground Cover (GC) 2.5

<25% Undesirable species

Habitat Support/Buffer 2.0

>300′ average buffer. 50% of buffer is comprised of planted loblolly, the remaining 50% is hardwood

Field Hydrology (HYD) 2.5

Natural wetland hydroperiod.

WQ Input & Treatment (WQ) 2.5

- Land use = Natural Undeveloped
- W.Q. Pretreatment = Natural Undeveloped

Wetland Rapid Assessment Procedure

WRAP 23

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/09/08	Everett/Stowe	Bottomland Forest

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.5

Wetland Ground Cover (GC): 2.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300'	2.5	100%	2.5

TOTAL: 2.5

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 2.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Nat. Undevel.	2.5	100%	2.5

(LU) TOTAL: 2.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Nat. Undeveloped	2.5	100%	2.5

PT TOTAL: 2.5

WRAP Score: 0.83

Wildlife Utilization (WU)	- Evidence of utilization by large mammals, aquatic macro-invertebrates, reptiles, amphibians and birds was observed - Abundant shelter, forage, and roosting is available to wildlife. - Minimal human intervention to wildlife.
Wetland Canopy (O/S)	-Good habitat -Canopy comprised of >90% desirable canopy species. -Strong evidence of natural recruitment
Wetland Ground Cover (GC)	<10% Invasive species composition, no exotic species present. There is minimal disturbance to ground cover.
Habitat Support/Buffer	>300' buffer on average. The wetland is connected to a wildlife corridor.
Field Hydrology (HYD)	Exhibits natural hydroperiod.
WQ Input & Treatment (WQ)	- Land use = Natural Undeveloped Land - W.Q. Pretreatment = Natural Undeveloped Land

Wetland Rapid Assessment Procedure

WRAP 24

☐ Check one
☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number:
Project Name: North American Coal
Date: 10/09/08
Evaluator: Everett/Stowe
Wetland Type: Pine-Hardwood Forest

Land Use:
FLUCCS Code:
Description:

Wildlife Utilization (WU): 2.5
Wetland Canopy (O/S): 2.5
Wetland Ground Cover (GC): 2.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>30 <300′	1	80%	0.8
>300′, consisting of >75% nuisance species	1	20%	0.2

TOTAL: 1.0

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

PT TOTAL: 1.5

WRAP Score: 0.69

Wildlife Utilization (WU) 2.5

- Evidence of utilization by large mammals, aquatic macro-invertebrates, reptiles, amphibians and birds was observed.
-Abundant shelter, forage, and roosting

Wetland Canopy (O/S) 2.5

-Minimal human disturbance
≈25% invasive species

Wetland Ground Cover (GC) 2.5

Wetland has a desirable diversity of vegetative ground cover.
No exotics observed

Habitat Support/Buffer 1.0

80% >30′ <300′; 20% >300′, consisting of >75% nuisance species

Field Hydrology (HYD) 2.5

Exhibits natural hydroperiod.

WQ Input & Treatment (WQ) 1.5

- Land use = Pine Plantation
- W.Q. Pretreatment = Pine Plantation

Wetland Rapid Assessment Procedure

WRAP 25

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/09/08	Everett/Stowe	Pine-Hardwood Forest

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU): 0.5

Wetland Canopy (O/S): 1.5

Wetland Ground Cover (GC): 1.5

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
<300′	0.5	100%	0.5

TOTAL: 0.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	1.5	100%	1.5
Pine Plantation			

PT TOTAL: 1.5

WRAP Score: 0.44

Wildlife Utilization (WU) 0.5	Minimal utilization of wetland and adjacent uplands by wildlife species. Minimal roosting and forage in wetland. Uplands have been replanted in loblolly pine.
Wetland Canopy (O/S) 1.5	Herbicide use has affected canopy species adjacent to clear-cut uplands. Immature canopy has potential. <25% Undesirable cover.
Wetland Ground Cover (GC) 1.5	~50% Undesirable ground cover, there is a sparse canopy and thick understory. ~No exotic species recorded in ground cover but 20% nuisance species were present.
Habitat Support/Buffer 0.5	<300′ average buffer width. Surrounding wetland has been cleared, sprayed, and replanted with undesirable species. The wetland is connected to offsite corridor.
Field Hydrology (HYD) 2.5	Hydroperiod is adequate, but soil subsidence was observed.
WQ Input & Treatment (WQ) 1.5	- Land use = Pine Plantation - W.Q. Pretreatment = undeveloped clear cut

Wetland Rapid Assessment Procedure

WRAP 26

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/09/08	Everett/Stowe	Field

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 2

Wetland Ground Cover (GC): 1

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>30'<300'	2	100%	2

TOTAL: 2

Field Hydrology (HYD): 2.0

WQ Input & Treatment (WQ)*: 1.13

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Rangeland	2.0	50%	1
ImprovedPasture	1	50%	0.5

(LU) TOTAL: 1. 5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Grass swales	1	50%	0.5
Cattle pasture	0.5	50%	0.25

PT TOTAL: 0.75

WRAP Score: 0.56

Wildlife Utilization (WU) 2	Evidence of utilization by large mammals, aquatic macro-invertebrates, amphibians and reptiles. Adjacent upland food source and cover are adequate.
Wetland Canopy (O/S) 2	<25% Undesirable canopy species composition. Evidence of recruitment of native species.
Wetland Ground Cover (GC) 1	~50% Undesirable cover (wet pasture)
Habitat Support/Buffer 2.0	* >30'<300' buffer on average. * Connected to offsite corridor.
Field Hydrology (HYD) 2.0	Hydroperiod adequate, but affected by ditching.
WQ Input & Treatment (WQ) 1.13	- Land use = 50% rangeland and 50% improved pasture - W.Q. Pretreatment = 50% grass swales, 50% cattle pasture(cattle feces in wetland)

Wetland Rapid Assessment Procedure

WRAP 27

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/09/08	Everett/Stowe	Planted Pine

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 0.5

Wetland Canopy (O/S): 0.0

Wetland Ground Cover (GC): 1

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300′, consisting of >75% nuisance species	1	100%	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	1.5	100%	1.5
Pine Plantation			

PT TOTAL: 1.5

WRAP Score: 0.36

Wildlife Utilization (WU) 0.5	Sparse adjacent upland food source. Little habitat for birds, mammals and reptiles.
Wetland Canopy (O/S) 0.0	No desirable species in the canopy. Canopy is comprised entirely of loblolly pine.
Wetland Ground Cover (GC) 1.0	>50% undesirable species
Habitat Support/Buffer 1	>300′ average buffer width, but is comprised of >75% nuisance species (loblolly pine). Connected to offsite corridor
Field Hydrology (HYD) 2.5	Wetland hydroperiod is adequate.
WQ Input & Treatment (WQ) 1.5	- Land use = pine plantation - W.Q. Pretreatment = undeveloped pine plantation

Wetland Rapid Assessment Procedure

WRAP 28

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	10/09/08	Everett/Stowe	Field

Land Use	FLUCCS Code	Description:	

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover (GC)
1	0	0.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' & 75%			
Nuisance species	1.0	100	1.0

TOTAL 1.0

Field Hydrology (HYD) 1.5

WQ Input & Treatment (WQ)* 0.75

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Improved	1	100%	1
Pasture			

(LU) TOTAL 1

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pre-treatment of water is obtained with grass swales; however, water entering wetland is contaminated by cattle feces.	0.5	100%	0.5

PT TOTAL 0.5

WRAP Score 0.26

Wildlife Utilization (WU) 1	- Minimal evidence of wildlife. - Limited adjacent upland food source.
Wetland Canopy (O/S) 0	No desirable canopy species were observed.
Wetland Ground Cover (GC) 0.5	- >75% undesirable cover. - Intensively maintained pasture.
Habitat Support/Buffer 1	- >300′ average buffer that consists of >75% nuisance species. - Connect to offsite wildlife corridor.
Field Hydrology (HYD) 1.5	- Plants are healthy and exhibit no sign of water stress. - Succession of wetland plant species into transitional/upland species.
WQ Input & Treatment (WQ) 0.75	- Land use = Improved pasture - Pre-treatment of water is obtained with grass swales; however, water entering wetland is contaminated by cattle feces.

Wetland Rapid Assessment Procedure

WRAP 29

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number:

Project Name: North American Coal

Date: 10/09/08

Evaluator: Everett/Stowe

Wetland Type: Hardwood

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 1.5

Wetland Ground Cover (GC): 1.5

Field Hydrology (HYD): 1

WQ Input & Treatment (WQ)*: 2.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>30<300'	2	100%	2

TOTAL: 2

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	2.5	100%	2.5

(LU) TOTAL: 2.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	2.5	100%	2.5

PT TOTAL: 2.5

WRAP Score: 0.61

Wildlife Utilization (WU)	2	- Evidence of utilization by small, medium and large mammals was observed. - Minimal human intervention was observed. - Adequate protective cover is available to wildlife.
Wetland Canopy (O/S)	1.5	- Canopy provides habitat to wildlife. - Canopy is mature, but sparse. Evidence of recruitment of native species was observed.
Wetland Ground Cover (GC)	1.5	~50% undesirable cover as a result of a thin canopy.
Habitat Support/Buffer	2	>30<300' buffer on average. Buffer provides cover and food source to wildlife.
Field Hydrology (HYD)	1.5	Wetland hydroperiod is adequate; however, drainage is reduced due to fill in the wetland near a small road crossing.
WQ Input & Treatment (WQ)	2.5	- Land use = 100% natural undeveloped - W.Q. Pretreatment = 100% natural undeveloped

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 30

Application Number:
Project Name: North American Coal
Date: 10/9/2008
Evaluator: D.K. and J.E.
Wetland Type: Field

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 1.5
Wetland Canopy (O/S): 1.5
Wetland Ground Cover: 1.5

Habitat Support Buffer

Buffer Type	(Score)	X (% of area)=	Sub Totals
>300' w/ >75% nuisace species	1	100	1

Total: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score)	X (% of area)=	Sub Totals
Improved	1	100	1
Pasture			

LU Total: 1.00

Pretreatment Category (PT)

PT Category	(Score)	X (% of area)=	Sub Totals
Grass swales	1	100	1

PT Total: 1

WRAP Score: 0.47

Field Notes:

Wildlife Utilization (WU)

Deer, turkey, reptiles and amphibians utilize the wetland. There is frequent human disturbance to the wetland and surrounding land. Limited cover and upland food source availability.

Wetland Canopy (O/S)

<25% Undesirable canopy species are present. Immature canopy, has potential.

Wetland Ground Cover

<25% Undesirable species composition in the herbaceous layer. Cover is impacted by human activities. Maintained as pasture.

Habitat Support/Buffer

>300' buffer on average. Buffer provides limited cover and adequate food source.

Field Hydrology (HYD)

Hydroperiod adequate, but swales and a culvert placed under the road running through the wetland adversely affect hydrology.

WQ Input & Treatment

(LU) - Improved Pasture (PT) - Grass swales

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 31

Application Number:
Project Name: North American Coal
Date: 10/9/2008
Evaluator: D.K. and J.E.
Wetland Type: Bottomland Forest

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2.5
Wetland Canopy (O/S): 2
Wetland Ground Cover: 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300' w/ >75% nuisance sp.	1	100	1

Total: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Pine	1.5	100	1.5
Plantation			

LU Total: 1.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Undeveloped	1.5	100	1.5
Pine			
Plantation			

PT Total: 1.5

WRAP Score: 0.61

Field Notes:

Wildlife Utilization (WU)

Deer, turkey, reptiles and amphibians utilize the wetland. Adequate upland food source and cover present. Connected to wildlife corridor.

Wetland Canopy (O/S)

<25% Undesirable canopy species are present. Canopy provides habitat. Evidence of native recruitment. Healthy canopy with few snags.

Wetland Ground Cover

<25% Undesirable species composition in the herbaceous layer. Cover is slightly impacted by human activities, a maintained road cuts through the wetland swale.

Habitat Support/Buffer

>300' buffer on average w/ >75% nuisance species. Buffer provides adequate cover and food source. Portions connected to off-site corridors.

Field Hydrology (HYD)

Hydroperiod adequate, but rutted in areas near roads. Little evidence of subsidence.

WQ Input & Treatment

(LU) - Pine Plantation (PT) - Undeveloped Pine Plantation

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 32

Application Number:
Project Name: North American Coal
Date: 10/10/2008
Evaluator: D.K. and J.E.
Wetland Type: Field

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 1.5
Wetland Canopy (O/S): 1
Wetland Ground Cover: 2

Field Hydrology (HYD): 1.5
WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals	Total
>300', >75%				
nuisance speci	1	50	0.5	
Natural				
Undeveloped	2.5	50	1.25	1.75

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Livestock			
Pasture	0.5	50	0.25
Natural			
Undeveloped	2.5	50	1.25
		LU Total	1.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Livestock			
Pasture	0.5	50	0.25
Natural			
Undeveloped	2.5	50	1.25
		PT Total	1.5

WRAP Score

0.51

Field Notes:

Wildlife Utilization (WU)

Utilized by deer, songbirds, reptiles and amphibians. Limited adjacent upland food source. Area is used as livestock pasture, cows were present in the wetland at the time of survey.

Wetland Canopy (O/S)

Has been cleared up to the edge of the floodplain. Some desirable species in canopy; immature but has potential. Environmental impacts in place, dead trees were observed in the wetland.

Wetland Ground Cover

~50% Undesirable ground cover; routinely managed as wet pasture for livestock grazing.

Habitat Support/Buffer

50% has buffer of >300', but has >75% nuisance species. The remaining 50% is >300' and is natural undeveloped land

Field Hydrology (HYD)

Dammed pond has advesely affected hydrology. Dead trees were observed in the wetland.

WQ Input & Treatment

(LU) - 50% Livestock Pasture, 50% Nat. Undeveloped (PT) - 50%Livestock Pasture, 50% Natural Undeveloped

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 33

Application Number

Project Name North American Coal

Date 10/10/2008

Evaluator D.K. and J.E.

Wetland Type Planted Pine

Land Use

Description

Wetland Acreage

Wildlife Utilization (WU) 1

Wetland Canopy (O/S) 1

Wetland Ground Cover 1

Field Hydrology (HYD) 2

WQ Input & Treatment * 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score)	X (% of area)=	Sub Totals
>300' with	1	100	1
predominantly			
nuisance			
species			

Total 1

Land use Category (LU)

LU Category	(Score)	X (% of area)=	Sub Totals
Planted Pine	1.5	100	1.5

LU Total 1.50

Pretreatment Category (PT)

PT Category	(Score)	X (% of area)=	Sub Totals
Planted Pine	1.5	100	1.5

PT Total 1.5

WRAP Score

0.42

Field Notes:

Wildlife Utilization (WU)

Minimal evidence of wildlife, not adequate for songbirds. Sparse upland food source. Abuts well travelled paved road.

Wetland Canopy (O/S)

>75% Undesirable species composition. 100% dominated by rowed, planted loblolly pine. Negligible habitat support.

Wetland Ground Cover

>75% Undesirable species composition. Cover highly impacted, mostly nuisance species.

Habitat Support/Buffer

>300', but has >75% nuisance species.

Field Hydrology (HYD)

Wetland hydrology adequate; however, heavy soil subsidence occurs in areas and hydrololgy is adveresely affected by paved and dirt roads. Plants show no sign of water stress.

WQ Input & Treatment

(LU) - Planted loblolly pine (PT) - Undeveloped Pine Plantation.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 34

Application Number:
Project Name: North American Coal
Date: 10/7/2008
Evaluator: D.K. and J.E.
Wetland Type: Hardwood-Pine Forest

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2
Wetland Canopy (O/S): 2.5
Wetland Ground Cover: 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300', but has >75% nuisance species	1	50	0.5
No Buffer	0	50	0

Total 0.5

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.13

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Imp. Pasture	1	50	0.5
LV Highway	1	25	0.25
Planted Pine	1.5	25	0.38

LU Total 1.13

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Grass swales	1	75	0.75
Undeveloped			
Planted Pine	1.5	25	0.38

PT Total 1.13

WRAP Score

0.56

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals. There is frequent human disturbance to wildlife due to the proximity of Liberty Rd. Cover and food sources are limited by the road and adjacent pasture.

Wetland Canopy (O/S)

Wetland canopy provides good habitat within the wetland. There is strong evidence of recruitment of native canopy species. Canopy is healthy and shows no sign of disease or stress.

Wetland Ground Cover

Ground cover is slightly impacted by human activity and soil subsidence; however the species composition is ideal for the mature hardwood/pine wetland in which it is located.

Habitat Support/Buffer

50% is comprised of a >300' buffer, with >75% nuisance species. The remaining 50% has no buffer due to Liberty road bordering the entire north side of the wetland.

Field Hydrology (HYD)

Adequate hydrology, but ditched and impounded by Liberty Rd.

WQ Input & Treatment

(LU) - 50%Improved Pasture, 25%Low Volume Highway, 25% Planted Pine (PT) - 75%Grass swales only, 25% Planted Pine

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 35

Application Number:

Project Name: North American Coal

Date: 10/7/2008

Evaluator: D.K. and J.E.

Wetland Type: Field

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 1

Wetland Ground Cover: 1

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score)	X (% of area)=	Sub Totals
>300', but has	1	100	1
>75% nuisance			
species			

Total: 1

Land use Category (LU)

LU Category	(Score)	X (% of area)=	Sub Totals
Improved	1	100	1
Pasture			

LU Total: 1.00

Pretreatment Category (PT)

PT Category	(Score)	X (% of area)=	Sub Totals
Grass swales	1	100	1
only			

PT Total: 1

WRAP Score
0.44

Field Notes:

Wildlife Utilization (WU)
Site provides adequate herbaceous forage, but little cover and adjacent upland food source currently exists.

Wetland Canopy (O/S)
Wetland has an immature canopy and is kept as pasture. There is minimal sign of recruitment of native canopy species.

Wetland Ground Cover
~50% Undesirable species composition. Routinely managed as improved pasture.

Habitat Support/Buffer
>300' buffer, but is comprised of >75% non-invasive nuisance species.

Field Hydrology (HYD)
Adequate hydrology, but adjacent to roads and ditching.

WQ Input & Treatment
(LU) - Improved Pasture (PT) - Grass swales only.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location

WRAP 36

Application Number	
Project Name	North American Coal
Date	10/7/2008
Evaluator	D.K. and J.E.
Wetland Type	Pine-Hardwood Forest
Land Use	
Description	
Wetland Acreage	
Wildlife Utilization (WU)	2
Wetland Canopy (O/S)	2
Wetland Ground Cover	2
Field Hydrology (HYD)	1.5
WQ Input & Treatment *	1

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2.5	75	1.9
>30<300'	2	25	0.5

Total 2.4

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Forested	1	100	1
Rangeland			

LU Total 1.00

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Forested	1	100	1
Rangeland			

PT Total 1

WRAP Score

0.61

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, amphibians and songbirds. There is adequate food and cover in the surrounding uplands to support large mammals.

Wetland Canopy (O/S)

<25% Undesirable species, wetland canopy provides habitat. Recruitment of native species was evident at the time of the survey.

Wetland Ground Cover

<25% Undesirable species in herbaceous layer. Cover is slightly impacted by loss of sediment into the wetland from an adjacent dirt road.

Habitat Support/Buffer

25% of the buffer is <30>300' on average, and the remaining 75% is >300' on average.

Field Hydrology (HYD)

Wetland hydrology is adequate; however, is impounded by a man-made pond and is bordered by a dirt road. There is evidence of soil subsidence.

WQ Input & Treatment

(LU) - Forested Rangeland (PT) - Forested Rangeland.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 37

Application Number:

Project Name: North American Coal

Date: 10/7/2008

Evaluator: D.K. and J.E.

Wetland Type: Pine-Hardwood Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2

Wetland Canopy (O/S): 2

Wetland Ground Cover: 2

Field Hydrology (HYD): 2.5

WQ Input & Treatment *: 2.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2.5	100	2.5

Total 2.5

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	100	2.5
Undeveloped			

LU Total 2.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	100	2.5
Undeveloped			

PT Total 2.50

WRAP Score
0.75

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, little sign of amphibians and songbirds. There is adequate food and cover in the surrounding uplands to support large mammals.

Wetland Canopy (O/S)

<25% Undesirable species, wetland canopy provides habitat. Recruitment of native species was evident at the time of the survey.

Wetland Ground Cover

<25% Undesirable species in herbaceous layer. Cover is slightly impacted by human activities.

Habitat Support/Buffer

>300' buffer , with predominantly desirable species.

Field Hydrology (HYD)

Wetland hydrology is adequate. The plants are healthy and show no sign of water stress. There is little evidence of soil subsidence.

WQ Input & Treatment

(LU) - Natural Undeveloped (PT) - Natural Undeveloped.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 38

Application Number:
Project Name: North American Coal
Date: 10/7/2008
Evaluator: D.K. and H.H.
Wetland Type: Field

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2
Wetland Canopy (O/S): 1.5
Wetland Ground Cover: 1

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals	
>300'	2.5	50	0.63	
>300', >75%				**Total**
nuisance spec	1	50	0.75	1.38

Field Hydrology (HYD): 2

WQ Input & Treatment *: 2

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Nat Und.	2.5	50	1.25
Planted			
Pine	1.5	50	0.75
		LU Total	2.00

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Undeveloped	1.5	50	0.75
Pine Plantation			
Nat Undevel.	2.5	50	1.25
		PT Total	2.00

WRAP Score
0.55

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, and songbirds. There is an adequate upland food source in the surrounding uplands to support large mammals.

Wetland Canopy (O/S)

Portions of the wetland were recently clear-cut and maintained as a hunting food plot in the floodplain of Chickasawhay Creek.

Wetland Ground Cover

Comprised mostly of non-native herbaceous species. Highly invasive tropical soda-apple was observed in the cleared area.

Habitat Support/Buffer

50% of the wetland has a >300' buffer , with predominantly desirable species. 50% of the buffer is >300' but has >75% nuisance species (Pine Plantation & Non-Native Herbaceous Species).

Field Hydrology (HYD)

Wetland hydrology is adequate. The plants are healthy and show no sign of water stress. Swales and logging ruts are in place.

WQ Input & Treatment

(LU) - 50% Natural Undeveloped, 50% Pine Plantation (PT) - 50% Natural Undeveloped, 50% Undeveloped Planted Pine.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 39

Application Number:

Project Name: North American Coal

Date: 10/8/2008

Evaluator: D.K. and H.H.

Wetland Type: Planted Pine

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 1.5

Wetland Canopy (O/S): 1

Wetland Ground Cover: 1.5

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300' w/ 75%	1	100	1
nuisance species			

Total: 1

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted	1.5	100	1.5
Pine			

LU Total: 1.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Planted			
Pine	1.5	100	1.5

PT Total: 1.50

WRAP Score
0.47

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals; no evidence of utilization by songbirds, reptiles. The available upland food source is limited and somewhat sparse. Human intervention is evident through manipulation of the land for purposes of managing timber.

Wetland Canopy (O/S)

>50% Undesirable species content. Canopy is dominated by planted loblolly pine. The sub-canopy was observed to have desirable native wetland species, showing future potential if timber harvest operations ceased.

Wetland Ground Cover

Comprised mostly of herbaceous species indicative of disturbed sites.

Habitat Support/Buffer

>300' on average, consisting of >75% nuisance loblolly pine. Buffer is connected with contiguous off-site corridors and provides cover.

Field Hydrology (HYD)

Wetland hydrology is adequate. The plants are healthy and show no sign of water stress. Swales and logging ruts are in place.

WQ Input & Treatment

(LU) - Planted Pine (PT) - Planted Pine.

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location: WRAP 40

Application Number:

Project Name: North American Coal

Date: 10/8/2008

Evaluator: D.K. and H.H.

Wetland Type: Bottomland Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 1.5

Wetland Canopy (O/S): 2

Wetland Ground Cover: 1.5

Field Hydrology (HYD): 2

WQ Input & Treatment *: 1.25

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	1	50	0.5
NB	0	25	0
<30'	1	25	0.25

Total 0.75

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Planted pine	1.5	50	0.75
Improved pasture	1	50	0.5
		LU Total	1.25

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Grass swales	1	50	0.5
Planted pine	1.5	50	0.75
		PT Total	1.25

WRAP Score

0.50

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, reptiles, amphibians, aquatic macroinverterbrates and fishes. Frequent human disturbance is created by the paved road. There is a marginal upland food source.

Wetland Canopy (O/S)

<25% Undesirable species present. Native recruitment is evident and the canopy provides good habitat. No sign of disease in canopy trees.

Wetland Ground Cover

<25% Undesirable species. Chinese privet has been established due to human impacts to the wetland ground cover.

Habitat Support/Buffer

The paved road to the north provides no buffer. To the east and south the buffer is >300' on average vegetated with predominantly loblolly pine, and the western edge of the wetland has a <30' buffer.

Field Hydrology (HYD)

Wetland hydrology is adequate. The plants are healthy and show no sign of water stress; however, culverts and soil subsidence negatively impact the wetland.

WQ Input & Treatment

(LU) - 50% Planted Pine, 50% Improved (PT) - 50% Planted Pine, 50% Grass Swales

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 41

Application Number:
Project Name: North American Coal
Date: 10/8/2008
Evaluator: D.K. and H.H.
Wetland Type: Hardwood-Pine Forest

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2
Wetland Canopy (O/S): 2
Wetland Ground Cover: 1.5

Field Hydrology (HYD): 2
WQ Input & Treatment *: 2.4

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2	50	1
>30<300'	1.5	50	0.75

Total 1.75

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Natural undeveloped	2.5	0.75	1.9
Improved pasture	1	0.25	0.5

LU Total 2.40

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Grass swales	1	0.25	0.5
Natural undeveloped	2.5	0.75	1.9

PT Total 2.40

WRAP Score
0.65

Field Notes:

Wildlife Utilization (WU)
Utilized by small and large mammals, reptiles, and amphibians. Minimal human disturbance and a marginal upland food source was observed.

Wetland Canopy (O/S)
<25% Undesirable species present. Native recruitment is evident and the canopy provides good habitat. No sign of disease in canopy trees.

Wetland Ground Cover
<25% Undesirable species. Cover slightly impacted by humans.

Habitat Support/Buffer
>300' on average to the east, <30>300' to the west(adjacent to road).

Field Hydrology (HYD)
Wetland hydrology is adequate. Soil subsidence was observed in the wetland.

WQ Input & Treatment
(LU) - 25% Improved Pasture, 75% Natural Undeveloped (PT) - 75% Nat. Undeveloped, 25% Grass Swales

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location

WRAP 42

Application Number:

Project Name: North American Coal

Date: 10/8/2008

Evaluator: D.K. and H.H.

Wetland Type: Field

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 1

Wetland Canopy (O/S): 0

Wetland Ground Cover: 0.5

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
NB	0	50	0
>300'	2	50	1

Total 1

Field Hydrology (HYD): 1

WQ Input & Treatment *: 1.75

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	50	1.25
undeveloped			
Improved	1	50	0.5
pasture			

LU Total 1.75

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Grass swales	1	0.5	0.5
Natural	2.5	0.5	1.25
undeveloped			

PT Total 1.75

WRAP Score

0.29

Field Notes:

Wildlife Utilization (WU)

Deer and raccoon may utilize the wetland; however, the habitat is very poor for songbirds and there is no cover and a limited upland food source.

Wetland Canopy (O/S)

No canopy present, mechanically cleared and maintained.

Wetland Ground Cover

Juncus effusus is the only prevalent native wetland species observed in the wetland.

Habitat Support/Buffer

50% No Buffer (due to road and pasture) 50% Natural Undeveloped

Field Hydrology (HYD)

A pond has been built to the north of the wetland, severly impacting hydrology.

WQ Input & Treatment

(LU) - 50% Improved Pasture, 50% Natural Undeveloped (PT) - 50% Nat. Undeveloped, 50% Grass Swales

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 43

Application Number:
Project Name: North American Coal
Date: 10/9/2008
Evaluator: D.K. and H.H.
Wetland Type: Field

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 1
Wetland Canopy (O/S): 0
Wetland Ground Cover: 1

Habitat Support Buffer

Buffer Type	(Score)	X (% of area)=	Sub Totals
Pasture	0.5	100	0.5
>300' but has			
>75% nuisance			
species			

Total 0.5

Field Hydrology (HYD): 1.5

WQ Input & Treatment *: 1

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score)	X (% of area)=	Sub Totals
Improved	1	100	1
pasture			

LU Total 1.00

Pretreatment Category (PT)

PT Category	(Score)	X (% of area)=	Sub Totals
Grass swales	1	100	1

PT Total 1.00

WRAP Score
0.28

Field Notes:

Wildlife Utilization (WU)

Herbaceous weedy cover is the only food available to wildlife. Upland food source is very sparse. The pasture is used for livestock grazing, cattle were observed in the wetland.

Wetland Canopy (O/S)

No canopy present, maintained as wet pasture.

Wetland Ground Cover

Disturbed by humans, weedy herbaceous species dominate the ground cover, including some non-native species.

Habitat Support/Buffer

Pasture, >300' but has >75% non-invasive nuisance species.

Field Hydrology (HYD)

A wetland swale drains a cattle pond, hydrology is adversely affected.

WQ Input & Treatment

(LU) - 100% Improved Pasture (PT) - 100% Grass Swales

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One
☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location
WRAP 44

Application Number:
Project Name: North American Coal
Date: 10/9/2008
Evaluator: D.K. and H.H.
Wetland Type: Pine-Hardwood Forest

Land Use:
Description:
Wetland Acreage:

Wildlife Utilization (WU): 2.5
Wetland Canopy (O/S): 2
Wetland Ground Cover: 2.5

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2.5	100	2.5

Total 2.5

Field Hydrology (HYD): 3

WQ Input & Treatment *: 2.28

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	75	1.9
Undeveloped			
Planted Pine	1.5	25	0.38
		LU Total	2.28

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	75	1.9
Undeveloped			
Planted Pine	1	25	0.38
		PT Total	2.28

WRAP Score
0.82

Field Notes:

Wildlife Utilization (WU)
Utilized by small and large mammals, songbirds. Adjacent upland food source and available cover are abundant for wildlife. Minimal human invervention was observed.

Wetland Canopy (O/S)
<25% Undesirable species, canopy provides habitat and shows no sign of stress or disease.

Wetland Ground Cover
<10% Undesirable species, no disturbance to the ground cover.

Habitat Support/Buffer
>300' in width. Connected to wildlife corridor, and is adjacent to the Okatibbee Wildlife Management Area.

Field Hydrology (HYD)
Wetland has healthy, non-stressed plants and exhibits a natural hydroperiod. No soil subsidence was observed.

WQ Input & Treatment
(LU) - 75% Natural Undeveloped, 25% Planted Pine (PT) - 75% Natural Undeveloped, 25% Planted Pine

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location: WRAP 45

Application Number:

Project Name: North American Coal

Date: 10/9/2008

Evaluator: D.K. and H.H.

Wetland Type: Bottomland Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2

Wetland Ground Cover: 2.5

Field Hydrology (HYD): 2.5

WQ Input & Treatment *: 2.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>300'	2.5	100	2.5

Total 2.5

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	100	2.5
Undeveloped			

LU Total 2.50

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Natural	2.5	100	2.5
Undeveloped			

PT Total 2.50

WRAP Score

0.81

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, songbirds. Adjacent upland food source and available cover are abundant for wildlife. Minimal human invervention was observed.

Wetland Canopy (O/S)

<25% Undesirable species, canopy provides habitat and shows no sign of stress or disease.

Wetland Ground Cover

<10% Undesirable species, no disturbance to the ground cover. Good species diversity was observed.

Habitat Support/Buffer

>300' in width. Connected to wildlife corridors, and provides food and cover to wildlife.

Field Hydrology (HYD)

Wetland has healthy, non-stressed plants and exhibits a natural hydroperiod. Soil subsidence was observed.

WQ Input & Treatment

(LU) - 100% Natural Undeveloped (PT) - 100% Natural Undeveloped

WETLAND RAPID ASSESSMENT PROCEDURE

☐ Check One

☐ Proposed Conditions ☐ Current Conditions

(WRAP)

WRAP Location

WRAP 46

Application Number:

Project Name: North American Coal

Date: 10/9/2008

Evaluator: D.K. and H.H.

Wetland Type: Bottomland Forest

Land Use:

Description:

Wetland Acreage:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.5

Wetland Ground Cover: 2.5

Habitat Support Buffer

Buffer Type	(Score) X	(% of area)=	Sub Totals
>30<300'	1	75	0.75
>300'	2.5	25	0.63

Total 1.38

Field Hydrology (HYD): 2.5

WQ Input & Treatment *: 1.38

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

LU Category	(Score) X	(% of area)=	Sub Totals
Improved	1	75	0.75
pasture			
Natural			
undevelope	2.5	25	0.63
		LU Total	1.38

Pretreatment Category (PT)

PT Category	(Score) X	(% of area)=	Sub Totals
Improved	1	75	0.75
pasture			
Natural			
undevelope	2.5	25	0.63
		PT Total	1.38

WRAP Score

0.71

Field Notes:

Wildlife Utilization (WU)

Utilized by small and large mammals, songbirds, fishes, amphibians and reptiles. Adjacent upland food source and available cover are abundant for wildlife. Minimal human invervention was observed.

Wetland Canopy (O/S)

<25% Undesirable species, canopy provides habitat and shows no sign of stress or disease.

Wetland Ground Cover

<25% Undesirable species, no disturbance to the ground cover. Good species diversity was observed.

Habitat Support/Buffer

50% is >300' in width, 50% is >30<300' with >75% undesirable species.

Field Hydrology (HYD)

Ponded area acts as a natural sediment catch, no human controlled elevation.

WQ Input & Treatment

(LU) - 25% Natural Undeveloped, 75% Improved Pasture (PT) - 25% Natural Undeveloped, 75% Improved Pasture

WRAP 47

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	7/25/08	J. Everett	Bottomland Forest

Land Use:

FLUCCS Code:

Description:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.5

Wetland Ground Cover (GC): 2.5

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 2.5

Buffer type	Habitat Support/Buffer (Score) X	(% of area)	=Sub Totals
>300′	2	100	2.5

TOTAL: 2.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Natural	2.5	100%	2.5

(LU) TOTAL: 2.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Natural	2.5	100	2.5

PT TOTAL: 2.5

WRAP Score: .83

Wildlife Utilization (WU) 2.5	- Evidence of utilization by large mammals, aquatic macro-invertebrates, reptiles, amphibians and birds was observed. - Negligible evidence of human disturbance observed. - There is adequate adjacent upland food source to support wildlife.
Wetland Canopy (O/S) 2.5	- <10% undesirable species composition of canopy species, no exotics were observed. - A healthy canopy was observed, and it provides good habitat to wildlife. - Strong evidence of natural recruitment of native species was observed.
Wetland Ground Cover (GC) 2.5	<10% undesirable plant species.
Habitat Support/Buffer 2.5	>300′ average wetland buffer. Wetland is connected to an offsite corridor.
Field Hydrology (HYD) 2.5	- Hydrology adequate to maintain wetland system. . - Plants are healthy and exhibit no water stress.
WQ Input & Treatment (WQ 2.5	LU- Natural Undeveloped Land PT- Natural Undeveloped Land

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

WRAP 48

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	7/25/08	J. Everett	Shrubland

Land Use: Pine Plantation

FLUCCS Code: Description:

Wildlife Utilization (WU): 1.0

Wetland Canopy (O/S): 0.5

Wetland Ground Cover (GC): 1.0

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300', comprised of >75% nuisance species.	1	100	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Grass swales	1.5	100	1.5

PT TOTAL: 1.5

WRAP Score: 0.42

Wildlife Utilization (WU) 1	Small and medium sized mammals utilize the wetland. Frequent human disturbance occurs due to the routine maintenance of the field.
Wetland Canopy (O/S) 0.5	- subject to recent clear-cutting
Wetland Ground Cover (GC) 1	- Approximately 50% undesirable species - Recently clear-cut
Habitat Support/Buffer 1	>300' average buffer, consisting of >75% nuisance species(loblolly pine)
Field Hydrology (HYD) 2.5	Wetland exhibits natural hydroperiod. Plants are healthy, and there is little evidence of soil subsidence into the wetland.
WQ Input & Treatment (WQ) 1.5	Land use – logging operation H_2O Treatment – grass swales

Wetland Rapid Assessment Procedure

WRAP 49

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	7/25/08	J. Everett	Hardwood-Pine Forest

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU): 1

Wetland Canopy (O/S): 1

Wetland Ground Cover (GC): 2

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300', comprised of >75% nuisance species.	1	100	1

TOTAL: 1

Field Hydrology (HYD): 1.5

WQ Input & Treatment (WQ)*: 1.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100	1.5

PT TOTAL: 1.5

WRAP Score: 0.45

Wildlife Utilization (WU) 1

-Sparse upland food source.
- Recently thinned, leaving little cover for wildlife.

Wetland Canopy (O/S) 1

-Immature canopy, but has potential.
- >50% Undesirable species composition.

Wetland Ground Cover (GC) 2

<25% undesirable species composition.

Habitat Support/Buffer 1

>300′ buffer on average, but consisting of >75% nuisance species(loblolly pine)

Field Hydrology (HYD) 1.5

-Rutting by logging equipment had adversely affected hydrology.
-Adequate hydroperiod

WQ Input & Treatment (WQ) 1

Land Use	WQ & Pretreatment
100% Pine Plantation	Undeveloped Pine Plantation

Wetland Rapid Assessment Procedure

WRAP 50

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number:

Project Name: North American Coal

Date: 06/02/08

Evaluator: J. Everett

Wetland Type: Field

Land Use: Pasture

FLUCCS Code: Description:

Wildlife Utilization (WU): 0.5

Wetland Canopy (O/S): 0

Wetland Ground Cover (GC): 2.5

Field Hydrology (HYD): 2.0

WQ Input & Treatment (WQ)*: 1.0

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average width, but consisting of >75% nuisance species	1	100	1

TOTAL: 1.0

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Improved Pasture	1	100%	1

(LU) TOTAL: 1.0

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Grass Swales	1	100	1

PT TOTAL: 1.0

WRAP Score: 0.39

Wildlife Utilization (WU) 0.5	Very minimal wildlife utilization. Only small rodents (squirrels) and birds (red-winged black bird) observed.
Wetland Canopy (O/S) 0	No wetland canopy or shrubbery.
Wetland Ground Cover (GC) 2.5	Less than 10% nuisance or exotic plant species. Large number of obligate wetland species. Wetland is grazed by cattle.
Habitat Support/Buffer 1.0	Greater than 300 ft average width, but buffer is improved pasture land. Very little forest areas to provide food or habitat for animals. Connected to offsite corridor.
Field Hydrology (HYD) 2.0	Wetland hydroperiod adequate, although conditions possibly interfering with or influencing the hydroperiod such as ditches.
WQ Input & Treatment (WQ) 1.0	100% Improved Pasture. Grass swales only.

Wetland Rapid Assessment Procedure

WRAP 51

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	6/5/08	J. Everett	Shrub Land

Land Use:

FLUCCS Code: Description:

Wildlife Utilization (WU): 2.0

Wetland Canopy (O/S): 2.0

Wetland Ground Cover (GC): 2.0

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average width, but consisting of >75 nuisance species	1	100	1

TOTAL: 1.0

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100	1.5

PT TOTAL: 1.5

WRAP Score: 0.61

Wildlife Utilization (WU) 2.0	Evidence of small and large mammals and reptiles. No evidence of aquatic life. Adequate amount of roosting and forage. Human disturbance appears to be minimal.
Wetland Canopy (O/S) 2.5	Canopy is mature providing abundant source for roosting and nesting. >10% exotic species recorded. Shrub density is less than 20%. Few snags or den trees.
Wetland Ground Cover (GC) 2.0	Ground cover is sparse, but cover is comprised of <25% undesirable species. Covers is slightly impacted by humans.
Habitat Support/Buffer 1.0	Upland buffer is greater than 300' wide on average and consists of 90% *Pinus taeda* (Loblolly pine). Portions connected to wildlife corridor.
Field Hydrology (HYD) 2.0	Plants appear to be healthy and do not exhibit stress associated with an unnatural hydroperiod. No ditches or swales. Soil subsidence/siltation is evident.
WQ Input & Treatment (WQ) 1.5	LU - Row Planted Pines – 100% PT - Row Planted Pines – 100%

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

WRAP 52

Application Number:

Project Name: North American Coal

Date: 06/03/08

Evaluator: J. Everett

Wetland Type: Field

Land Use: Forested

FLUCCS Code:

Description:

Wildlife Utilization (WU): 2.5

Wetland Canopy (O/S): 2.0

Wetland Ground Cover (GC): 2.0

Field Hydrology (HYD): 2.5

WQ Input & Treatment (WQ)*: 2

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
<300′	1	.50	0.5
>300	2	.50	1

TOTAL: 1.5

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	2.5	50%	1.25
Pine Plantation	1.5	50%	.75

(LU) TOTAL: 2

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	50	.75
Nat Undeveloped	2.5	50	1.25

PT TOTAL: 2

WRAP Score: 0.69

Wildlife Utilization (WU) 2.5	Evidence of large mammals, reptiles, and fish. Adequate food source, habitat and roosting. Macro-invertebrates and small forage fish species observed in standing water.
Wetland Canopy (O/S) 2.0	Wetland canopy healthy, minimal evidence of stressed trees. Few den trees and snags present. Exotic species present in small numbers.
Wetland Ground Cover (GC) 2.0	Wetland ground cover is desirable with >10% <25% undesirable species. Exotic species present.
Habitat Support/Buffer 1.5	50% <300′ next to small farm that is worked daily. Exotics common. Connected to offsite wildlife corridor. 50% >300′ connected to offsite corridor with abundant upland habitat and food source. Exotics scattered throughout.
Field Hydrology (HYD) 2.5	Wetland hydrology adequately supports wetland function. Siltation/disturbance evident, but overall impact minimal.
WQ Input & Treatment (WQ) 2	LU 50% Natural undeveloped – 2.5 50% Undeveloped Pine Plantation – 1.5 PT 50% Undeveloped Pine Plantation – 1.0 50% Natural undeveloped – 2.5

Wetland Rapid Assessment Procedure

☐ Check one

☐ Existing Conditions ☐ Proposed Conditions (WRAP)

WRAP 53

Application Number	Project Name	Date	Evaluator	Wetland Type
	North American Coal	06/05/08	J. Everett	Field

Land Use: Pine Plantation

FLUCCS Code: ☐ Description:

Wildlife Utilization (WU): 1.0

Wetland Canopy (O/S): 0.5

Wetland Ground Cover (GC): 2.5

Field Hydrology (HYD): 0.5

WQ Input & Treatment (WQ)*: 1.5

Habitat Support/Buffer

Buffer type	(Score) X	(% of area)	=Sub Totals
>300' average width, but consisting of >75% nuisance species	1	100	1

TOTAL: 1

Land use Category (LU)

Land use Category	(Score) X	(% of area)	=Sub Totals
Pine Plantation	1.5	100%	1.5

(LU) TOTAL: 1.5

Pretreatment Category (PT)

Pretreatment Category	(Score) X	(% of area)	=Sub Totals
Undeveloped	1.5	100	1.5
Pine Plantation			

PT TOTAL: 1.5

WRAP Score: 0.39

Wildlife Utilization (WU) 1.0	Minimal evidence of wildlife utilization, little habitat for birds, mammals, and reptiles, uplands consists of young row planted pines.
Wetland Canopy (O/S) 0.5	No overstory in head of wetland, only young 6 feet tall *Pinus taeda* (Loblolly) and different species of grasses. Subject to recent clear cutting with little evidence of native canopy regeneration.
Wetland Ground Cover (GC) 2.5	Less than 10% nuisance species, no recorded exotics, ground cover impacted from pine planting (shade, bedding).
Habitat Support/Buffer 1	>300′ uplands surrounding wetland and consists of row planted pines. Wetlands further down stream are naturally forested and connected to offsite corridor. Pines do not provide desirable habitat or adequate food source for wildlife.
Field Hydrology (HYD) 0.5	Wetland hydrology altered due to establishment of monoculture pine plantation. Bedding/rows have altered natural topography and hydroperiod. Has allowed encroachment of upland species.
WQ Input & Treatment (WQ) 1.5	100% planted pine plantation in buffer zone. Pine plantation alters pH of runoff and surface flow characteristics.

APPENDIX L

KEMPER COUNTY IGCC PROJECT NATIVE AMERICAN TRIBAL CONSULTATIONS

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TRIBAL SHIPPING ADDRESSES

1. Absentee-Shawnee Tribe of Oklahoma
Ms. Karen Kaniatobe
Director of the Cultural/Historical Preservation Department
2025 South Gordon Cooper Drive
Shawnee, OK 74801
405-275-4030 ext. 124
Tribal Leader: Scott Miller, Governor

2. Alabama-Coushatta Tribe of Texas
Mr. Bryant Celestine, Historical Preservation
571 State Park Road 56
Livingston, TX 77351
936-563-1181
Tribal Leader: Oscola Clayton Sylestine, Principal Chief

3. Alabama-Quassarte Tribal Town of the Creek Nation of Oklahoma
Ms. Rovena Yargee, Historical Officer
101 East Broadway
Wetumpka, OK 74883
405-452-3987
Tribal leader: Tarpie Yargee, Tribal Town Chief

4. Caddo Tribe of Oklahoma
Mr. Robert Cast, THPO
5 miles East Intersection 281 and 152
Binger, OK 73009
405-656-2901
Tribal Leader: LaRue Martin Parker, Chairperson

5. The Catawba Tribe of South Carolina
Dr. Wenonah Haire, CIN-THPO
1536 Tom Steven Road
Rock Hill, SC 29730
803-328-2427
Tribal Leader: Donald Rogers, Chief

6. The Cherokee Nation of Oklahoma
Dr. Richard Allen, Ed.D., THPO
22361 Bald Hill Road, 74464
Tahlequah, OK 74464
918-456-0671
Tribal Leader: Chadwick Smith, Principal Chief

7. The Chickasaw Nation
Ms. Virginia Nail, THPO
2020 East Arlington, Suite 4
Ada, OK 74820
580-436-2603
Tribal Leader: Bill Anoatubby, Governor

8. Chitimacha Tribe of Louisiana
Kimberly S. Walden, Cultural Director
3289 Chitimacha Trail
Charenton, LA 70523
337-923-4395
Tribal Leader: Lonnie Martin, Tribal Chairman

9. Choctaw Nation of Oklahoma
Mr. Terry D. Cole, Director Historic Preservation Dept
3010 Enterprise Boulevard
Durant, OK 74701
580-924-8280
Tribal leader: Gregory E. Pyle, Chief

10. Coushatta Tribe of Louisiana
Dr. Linda Langley, Section 106 Contact
1940 CC Bell Road
Elton, LA 70532
337-584-2261
Tribal Leader: Kevin Sickey, Tribal Chairman

11. Eastern Band of the Cherokee Nation
Russell Townsend, THPO
Tyler Howe, Section 106 Specialist
88 Council House Loop
Cherokee, NC 28719
828-497-2771
Tribal leader: Michell Hicks, Principal Chief

12. Eastern Shawnee Tribe of Oklahoma
Robin Dushane, Cultural Preservation Officer
127 West Oneida Street
Seneca, MO 64865
918-666-2435
Tribal leader: Glenna J. Wallace, Chief

13. Jena Band of Choctaw Indians
Christine Norris, Chief
1052 Chanaha Hina Street
Trout, LA 71371
318-992-2717
Tribal leader: Christine Norris, Chief

14. Kialegee Tribal Town of the Creek Nation of Oklahoma
Jennie Lillard, Town King/Mekko
627 East Highway 9
Wetumpka, OK 74883
405-452-3262
Tribal leader: Jennie Lillard, Town King/Mekko

15. Miccosukee Tribe of Indians of Florida
Mr. Steven Terry, Land Resources Manager
U.S. 41, Mile Marker 70
Tamiami Trail
Miami, FL 33144
305-223-8380
Tribal Leader: Billy Cypress, Chairman

16. Mississippi Band of Choctaw Indians
Mr. Kenneth H. Carleton, TPHO
101 Industrial Road
Choctaw, MS 39350
601-656-5251
Tribal leader: Beasley Denson, Chief

17. Muscogee (Creek) Nation of Oklahoma
Ms. Joyce Bear, THPO
Highway 75 and Loop 56
Okmulgee, OK 74447
918-732-7600
Tribal Leader: A.D. Ellis, Chief
Alfred Berryhill, 2nd Chief

18. Poarch Band of Creek Indians
Mr. Robert Thrower, THPO
5811 Jack Springs Road
Atmore, AL 36502-5025
251-368-9136
Tribal Leader: Buford Rolin, Chairman

19. Quapaw Tribe of Oklahoma
Carrie V. Wilson, THPO
5681 South 630 Road
Quapaw, OK 74363-0765
918-542-1853
Tribal Leader: John Berrey, Chairman

20. Shawnee Tribe
Ms. Kim Jumper, THPO
29 South Highway 69A
Miami, OK 74355
918-542-2441
Tribal Leader: Ron Sparkman, Chairman

21. Seminole Nation of Oklahoma
Ms. Jennifer Johnson, THPO
Junction 270 and 56 Highway
¼ Mile East on 270
Wewoka, OK 74884
405-257-7200
Tribal Leader: Enoch Kelly Haney, Principal Chief

22. Seminole Tribe of Florida
Mr. Willard Steele, THPO
6300 Stirling Road
Hollywood, FL 33024
954-966-6300
Tribal Leader: Mitchell Cypress, Acting Chairman/President

23. Thlopthlocco Tribal Town
Mr. Charles Coleman, Warrior, THPO
Exit 227, 7 miles east of Okemah on I-40
Okemah, OK 74859
918-560-6198
Tribal Leader: Vernon Yarholar, Mekko

24. Tunica-Biloxi Tribe of Louisiana
Earl J. Barbry, Jr., Director, THPO
151 Melacon Drive
Marksville, LA 71351
318-253-9767
Tribal Leader: Earl J. Barbry, Sr., Chairman

25. United Keetoowah Band of Cherokee Indians in Oklahoma
Lisa Stopp, CSI Office, THPO
18771 Wiskeetoowah Circle
Tahlequah, OK 74464
918-431-1818
Tribal leaders: George C. Wickliffe, Chief

26. Santee Sioux Tribe of the Santee Reservation Nebraska
Mr. Roger Trudell, Chairman
108 Spirit Lake Avenue West
Niobrara, NE 68760
402-857-2772
Tribal Leader: Roger Trudell, Chairman

U.S. Department of Energy

National Energy Technology Laboratory

September 24, 2008

Ms. Karen Kaniatobe
Director of the Cultural/Historical Preservation Department
Absentee-Shawnee Tribe of Oklahoma
2025 South Gordon Cooper Drive
Shawnee, OK 74801

Dear Ms. Kaniatobe:

The U. S. Department of Energy (DOE) is beginning the process of preparing an environmental impact statement (EIS) under the National Environmental Policy Act (NEPA) for DOE's involvement in the proposed Kemper County Integrated Gasification Combined Cycle (IGCC) Project under the Clean Coal Power Initiative (CCPI) Program. DOE published a Notice of Intent to prepare the EIS on September 22, 2008. The U.S. Army Corps of Engineers (Corps) will be a cooperating agency in the preparation of the EIS. DOE and the Corps are also required to comply with Section 106 of the National Historic Preservation Act (NHPA) for this undertaking as well as with NEPA. The Mobile District of the Corps would be managing the Corps participation in this process.

The proposed IGCC is an electrical generating facility. It would be constructed on an approximately 1,650-acre undeveloped site located in east-central Mississippi near the town of Liberty, in Kemper County. This site is approximately 20 miles north of the city of Meridian (see enclosed map). It is estimated the IGCC facility would occupy approximately 150 acres of the site. The balance would remain undeveloped, with the exception of new transmission lines, a natural gas supply pipeline, a carbon dioxide (CO_2) pipeline and site access and fuel handling infrastructure. While the proposed project would consist of the gasifiers to generate synthesis gas from lignite coal, cleanup systems, two combustion turbines and heat recovery steam generators, a steam turbine, and supporting facilities and infrastructure, the EIS will also address the proposed construction and operation of the neighboring surface lignite coal mine, associated transmission lines (and substations), CO_2 capture systems and CO_2 pipeline, and a natural gas pipeline, as connected actions.

The proposed mine would be operated by North American Coal Corporation and would provide the primary source of fuel for the project. The outer boundary of the mining area would encompass approximately 31,000 acres principally in Kemper County and partially in Lauderdale County. Within this area, a total of approximately 15,500 acres would be disturbed and reclaimed over the life of the mine. Mining would disturb uplands, wetlands and require stream diversions. The proposed mine would use draglines and a truck and shovel operation to remove the overburden, mine the lignite coal, and reclaim the site in accordance with an approved mine plan. The lignite coal would be transported by truck and /or overland conveyor. Following lignite removal, approximately 275 acres/year of mined land would be restored to approximate the pre-mine land contour and re-vegetated to a land use consistent with an approved mine reclamation plan.

The purpose of this letter is to notify your tribal government of this project and to request a response as to whether this proposed project may have any potential effects to any historic properties of traditional religious or cultural importance to your tribe. If you need any additional information to make this determination, please contact George Pukanic at 412-386-6085 or by email at pukanic@netl.doe.gov. If we do not receive a response from you by October 30, 2008, we will assume you have not identified any potential effects to such resources and that it is not necessary to involve you further in our NEPA and NHPA reviews.

Thank you for your assistance.

Sincerely,

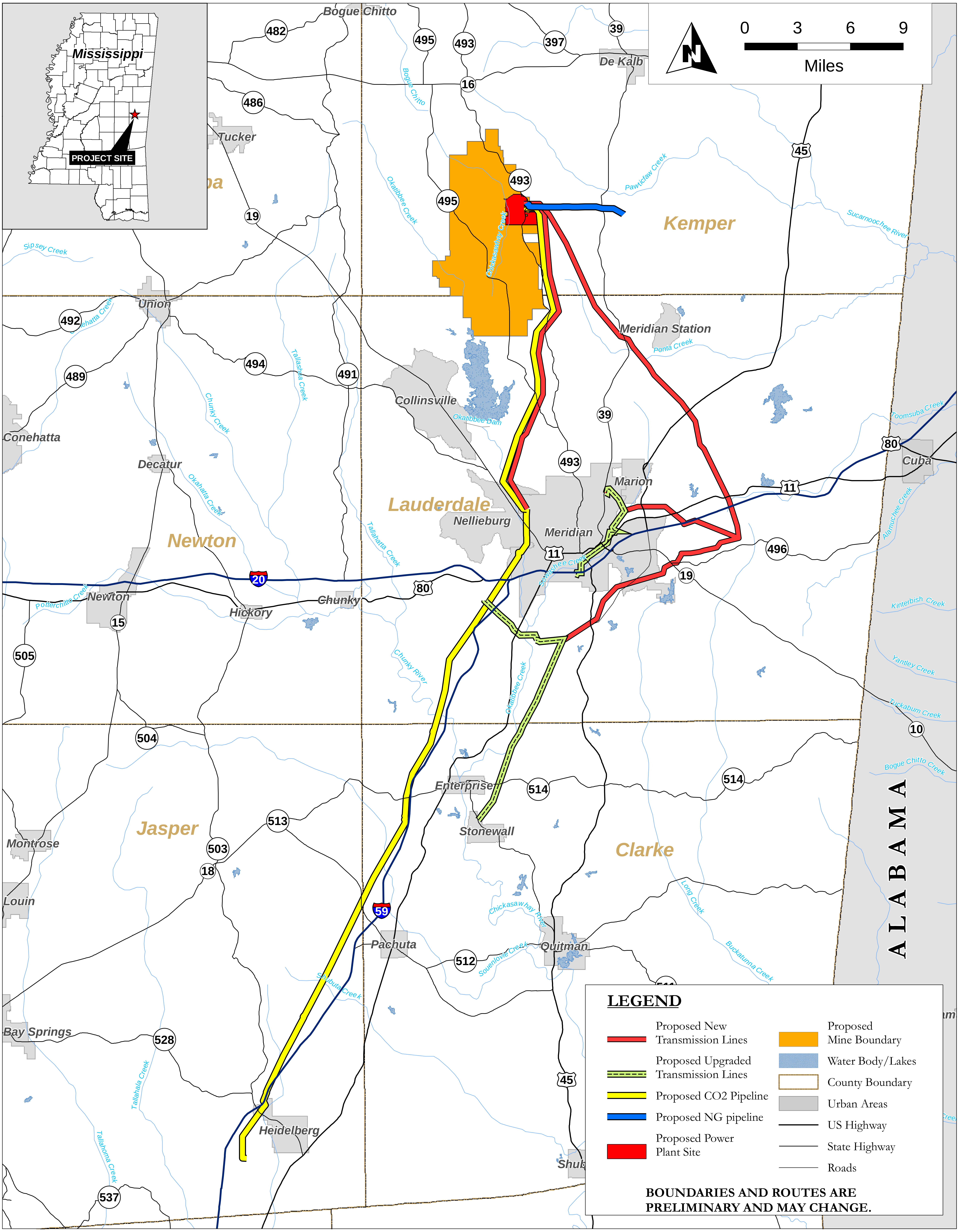
Richard A Hargis Jr

Richard A. Hargis, Jr.
National Environmental Policy Act (NEPA) Document Manager

Enclosure

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
hargis@netl.doe.gov@netl.doe.gov • Voice (412) 386-6065 • Fax (412) 386-4604 • www.netl.doe.gov

Preliminary Map for Proposed Kemper County IGCC Project



BOUNDARIES AND ROUTES ARE PRELIMINARY AND MAY CHANGE.

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Seminole Nation of Oklahoma

Historic Preservation Office

Mr. Richard A. Hargis, Jr.
NEPA Document Manager
U. S. Department of Energy
National Energy Technology Laboratory
P. O. Box 10940
Pittsburgh, PA 15236

October 08, 2008

Re: Proposed Kemper County IGCC Project

Dear Mr. Hargis, Jr.:

At this time, we have no interest in this site. However, we would like to reserve the right to participate in future consultation if discoveries are made or resources are impacted that are of significance to the Seminole Nation of Oklahoma.

If you have any further questions, please do not hesitate to contact my office.

Sincerely,

Jennifer Johnson, M.Ed

Tribal Historic Preservation Officer

ALABAMA-COUSHATTA TRIBE OF TEXAS
571 State Park Rd 56 • Livingston, Texas 77351 • (936) 563-1100

October 21, 2008

George Pukanic
U.S. Department of Energy
National Energy Technology Laboratory
P.O. Box 10940
Pittsburg, PA 15236

Dear Mr. DeMarcay,

On behalf of Chief Oscola Clayton Sylestine and the Alabama-Coushatta Tribe, our appreciation is expressed on your efforts to consult with us concerning the **proposed Kemper County Integrated Gasification Combined Cycle** in Kemper County.

Our Tribe maintains ancestral associations within the state of Mississippi despite the absence of written records to completely identify Tribal activities, villages, trails, or grave sites. However, our objective is to ensure any significances of Native American ancestry including the Alabama-Coushatta Tribe are administered with the utmost regard.

Upon review of the September 24, 2008 information summary submitted to our Tribe, impacts to religious, cultural, or historic assets of the Alabama-Coushatta Tribe of Texas could not be ascertained. In the event of inadvertent discovery of human remains and/or archaeological artifacts associated with this project, activity in proximity to the location must cease immediately and appropriate authorities, including this office, notified without delay.

Should you be in need of additional assistance, please do not hesitate to contact us.

Respectfully submitted,

Bryant J. Celestine
Historic Preservation Officer

Telephone: 936 – 563 – 1181 celestine.bryant@actribe.org Fax: 936 – 563 – 1183

Catawba Indian Nation
Tribal Historic Preservation Office
1536 Tom Steven Road
Rock Hill, South Carolina 29730
803-328-2427 Fax 803-328-5791

22 October 2008

Attention: Richard A. Hargis, Jr.
NEPA Document Manager
PO Box 10940
Pittsburgh, PA 15236

Re. THPO #	Project description, project location:
2008-29-25	US Dept Energy National Energy Tech. Lab. EIS for proposed Kemper County Integrated Gasification

Dear Mr. Hargis,

The Catawba Indian Nation THPO will defer comment on this proposed project to those federally recognized Indian Tribes whose cultural and geographic affiliation to this area are closer than our own. These sites are not within the geographic area that is reviewed by the Catawba Indian Nation THPO.

If you have questions please contact Beckee Garris 803-328-2427 x 232 or email beckeeg@ccppcrafts.com.

Sincerely,

Sandra Reinhardt for

Wenonah G. Haire
Tribal Historic Preservation Officer

Jeff Meling

From: Linda A Langley [llangley@mcneese.edu]
Sent: Wednesday, November 19, 2008 4:25 PM
To: Jeff Meling
Subject: Re: consult letter

Mr. Meling,
Thank you for taking the time to send me replacement copies. Because the proposed mining project has the potential to impact sites of historic and/or cultural significance to the Coushatta people, the Tribal Council has asked me to express their ongoing interest in the project. Please continue to keep me on the project mailing list so that I can give the Council regular updates on the progress of the project.
Thank you again,
Linda Langley, Ph.D.

----- Original Message -----
From: "Jeff Meling" <jmeling@ectinc.com>
To: llangley@mcneese.edu
Sent: Wednesday, November 19, 2008 2:52:28 PM GMT -06:00 US/Canada Central
Subject: consult letter

Dr. Langley,

Thanks for taking the time to speak with me. Here are the missing letters. I’d appreciate your email reply stating interest. Thanks again.

Jeffrey L. Meling, P.E.

Senior Vice President

Environmental Consulting & Technology, Inc.

3701 NW 98th Street

Gainesville , FL 32606

jmeling@ectinc.com

Off (352) 332-0444, ext 11352

From: Lillie McCormick [lstrangejbc@centurytel.net]
Sent: Monday, December 08, 2008 4:02 PM
To: George Pukanic
Subject: Re: Kemper County IGCC Power Plant Project

Mr. Pukanic

Thank you for informing the Jena Band of Choctaw Indians of this proposed project for the Kemper County IGCC power plant project and mine and supporting facilities.

At this time, the Jena Choctaw are only concerned with the areas of LaSalle, Grant, and Rapides Parishes in Louisiana. with that being said we will more than likely not participate in the tribal consultation.

if i can be of any further assistance please do not hesitate to call.

Lillie McCormick
Environmental Director
Jena Band of Choctaw Indians
Ph: 318-992-8258
Fax: 318-992-8244
lmccormickjbc@centurytel.net

Quoting George Pukanic :

> As per our telephone conversation, attached please find a project fact sheet and a map for the proposed Kemper County IGCC power plant project and mine and supporting facilities. After you have reviewed the information on the project, please let me know of your interest in participating in a tribal consultation meeting for the project. If you are interested, DOE’s environmental support contractor (Environmental Consulting and Technology, Inc.) will be contacting you concerning arrangements for a tribal consultation meeting. In any event, you will be included on the distribution list for the draft and final Environmental Impact Statements for the project.

--

Meeting Summary
Kemper County IGCC Project
Consultation with Tribal Representatives

February 5, 2009
Mississippi Department of Archives and History
Jackson, MS

A meeting was held in Jackson, MS, to discuss cultural resources matters associated with the proposed Kemper County IGCC Project and to consult with representatives of interested tribes. Two tribes sent representatives: Mississippi Band of Choctaw Indians and Choctaw Nation of Oklahoma. The agenda for the meeting was:

- Introductions.
- Project overviews and updates given by DOE, Mississippi Power and North American Coal.
- Preliminary reports on field surveys and findings.
- Review of draft Programmatic Agreement.
- Other matters of interest to participants.

The list of meeting attendees is attached. The U.S. Army Corps of Engineers was also invited but was unable to send a representative. Information handed out during the meeting is also attached (maps showing locations of cultural resources sites have been omitted from the attachments due to the sensitivity of the information).

The meeting began at approximately 9:30 a.m. with an invocation given by Olin Williams.

Following attendee introductions, John Templeton gave an overview of the project, then Joel Truart presented NAC's surface lignite mine plans. Truart stressed that all land potentially impacted by mining activities will be surveyed for cultural resources and that, given the long-term nature of surface mining, these surveys will be ongoing for decades.

Ken Carleton noted that the long-term nature of survey activities drives the need for a Programmatic Agreement, which should secure the consultation rights of interested tribes and be signed by all appropriate parties.

It was noted that DOE should involve the Advisory Council.

The discussion focused for some time on the particulars of a PA. It was noted that DOE's direct involvement with the project would end with the completion of the demonstration program (although with some uncertainty regarding the possible Loan Guarantee aspect).

Carleton agreed that an initial PA running through the end of the demonstration program was sensible, although he stressed that he would want the Corps and MDEQ as signatories from the start to provide continuity for the subsequent PAs not requiring DOE's involvement.

Janet Rafferty summarized the work done to-date to survey portions of the potential mine area. She stated the goal of completing field surveys for the entire mine area and completing assessments of eligibility by the end of 2009.

Hunter Johnson summarized the field work and results of the surveys of planned transmission line and NG pipeline corridors. He noted that 8 potentially eligible sites had been found.

Jeff Meling summarized the similar work completed by another contractor on the southern 40-mile stretch of planned CO_2 pipeline corridor.

Carleton expressed satisfaction with the amount of cultural resources survey information and the level of detail in the summary reports.

It was agreed that MDAH and the tribes would be sent the draft Phase 1 reports for their review and comment.

George Pukanic returned the discussion to the PA and provided an outline. It was generally agreed that the outline constituted a good start to DOE generating an initial draft.

The meeting adjourned at approximately 4:30 p.m.

Kemper County Tribal Consultation Meeting
Feb 5, 2009

Name	Affiliation	Phone #	Email
Jeff Meling	ECT, Inc.	(352) 332-0444	jmeling@ectinc.com
RICH HARGIS	U.S. DOE	412 386-6065	HARGIS@NETL.DOE.GOV
David Abbott	MDAH	601-576-6940	dabbott@mdah.state.ms.us
Kenneth H Carleton	MS Choctaw	601.650.7316	kcarleton@choctaw.org
Mark L. McKoy	U.S. DOE	304-285-4426	mmckay@netl.doe.gov.
Dan Warren	Southern Company	205 2576947	dhwarren@southernco.com
GRADY MOORE	Balch & Bingham	(205) 226-8718	gmoore@balch.com
Olin Williams	Choctaw Nation of Oklahoma	580-924 8280	olinwilliams@choctawnationofOKla
Hunter Johnson	TVAR	(256) 283-4819	hunter@tvaresearch.com
Rebecca Buell	RHM	662-387-5260	rebecca.buell@nacoal.com
Tres Tipton	RHM	662-387-5200	tres.tipton@nacoal.com
Joel Trouart	NACC	214.300.8210	jtrouart@nacoal.com
Janet Rafferty	MSU	662-325-7521	Rafferty@anthro.msstate.edu
John Templeton	MPC	228-897-4332	jdtemple@southernco.com
George Pukanic	DOE	412-386-6085	pukanic@netl.doe.gov
Pam Lieb	MDAH	601-576-6945	plieb@mdah.state.ms.us

KEMPER COUNTY INTEGRATED GASIFICATION COMBINED CYCLE PROJECT

> "It will be the cleanest, most efficient coal-based technology available."
> – Anthony Topazi
> President and CEO, Mississippi Power

Mississippi Power is revolutionizing the electric utility industry as we know it in Kemper County, Mississippi. Taking unprecedented steps towards the advancement of clean coal technology, Mississippi Power's state-of-the-art Kemper County IGCC Project is the first of its kind in the world to lead the way in providing affordable, reliable and yes, cleaner energy for Mississippi Power customers, Mississippians and Americans alike.

This literature will provide you with a comprehensive look at the Kemper County IGCC Project as well as explain what makes this advanced technology so extraordinary and how clean coal technology is possible.

The question is, are you ready to be a part of the future of generating electricity today?

We believe you are. And we believe Mississippi is the right state and Mississippi Power is the right company to show the world we can make coal, the country's most abundant fuel alternative, work for our environment and our customers' pocketbooks.

2/5/09

WHY KEMPER COUNTY?

Imagine electricity being supplied across the South with power generated in Mississippi, by Mississippians, with a resource from Mississippi. The unique geology of Kemper County makes this vision possible.

Kemper County possesses a generous supply of lignite coal, a lower-grade coal with very little market application except in a mine-mouth operation like that being considered. Lignite is one of many types of low rank coals that make up half the proven U.S. and worldwide coal reserves. Mississippi has a lion's share of that coal with an estimated 4 billion tons of lignite reserves. Mississippi Power wants to turn this otherwise underutilized resource into economic opportunity for citizens of Kemper County and Mississippi.

By combining Mississippi lignite and advanced technology, Mississippi and Mississippi Power can help lead the way in demonstrating that we can make coal, the country's most abundant fuel alternative, work for our environment, our state and our citizens.

The advanced coal gasification facility will draw interest from all over the world and ultimately bring a brighter future to Kemper County and the state of Mississippi.

CONTACT US

We encourage you to stay informed as the facility is being constructed and put into commercial service in 2013 by visiting our website at *www.mississippipower.com/kemper* and signing up for regular updates on this exciting project.

You can also email your questions to kemper@southernco.com or call Mississippi Power Corporate Communications at 1-800-532-1502 to speak with a company representative.

Dear Citizen:

We are proud to announce our proposal to build the most technologically advanced electric coal-based generating facility in Kemper County. We expect to achieve three very significant objectives.

First, at Mississippi Power we must plan for the future. This facility will allow Mississippi Power to meet the growing energy needs of our customers as well as be prepared for future energy load growth to successfully accommodate the steady stream of economic development happening in our state. Industry and development will not come without reliable power to light the way. Secondly, President Barack Obama has made clean energy a top national priority. His campaign platform was to "develop and deploy clean coal technology" and we believe we can play a role in that critically important goal by building one of the first, if not the first, full-scale clean coal technology generating facility in the nation. Lastly and perhaps arguably most important to our customers, the utilization of Mississippi lignite as our primary fuel source makes this project the most economical decision for our customers. It provides a fuel source independent from natural gas and coal, and will lessen the grip of volatile and unpredictable fuel markets on our state and our nation. The energy benefits of this project significantly outweigh the upfront capital investment.

After more than a decade of concentrated research and more than two years of due diligence and commitment from my company, Mississippi Power is ready to move forward. Clean coal technology using IGCC is a sound, contemporary solution that will help resolve the long-standing energy and environmental issues facing this country.

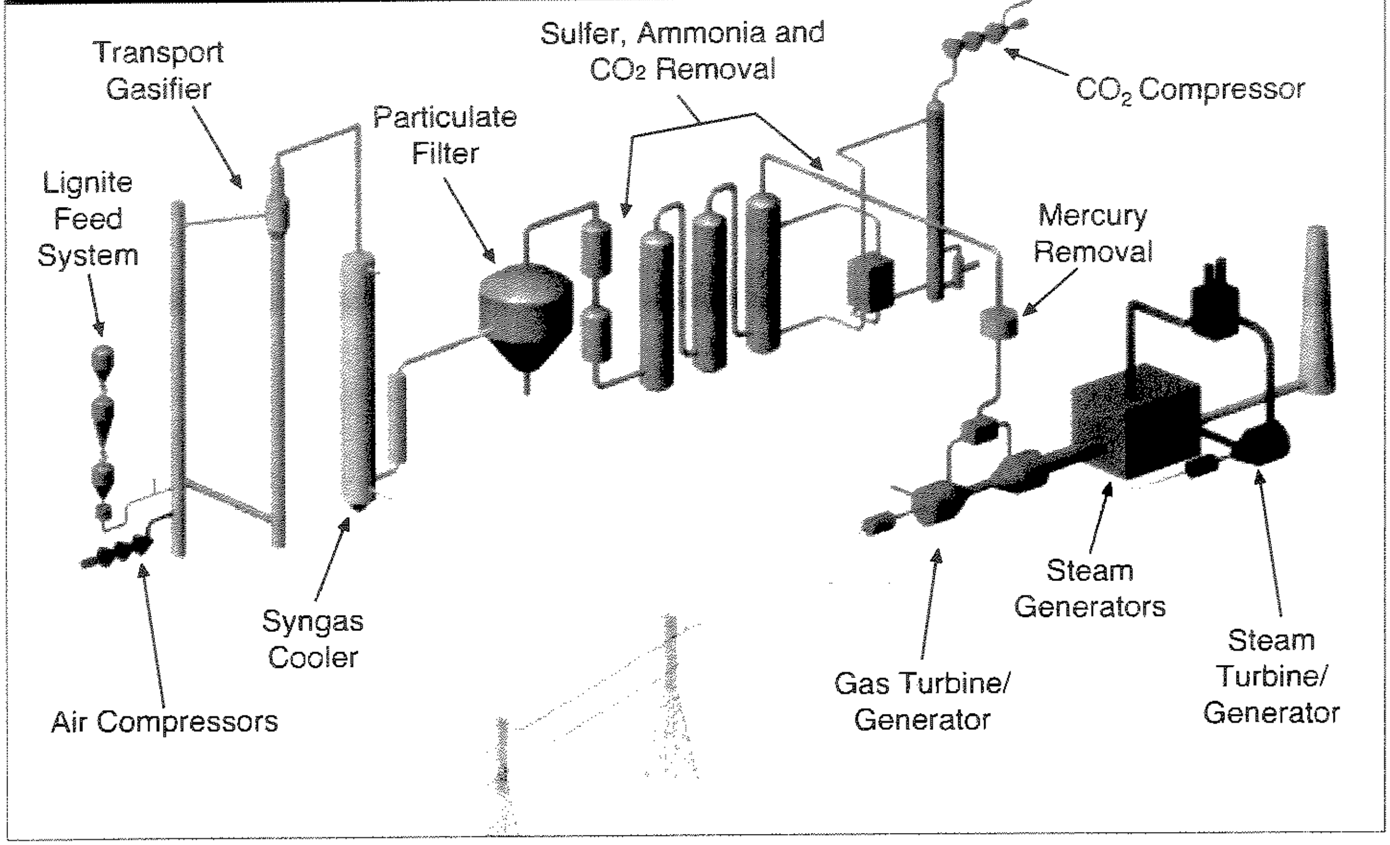
The proposed new facility would make a remarkable impact in this area and to the state as a whole. With this project, we can strengthen the Mississippi economy, reduce our national reliance on foreign fuels and protect the environment.

Thank you for your ongoing interest and support as Mississippi Power plans the next generation of coal plants and positions Mississippi as the model for making coal, our country's most abundant source of energy, work cleaner and smarter for our customers and our environment.

Sincerely,

Anthony Topazi, President and CEO
Mississippi Power

SIMPLIFIED DIAGRAM OF IGCC WITH CO_2 CAPTURE™



WHAT IS IGCC AND HOW DOES IT WORK?

The power generating plant proposed for Kemper County is an Integrated Gasification Combined Cycle (IGCC) design.

Unlike a conventional coal-fired power plant – which burns coal to produce heat that converts water into steam that drives a steam turbine-generator – an IGCC plant turns the coal into a synthesis gas called syngas that is used to fuel a combined cycle generating plant.

The figure above is a simplified depiction of the IGCC gasification technology design for the Kemper County IGCC Project.

The IGCC plant will be fueled with lignite which is surface mined at the mine site adjacent to the plant.

The lignite will be delivered to the plant over conveyors through crushers, into silos and then into driers where the lignite is dried to approximately one half of its original moisture content.

The lignite is then pulverized and fed into the gasifier. Inside the gasifier, a proven chemical process heats the lignite and extracts the syngas.

After the syngas is cooled, it goes through the processes necessary to remove the particulates, sulfur, nitrogen oxides (NO_x) and mercury contained in the syngas.

In the next stage, carbon dioxide (CO_2) is removed from the syngas stream. This CO_2 is then compressed and delivered for sequestration via an enhanced oil recovery process.

The cleaned syngas is then used to fuel a combined cycle generating plant similar to the natural gas-fired combined cycles at Mississippi Power's Plant Daniel.

This combined cycle configuration consists of two gas turbines with associated generators, two heat recovery steam generators and a single steam turbine with its generator.

The syngas powers the two gas turbines and the gas turbine exhaust provides heat to the HRSGs to produce steam which drives the steam turbine.

The combined output of the generators is delivered to the electric grid.

▪ ▪ ▪ ▪ FREQUENTLY ASKED QUESTIONS ▪ ▪ ▪ ▪ ▪

WHAT KIND OF POWER PLANT IS BEING PROPOSED BY MISSISSIPPI POWER?

The proposed electric power plant is a 582-megawatt integrated gasification combined cycle (IGCC). IGCC is an advanced gasification plant and a combined cycle plant designed specifically to work together. The clean coal facility will be located in Kemper County, Mississippi, approximately, 30 miles north of Meridian. It will be owned and operated by Mississippi Power.

WHY DOES MISSISSIPPI POWER NEED TO BUILD A POWER PLANT?

The state of Mississippi is growing, and Mississippi Power must plan for the future needs of its customers. After considering fuel and generation diversity, risk of environmental regulation, customer load growth and the available capacity options, Mississippi Power's planning process indicates a need for additional electricity by the summer peak season of 2014.

WHY DID MISSISSIPPI POWER CHOOSE KEMPER COUNTY FOR A POWER PLANT?

Mississippi Power assessed numerous sites in the state to build a potential IGCC power plant to serve customers. The best site turned out to be outside Mississippi Power's service territory in Kemper County, because it takes advantage of an untapped, natural resource – Mississippi lignite; is close to lignite and natural gas; and provides geographic diversity to help balance the electric demand and strengthens electric reliability in Mississippi.

WHAT IS THE ECONOMIC IMPACT ON THE REGION? (JOBS, TAX REVENUE, ETC.)

Mississippi Power's capital investment will be approximately $2.2 billion, which will greatly expand the local tax revenue. About 260 permanent jobs, plus 1,000 jobs during peak construction, will be created. Revenue from the project will enhance local schools, lower property taxes, and will help first responders.

WHAT ENVIRONMENTAL IMPACT WILL THIS PLANT HAVE ON THE REGION AND THE STATE?

The Kemper County IGCC plans to capture and sequester 50 percent of the plant's CO_2 emissions. In addition, the plant has fewer nitrous oxide, sulfur dioxide and mercury emissions than traditional pulverized coal plants.

WHAT IS "CLEAN COAL TECHNOLOGY"?

The IGCC process sends coal through a device called a gasifier. By being subjected to high temperatures and high pressure in the gasifier, the coal undergoes a chemical reaction that creates a synthesis gas. The cleaner "syngas" is then used in a gas turbine to generate power with fewer emissions than traditional coal plants.

HOW IS CO_2 USED IN ENHANCED OIL RECOVERY (EOR)?

Much of the facility's CO_2 byproduct will be sold for EOR. CO_2 injection is a common method of EOR, in which the CO_2 is injected into abandoned oil wells to force oil out of the ground.

WHAT WILL THE PLANT LOOK LIKE?

In appearance, this plant will not be unlike other types of generating plants. Mississippi Power takes great pride in being a partner in the communities in which we live and work, and will ensure the plant's appearance and integration into the Kemper County community are in keeping with all community standards and regulations.

WHAT IS THE NOISE LEVEL LIKE?

Neighbors can expect a quiet operation from the project proposed in Kemper County, with noise levels at the site boundary being lower than those of a normal conversation.

HOW WILL THE FUEL BE BROUGHT INTO THE PLANT?

All lignite will be transported internally on the mine and plant site by trucks and conveyors that will not cross public roads. Natural gas will be routed to the site from the Tennessee Gas pipeline, which already exists near the property boundary.

WILL THERE BE MORE TRAFFIC ON KEMPER COUNTY ROADS?

Yes. During construction, crews will use an access road just south of Hwy. 493 to enter the plant site. Once operational, the facility will sell byproducts from plant operations which will be transported in approximately 12-15 truckloads per day.

DOES KEMPER COUNTY HAVE TO PAY FOR NEW OR IMPROVED ROADS NECESSARY FOR THE POWER PLANT?

The county will improve roads and bridges with tax revenue and other sources derived from the project.

WHAT HAPPENS TO THE POWER PLANT AFTER THE LIGNITE SUPPLY IS EXHAUSTED? HOW MANY YEARS WILL THE WHOLE OPERATION LAST?

Over the life of the plant, only a small fraction of proven lignite reserves in Mississippi will be utilized. Typically, the life expectancy of power plants is 30-40 years, but Mississippi Power plants boast a successful history of being well-maintained and stay in operation longer than the industry standard.

WHAT WILL THIS DO TO KEMPER COUNTY HUNTING AND FISHING?

In a similar arrangement with a generating plant and an adjacent mining site in Choctaw County, deer, birds and other wildlife coexist with the project. We expect the same peaceful habitat at the Kemper County IGCC facility.

WHEN DO YOU ANTICIPATE CONSTRUCTION OF THE PLANT?

Construction of the plant is subject to Mississippi Public Service Commission approval. We expect to begin construction in 2010.

DOES MISSISSIPPI POWER HIRE LOCALLY OR USE ITS OWN CREWS?

Plant operating staff can be hired locally or from within the company, depending upon qualifications. Mississippi Power continually seeks qualified employees. Go to Careers at *www.mississippipower.com* to submit a resume and/or apply for current job openings..

MISSISSIPPI POWER
A SOUTHERN COMPANY

PROJECT HIGHLIGHTS

DEMAND

- Mississippi Power has a need for a new base load generation resource by 2014.
- Mississippi Power has completed financial, technology, environmental and fuel assessments and determined the Kemper County Integrated Gasification Combined Cycle Project provides the lowest cost and is the best alternative of new generation for our customers.

FEDERAL FUNDING

- To offset the costs to construct the facility, Mississippi Power has received a $270 million grant from the Department of Energy for the project and $133 million in investment tax credits approved by the Internal Revenue Service and provided for under the National Energy Policy Act of 2005.

LOCAL IMPACT

- The Kemper IGCC plant, a 582-megawatt lignite-fueled generating facility is a $2.2 billion dollar total investment. Tax revenues from the project will enhance local schools, provide for lower property taxes and help equip first responders.
- The plant and adjacent lignite mine will be situated on approximately 1,650 acre site, located in southwest Kemper County between Hwy. 493 and Hwy. 495, south of Hwy. 16.
- The total acreage expected to be mined over the 40-year life of the project is 10,000 acres. Roughly 899 acres will be in active mining use at any given time.
- This facility would create approximately 500 new construction jobs (1,000 at the peak of construction), for approximately three years. Once put into operation, the facility, owned and operated by Mississippi Power, will require 80-100 permanent jobs while the lignite mining operation will require an additional 180 permanent jobs.

LIGNITE

- The facility will utilize approximately 300,000 tons of locally mined lignite per month or almost 140 million tons over its expected 40-year life.
- Lignite, an abundant local resource, is an affordable fuel alternative and not subject to the highly volatile pricing swings experienced with natural gas and transported coal.

RESEARCH AND TECHNOLOGY

- The U.S. Department of Energy (DOE), Mississippi Power's parent company, Southern Company of Atlanta, Georgia, and KBR have conducted partnership research on advanced coal technologies at the Power Systems Development Facility (PSDF) outside Birmingham, Alabama, for more than a decade readying the innovative technology for commercial application.
- IGCC is a coal gasification plant and a combined-cycle plant designed specifically to work with each other.
- The facility will use advanced coal gasification technology called TRIG™ (TRansport Integrated Gasification), developed at Southern Company's PSDF in Wilsonville, Alabama.
- The advancement of clean coal technologies is critical to our nation's energy future. TRIG™ technology will show the world we can make coal, the country's most abundant fuel alternative, work for our environment.
- The TRIG™ technology being utilized for the Kemper County IGCC Project will capture and sequester 50 percent of the plant's CO_2 emissions. With 50 percent CO_2 capture, the plant's emissions would be comparable to natural gas-powered generation.
- The CO_2 captured for the plant will be sequestered via Enhanced Oil Recovery (EOR). EOR is a process where CO_2 can be injected into depleted oil fields, generating more domestic oil production and sequestering CO_2.

KEMPER COUNTY IGCC PROJECT
FACT SHEET

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MISSISSIPPI POWER
A SOUTHERN COMPANY

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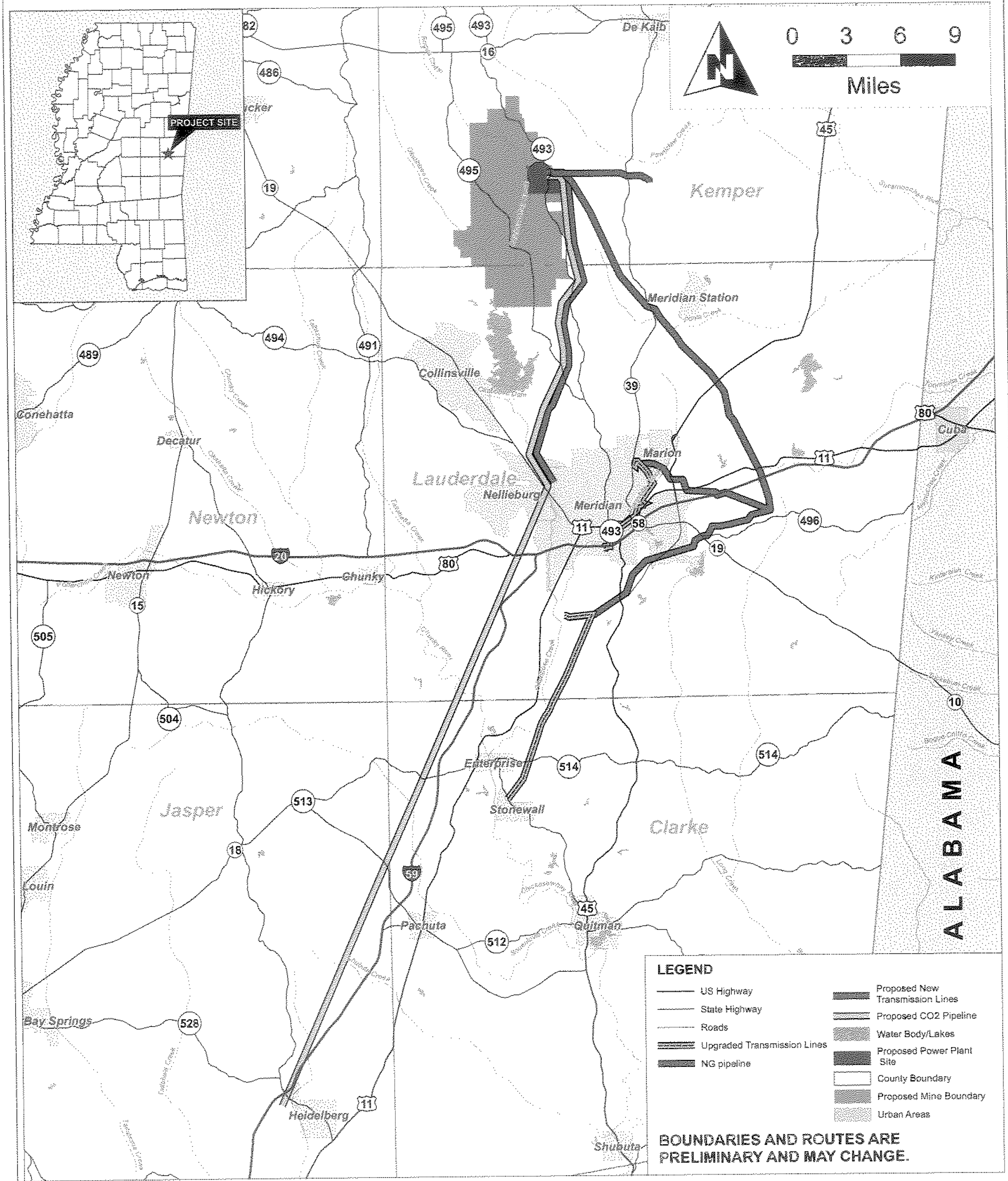


PRELIMINARY LOCATION MAP FOR PROPOSED MINE AND PROPOSED KEMPER COUNTY IGCC PROJECT AND SUPPORTING FACILITIES

Sources: US CENSUS, 2000; MARIS, 2008; ECT, 2008.

ECT

Environmental Consulting & Technology, Inc.

Cultural Resources Meeting – Kemper County ICGG/Mine Project

Jackson, MS

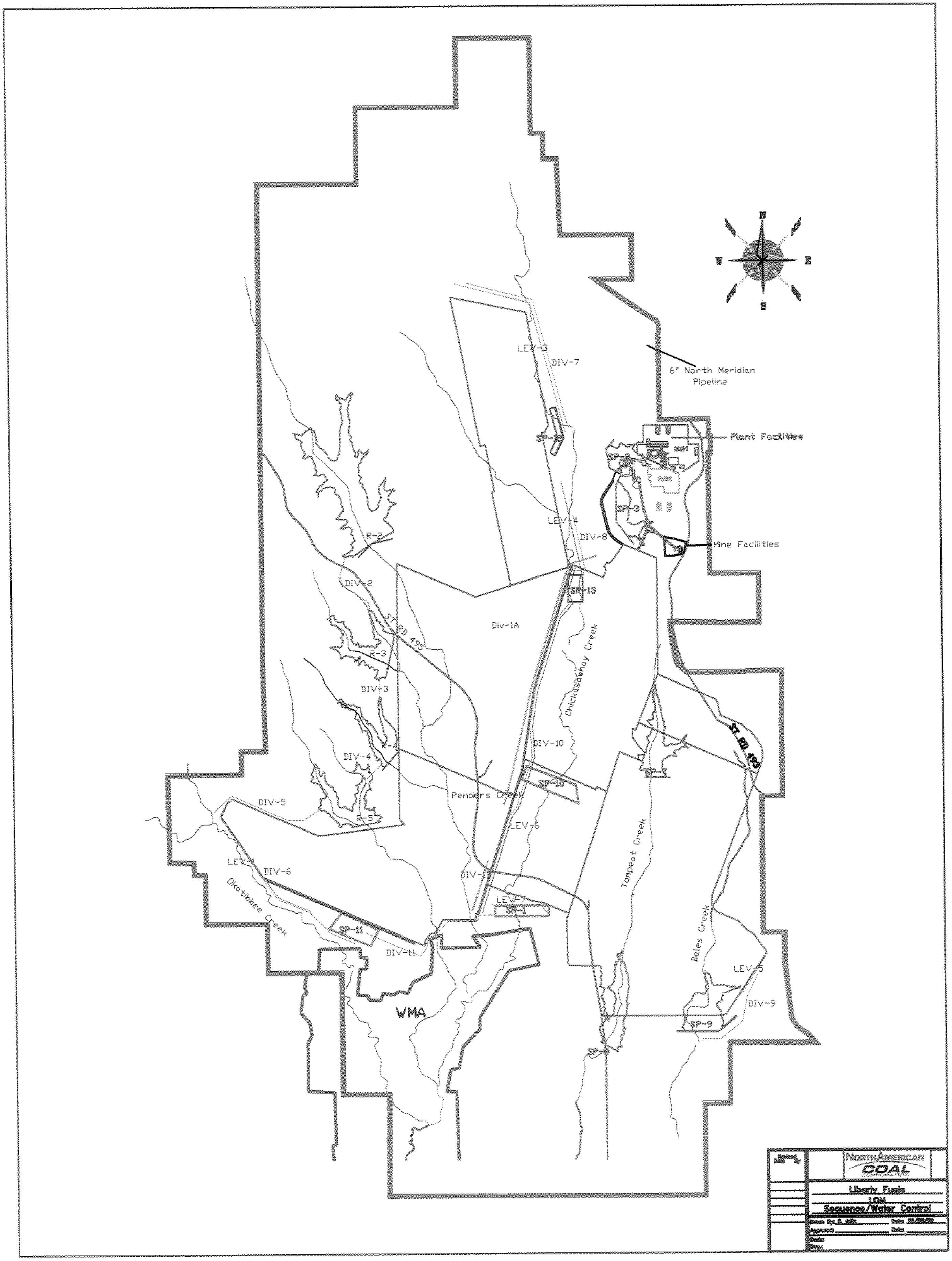
February 5, 2009

NACC Overview and Update:

1. Timeline with detail:
    a. Initial cultural resources report for the EIS: January 2009
    b. Ongoing cultural resources field work for the MDEQ permit: to be finished June 2009
    c. MDEQ permit preparation starts in February 2009 with a submittal of February 2010
    d. MDEQ review starts February 2010 and it is anticipated to be complete February 2011
    e. Anticipated MDEQ permit approval: February 2011
    f. Dragline shipped to Kemper County by August 2009 (Page 757)
    g. Dragline construction starts December 2009 and should be completed by June 2011.

2. Permitting process with regard to cultural resources:
    a. The work for the EIS provides a representation of the density and types of cultural resources to be expected on the mine site. As Janet will address, there were 170 sites in 21% of the mine project area. (I don't think a direct correlation to 100% of the project is appropriate at this juncture.)
    b. Ongoing cultural resource field work is occurring for the state mine permit. This work will cover the majority of the remaining mine project acres with special emphasis on the first five years of mining and mine related disturbance.
    c. The ultimate goal is to have 100% Phase I cultural resources survey on the Life of Mine disturbance site by mid-year 2009 and, once approved, to initiate the Phase II assessment on the first five year blocks in subsequent years.
    d. Even as each mine block is cleared through the Phase I, II, and III process, as mining and soil disturbance occurs these areas are visually monitored for evidence of additional cultural resources.

3. The mine plan for Kemper County:
    a. Map and chronology – permitting process in five year blocks.

N
W
E
S
6" North Meridian Pipeline
Plant Facilities
Mine Facilities
LEV-3
DIV-7
SP-12
SP-2
SP-3
LEV-4
DIV-8
SP-13
R-2
DIV-2
ST. RD 495
Div-1A
Chickasawhay Creek
R-3
DIV-3
R-4
DIV-4
DIV-10
ST. RD 493
SP-4
SP-10
Penders Creek
DIV-5
R-5
LEV-6
Tompeat Creek
LEV-1
DIV-6
Okatibbee Creek
DIV-1
LEV-7
SP-1
SP-11
DIV-11
Bales Creek
WMA
LEV-5
DIV-9
SP-9
SP-8
Revised Date By
NORTH AMERICAN COAL
Liberty Fuels
LOM
Sequence/Water Control
Drawn By:
Date:
Approved:
Date:
Scale:
Dwg:

2/5/09

Systematic Archaeological Survey of a Mine Area in Kemper and Lauderdale Counties, Mississippi

Janet Rafferty
Jeffrey Alvey
Keith A. Baca

Cobb Institute of Archaeology
Mississippi State University
P.O. Box AR
Mississippi State, MS 39762

Submitted to North American Coal Corporation by Cobb Institute of Archaeology, Mississippi State University

January 2, 2009

2/5/09

Management Summary

This report presents the results of systematic, intensive archaeological survey of 21% (6,461 acres) of the 30,420 acre lignite mine area proposed by North American Coal Corporation and to be located in Kemper and Lauderdale counties, Mississippi. The report's focus is on the data, including location, site description, artifact analysis, and chronological and use information, that has been recorded for 170 archaeological sites that were found in the 21% survey. The report is planned to be used in support of the Environmental Impact Statement for the project to be prepared by the Department of Energy. In order to obtain information on the diversity of site locations in the area, the survey was stratified by soil slope categories. The amount surveyed in each of the four strata reached the 19-22% level, so it is believed that the archaeological sites found include most of the kinds of sites that will be found in the ongoing 100% survey of the proposed mine area. Efforts to complete the full survey continue, with that anticipated to occur by the end of May, 2009. The final report on all of the Phase I work, covering 100% of the proposed mine area, will be submitted to North American Coal Corporation by December 31, 2009. Included in that report will be National Register significance assessments for archaeological sites, cultural landscapes, and standing structures in the mine area. These latter include houses, stores, and bridges, the recording and assessment of which will be done by an architectural historian.

The fieldwork methods used in the 21% archaeological survey followed the plan proposed to North American Coal, with shovel testing at 30 meter intervals in all areas covered with forest, pasture, or other vegetation and that had slopes between 2 and 8%. Floodplain areas were tested using a tractor-mounted auger, with holes being placed at 500 meter intervals. No evidence of buried soil horizons or artifacts was found in the augering program. Land with a greater than 8% slope was not shovel tested, but was walked over in order to identify any areas of lesser slope, which were tested.

Artifact analyses were done to extract chronological, use, and technological data for each assemblage. Detailed analysis of aboriginal and historic period pottery, glass, projectile points, and lithic debitage was included. The 170 sites found in the 21% sample included 44 dating to the prehistoric/Protohistoric/Historic Indian periods, 91 that contained historic components only, and 35 that produced evidence of both aboriginal and historic period artifacts.

This survey represents part of a Phase I effort, the goal of which is to find, record, and assess the significance of as many archaeological sites and standing structures as possible within the project area. Significance will be linked to National Register of Historic Places eligibility statements, as required under Section 106 of the National Historic Preservation Act. A plan for significance assessment of archaeological sites is included in the report, but such assessments cannot be made until the completion of the 100% survey. Significance will be assessed by using information on occupational duration and intensity, combined with measures of the richness and evenness of artifact classes in each assemblage.

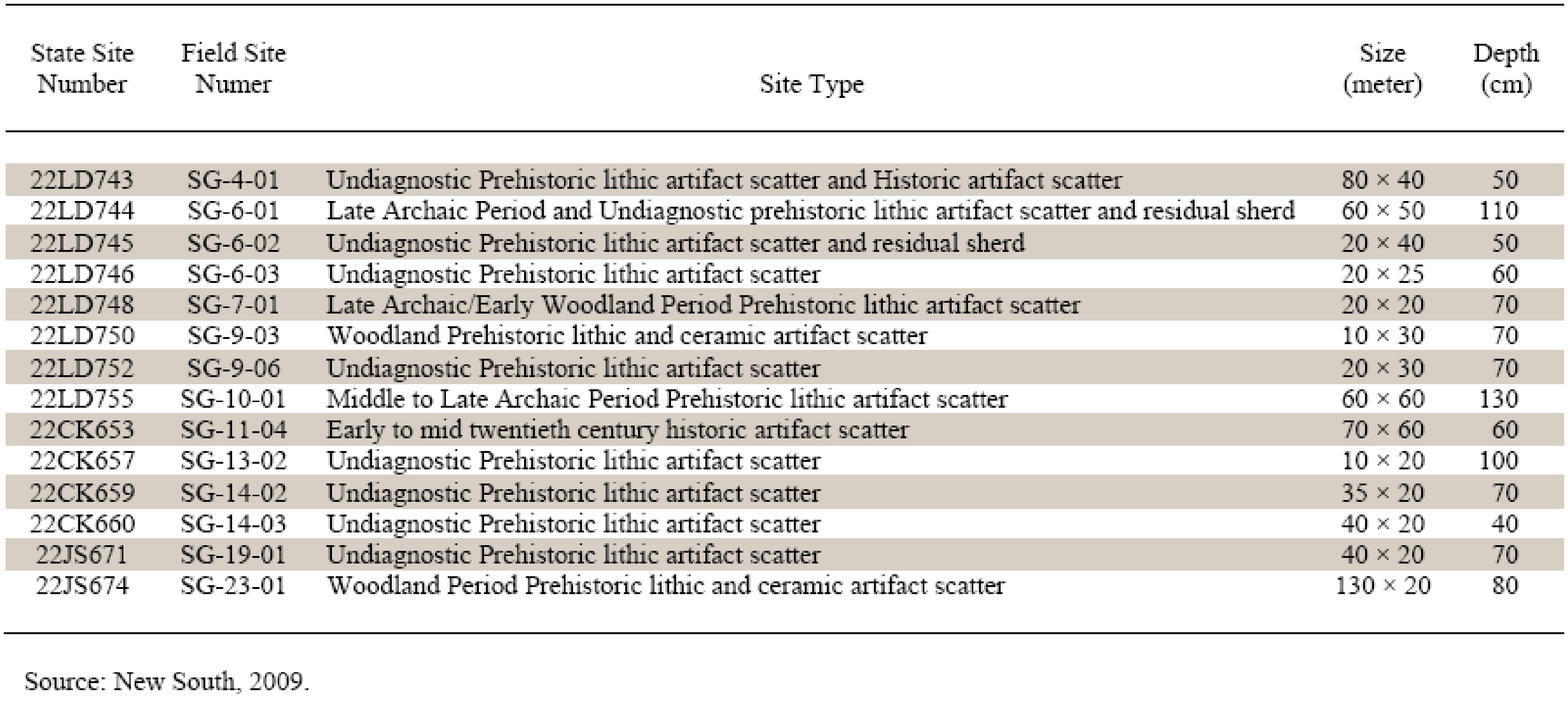
Project impact assessment will be an important step before Phase II and Phase III archaeological work can be planned. Impacts to archaeological sites come primarily from ground-disturbing activities, including mining, road construction, utility line placement, and other related work. Impacts to standing structures additionally may include viewshed alterations and activities that affect the integrity of the structure's setting. Such impacts cannot be assessed until the mine plan has been completed by North American Coal Corporation. Once this has been done, it will be possible to identify which archaeological sites, cultural landscapes, and structures, among those that have been found to be potentially eligible for the National Register, will be impacted and the kinds of impacts that are likely. Potentially eligible sites that will be adversely impacted will then require Phase II work to decide whether they are eligible or ineligible for the Register. In cases where sites are determined eligible in the Phase II work, Phase III archaeological work will be necessary. Included within Phase II and Phase III work will be plans to investigate all Protohistoric/Historic Choctaw sites, as these are of special concern to the Mississippi Band of Choctaw Indians because they may contain burials. Impacts on eligible cultural landscapes and standing structures can be mitigated through recording them, as well as through use of buffer zones, viewshed protection, and other changes to project plans, if necessary.

Kemper County IGCC Project
Phase I Cultural Resources Surveys

Southern 40 miles of CO_2 pipeline corridor surveyed by New South Associates, Inc. New South found:

- 33 archaeological sites and 20 isolated finds.
- 1 archaeological site recommended as eligible for NRHP listing.
- 13 sites recommended as potentially eligible for listing.

Archaeological Sites Identified by New South as Eligible or Potentially Eligible for NRHP Listing



State Site Number	Field Site Numer	Site Type	Size (meter)	Depth (cm)
22LD743	SG-4-01	Undiagnostic Prehistoric lithic artifact scatter and Historic artifact scatter	80 × 40	50
22LD744	SG-6-01	Late Archaic Period and Undiagnostic prehistoric lithic artifact scatter and residual sherd	60 × 50	110
22LD745	SG-6-02	Undiagnostic Prehistoric lithic artifact scatter and residual sherd	20 × 40	50
22LD746	SG-6-03	Undiagnostic Prehistoric lithic artifact scatter	20 × 25	60
22LD748	SG-7-01	Late Archaic/Early Woodland Period Prehistoric lithic artifact scatter	20 × 20	70
22LD750	SG-9-03	Woodland Prehistoric lithic and ceramic artifact scatter	10 × 30	70
22LD752	SG-9-06	Undiagnostic Prehistoric lithic artifact scatter	20 × 30	70
22LD755	SG-10-01	Middle to Late Archaic Period Prehistoric lithic artifact scatter	60 × 60	130
22CK653	SG-11-04	Early to mid twentieth century historic artifact scatter	70 × 60	60
22CK657	SG-13-02	Undiagnostic Prehistoric lithic artifact scatter	10 × 20	100
22CK659	SG-14-02	Undiagnostic Prehistoric lithic artifact scatter	35 × 20	70
22CK660	SG-14-03	Undiagnostic Prehistoric lithic artifact scatter	40 × 20	40
22JS671	SG-19-01	Undiagnostic Prehistoric lithic artifact scatter	40 × 20	70
22JS674	SG-23-01	Woodland Period Prehistoric lithic and ceramic artifact scatter	130 × 20	80

Source: New South, 2009.

Additional Information on Eligible and Potentially Eligible Sites

Archaeological Site **22LD755** is a mid- to late Archaic site that was recommended as *eligible* for NRHP. The site's dimensions were found to be 60 meters north-south by at least 60 meters east-west within the corridor. The site appeared to continue outside the corridor to the east and west. This site exhibited evidence that recent looting had occurred. There was a cut into the bank of the Chunky River that extended approximately 20 meters onto the landform exposing soils and lithic artifacts. Shovel size and shaped holes were present in and along the cut bank and lithic artifacts were observed in small piles near these areas. A total of15 shovel tests were placed at the site, and 12 contained artifacts. A surface inspection and collection was made in the exposed areas. No diagnostic artifacts were observed on the surface. It was suspected that the looters collected any diagnostic projectile points/knifes and, therefore, none were recovered during the current survey. A total of 401 lithic artifacts were recovered from the surface and from shovel tests excavated; artifacts were recovered between0 to 130 centimeters below surface (cmbs). A proximal and medial portion of a projectile point/knife was recovered but could not be clearly identified by type; it is believed to date to the mid- or late Archaic periods.

Sites recommended as *potentially eligible* for the NRHP include 22CK653, 22CK657, 22CK659, 22CK660, 22JS671, 22JS674, 22LD743, 22LD744, 22LD745, 22LD746, 22LD748, 22LD750, and 22LD752.

Site **22CK653** is an early to mid-20th century historic artifact scatter likely associated with a farmstead. A total of 82 artifacts were recovered from shovel tests, and most were identified as kitchen remains including glass and ceramics. Eleven architectural artifacts were recovered including five brick fragments, five nail fragments, and one piece of flat glass, indicating the likelihood that a house or other building once stood here. Fragments of a tobacco tin were also recovered. A possible subsurface feature was encountered in one shovel test. At approximately 60 cmbs, burned clay and a dense charcoal lens were encountered. The function of the feature was unclear. A large circular depression approximately 2 by 2 meters in size was observed between three trees. The nature of the depression was unclear, and no artifacts were found in association with the feature. It is possible that the depression is a well.

Site **22CK657** is an undiagnostic prehistoric lithic scatter. It probably continues west outside of corridor. Due to the size and slope of the landform, only one additional shovel test was excavated east of the initial positive test. Both shovel tests contained a total of 26 pieces of lithic debitage. Artifact density from the initial positive shovel test was moderately high and appeared to yield artifacts from two separate levels or cultural strata (0 to 30and 30 to 100 cmbs).

Site **22CK659** is a prehistoric lithic artifact scatter. A total of 85 artifacts were recovered from the shovel tests, including 61 Tallahatta Quartzite lithic artifacts, 20 unmodified sandstone fragments, and four pieces of hardened clay or daub.

Site **22CK660** is a prehistoric lithic artifact scatter, possibly extending outside the corridor to the west. A total of 12 lithic artifacts were recovered, including six shatter fragments, two flake fragments, one interior flake, one primary flake, one biface thinning flake, and one core. Site 22CK660 is separated from 22CK659 by what appears to be a breach in the landform. It is possible that the two sites are related or were once the same site.

Site **22JS671** is an undiagnostic prehistoric lithic scatter. It is possible that the site continues to the west, outside the corridor. A total of eight lithic artifacts were recovered, including one chert uniface fragment and three chert shatter fragments.

Site **22JS674** is a Woodland period lithic and ceramic scatter. The site continues west outside the corridor. A total of 30 prehistoric artifacts were recovered including two sand tempered sherds and three residual sherds. The ceramic artifacts recovered were collected from between 10 and 30 cmbs, while lithics appeared to be present between 60 and 70 cmbs.

Site **22LD743** was found to consist of an undiagnostic prehistoric lithic and ceramic scatter. The site was believed to continue outside of the project area to the west. A total of 42 prehistoric artifacts were recovered, including38 lithic artifacts, two prehistoric ceramics, and two red ochre fragments. Of the lithic artifacts recovered, two projectile point/knife fragments were recovered. Unfortunately, they were unidentifiable as to type.

Site **38LD744** is a late Archaic lithic artifact scatter and residual sherd. The site appears to extend outside the corridor to the west. A total of 224 lithic artifacts were recovered. All of the lithic material was identified as Tallahatta Quartzite, with the exception of one chert biface fragment. One projectile point/knife, a late Archaic stemmed point, was recovered. One residual sherd and one fragment of fossilized animal bone were also recovered.

Site **38LD745** is an undiagnostic prehistoric lithic scatter and residual sherd. The site is essentially surrounded by wetlands. A total of 62 pieces of prehistoric lithic debitage were recovered, as well as one residual sherd.

Site **22LD746** is an undiagnostic prehistoric lithic scatter. Eighty-eight lithic artifacts were recovered including one core and a Stage 2 biface.

Site **38LD748** is a late Archaic/early Woodland period lithic scatter. A total of five lithic artifacts were recovered including a complete projectile point/knife to a depth of 70 cmbs. The point resembled late Archaic/early Woodland styles with a triangular blade and long rounded contracting stem. The stem was longer than the blade, and it was found likely that the blade was modified from its original length to the current form.

Site **22LD750** is a Woodland lithic and ceramic scatter. A total of 24 lithic artifacts were recovered as well as one decorated sand tempered sherd of an undetermined type.

Site **22LD752** is an undiagnostic lithic scatter. A total of 24 lithic artifacts were recovered including 10 interior flakes, seven flake fragments, four biface thinning flakes, and three shatter fragments down to 70 cmbs.

Draft
Outline

Elements for Consideration in Programmatic Agreement For the Kemper County IGCC Project

Tribal Consultation Meeting
February 5, 2009

WHEREAS CLAUSES

I. PURPOSE OF THE PROJECT AND NEED FOR A PROGRAMMATIC AGREEMENT

II. ROLES OF SIGNATORIES

III, STATUTORY BASIS

STIPULATIONS

I. COMPONENTS OF THE UNDERTAKING

This section would describe the components of the project to be covered by this Programmatic Agreement:

A. IGCC Power Plant
B. Lignite Mine
C. Transmission Lines
D. Pipeline Corridors
E. Substation Modifications
F. New Access Roads
G. Staging/Laydown Areas
H. Borrow Areas
I. Other Areas

II. AREAS OF POTENTIAL EFFECTS (APEs)

This section would describe the area of potential effect for the components listed in (I) above, as well as the process to be followed for amendments to APEs.

III. STANDARDS

This section would describe the professional qualifications required of persons involved in the identification, treatment, etc, of cultural resources, as well as documentation and curation standards.

IV. IDENTIFICATION

This section would describe the steps involved in the identification of cultural resources.

A. Records, Literature and Site File Check:

B. Phase I Surveys

C. Phase II Surveys

D. Confidentiality:

V. DETERMINATIONS OF ELIGIBILITY

This section describes the process by which a determination of eligibility to the National Register is made, including the roles of the signatories in making this determination.

VI. DETERMINATIONS OF EFFECT

This section will describe the procedure for the responsible Federal agency to follow in making an effect determination.

VII. HISTORIC PROPERTIES TREATMENT PLAN

This section will describe the procedure to follow in developing a treatment plan, including avoidance and mitigation.

VIII. REVIEW, COMMENT, AND CONSULTATION

This section will describe the procedure for the responsible Federal agency to follow in distributing and finalizing reports and plans, as well as the responsibilities of signatories in reviewing the reports and plans.

IX. DISCOVERIES AND UNANTICIPATED EFFECTS

This section will describe the implementation of a plan for discovery of cultural resources.

X. DISCOVERY OF HUMAN REMAINS OR CULTURAL ITEMS

This section will describe the procedure to follow in the event that human remains or cultural items are discovered during inventory, testing, mitigation or any construction-related activities.

XI. UNDERTAKING MODIFICATIONS

This section describes the procedure for modifying the treatment plan (VII above).

XII. INITIATION OF CONSTRUCTION ACTIVITIES

This section describes conditions under which construction activities can be initiated.

XIII. AMENDMENTS TO AGREEMENT

This section describes the process to follow in amending the agreement.

XIV. DISPUTE RESOLUTION

This section describes the procedure for dispute resolution (36 CFR 800.13).

XV. REVIEW OF PUBLIC OBJECTIONS

XVI. REQUIREMENTS OF STATE AGENCY PARTICIPATION

XVII. TERMINATION

XVIII. DURATION OF THIS AGREEMENT

XIX. FUNDING

SIGNATORIES

APPENDICES/ATTACHMENTS

Choctaw Nation of Oklahoma

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

Gregory E. Pyle
Chief

Gary Batton
Assistant Chief

June 23, 2009

John Templeton
Mississippi Power
PO Box 4079
Gulfport, Mississippi 39502-4079

Dear John Templeton:

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

Project Description: Cultural Resource Survey of a 40-mile Pipeline

Comments: Please keep the Choctaw Nation of Oklahoma Tribal Historic Preservation office apprised of what is close to potentially register-eligible sites. Please contact our office @ 1-800-522-6170 ext. 2137 with any questions.

Sincerely,

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

By:
Ian Thompson PhD, RPA
NAGPRA Specialist/Tribal Archaeologist
Choctaw Nation of Oklahoma

IAT:vr

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APPENDIX M

MISSISSIPPI DEPARTMENT OF ARCHIVES AND HISTORY REPLIES TO PHASE I CULTURAL RESOURCES ASSESSMENTS

MISSISSIPPI DEPARTMENT *of* ARCHIVES AND HISTORY

MDAH

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

October 24, 2008

Mr. John Templeton
Mississippi Power Company
2992 West Beach Blvd.
Gulfport, Mississippi 39501

RE: A Phase I Cultural Resources Assessment of a Proposed Integrated Gasification Combined Cycle Generating Station, MDAH Project Log #09-118-08, Kemper County

Dear Mr. Templeton:

We have reviewed the revised cultural resources survey report by Jason A. Gardner. Principal Investigator. for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that sites 22Ke604, 22Ke605, 22Ke606, 22Ke607, 22Ke608 and 22Ke609 are ineligible for listing in the National Register of Historic Places. We do not concur, however, that the standing structure identified in the report is ineligible. Rather, our staff has determined that the Goldman House is potentially eligible as a local example of a vernacular rural house with late Victorian details. As such, demolition of this resource would be an adverse effect. To mitigate the adverse effect, it is our recommendation that HABS-level documentation (including measured drawings and archival photographs) would, at a minimum, be appropriate mitigation. If, after consultation, this is determined to be the appropriate mitigation, we would be happy to provide information on the type of documentation referenced.

There remains the possibility that unrecorded cultural resources may be encountered. Should this occur, we would appreciate your contacting this office immediately in order that we may offer appropriate comments under 36 CFR 800.13.

Please provide a copy of this letter to Mr. Gardner. If you need further information, please let us know.

Sincerely,

Jim

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

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OCT 28 2008
ENVIRONMENTAL QUALITY

c: Clearinghouse for Federal Programs

Barry A. Vittor & Associates, Inc.
8060 Cottage Hill Road
Mobile, Alabama 36695

MISSISSIPPI DEPARTMENT *of* ARCHIVES AND HISTORY

MDAH

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

March 10, 2009

Environmental Consulting & Technology, Inc.
3701 Northwest 98th Street
Gainesville, Florida 32606

RE: Phase I Cultural Resource Survey of 40-Mile CO_2 Pipeline, MDAH Project Log #02-127-09, Lauderdale, Clarke and Jasper Counties

Dear Sirs:

We have reviewed the January 14, 2009, cultural resources survey report by Natalie P. Adams, Principal Investigator, received on February 18, 2009, for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that sites 22LD739, 22LD740, 22LD741, 22LD742, 22LD747, 22LD749, 22LD751, 22LD753, 22LD754, 22CK651, 22CK652, 22CK654, 22CK655, 22CK656, 22CK658, 22CK661, 22CK662, 22JS672, and 22JS673 are ineligible for listing in the National Register of Historic Places. We also concur that sites 22LD743, 22LD744, 22LD745, 22LD746, 22LD748, 22LD750, 22LD752, 22CK653, 22CK657, 22CK659, 22CK660, 22JS671 and 22JS674 are potentially eligible for listing in the NRHP, and that site 22LD755 is eligible for listing in the NRHP. We further concur with the recommendation for avoidance of the potentially eligible sites and eligible site, with Phase II and/or Phase III testing if avoidance is not possible. We also concur with the eligibility determinations for the architectural resources. Specifically, we concur that Pleasant Grove M.B. Church and Cemetery, the house on the S. side of Hwy. 513 W. of I-59 interchange, and the house at 6018 Highway 18 West are eligible for listing in the NRHP. While eligible, we also concur that the project will have no effect. We also concur that the other seven (7) properties identified in the report are ineligible for listing in the NRHP. With these determinations, we have no objection with the proposed undertaking.

There remains the possibility that unrecorded cultural resources may be encountered during the project. Should this occur, we would appreciate your contacting this office immediately in order that we may offer appropriate comments under 36 CFR 800.13.

Please provide a copy of this letter to Ms. Adams. If you need further information, please let us know.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

MISSISSIPPI DEPARTMENT *of* ARCHIVES AND HISTORY

MDAH

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

May 22, 2009

Mr. Hunter B. Johnson
Principal Investigator
Tennessee Valley Archaeological Research
2211 Seminole Drive, Suite 302
Huntsville, Alabama 35811

RE: A Cultural Resources Management Survey of the Proposed New Natural Gas Line, Access Roads, and Liberty Metering Site Associated with the Mississippi Power Kemper County IGCC Project, MDAH Project Log #04-090-09, Kemper County

Dear Mr. Johnson:

We have reviewed your January 2009 cultural resources survey report, received on April 15, 2009, for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that sites 22Ke617, 22Ke618, 22Ke619, and the five (5) isolated finds are ineligible for listing in the National Register of Historic Places (NRHP). We also concur that neither of the standing structures identified in the report (Structures 10 and 11) are eligible for listing in the National Register of Historic Places. Therefore, we concur that the proposed natural gas line corridor will not affect any known cultural resources, and that the project may proceed as planned.

There remains the possibility that unrecorded cultural resources may be encountered during the project. Should this occur, we would appreciate your contacting this office immediately in order that we may offer appropriate comments under 36 CFR 800.13.

Please provide a copy of this letter to Mississippi Power, 2992 West Beach Blvd., Gulfport, Mississippi 39501. If you need further information, please let us know.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

MISSISSIPPI DEPARTMENT *of* ARCHIVES AND HISTORY

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

May 26, 2009

Mr. Hunter B. Johnson
Principal Investigator
Tennessee Valley Archaeological Research
2211 Seminole Drive, Suite 302
Huntsville, Alabama 35811

RE: A Cultural Resources Management Survey of the Proposed New Transmission Lines Associated with the Mississippi Power Kemper County IGCC Project in Kemper and Lauderdale Counties, MDAH Project Log #04-185-09, Kemper and Lauderdale Counties

Dear Mr. Johnson:

We have reviewed your February 2009 cultural resources survey report, received on April 29, 2009, for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that of the twenty-seven (27) new archaeological sites and twenty-six (26) isolated finds identified in the survey, two of the sites (22Ke611 and 22Ld794) are potentially eligible for listing in the National Register of Historic Places (NRHP) and should be avoided. We also concur that none of the twenty-three (23) standing structures identified in the report are eligible for listing in the National Register of Historic Places. Therefore, with the recommendation for avoidance of the two sites listed above, we concur that the proposed transmission line corridor will not adversely affect any known cultural resources, and that the project may proceed as planned.

There remains the possibility that unrecorded cultural resources may be encountered during the project. Should this occur, we would appreciate your contacting this office immediately in order that we may offer appropriate comments under 36 CFR 800.13.

Please provide a copy of this letter to Mississippi Power, 2992 West Beach Blvd., Gulfport, Mississippi 39501. If you need further information, please let us know.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

MISSISSIPPI DEPARTMENT *of* ARCHIVES AND HISTORY

MDAH

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

June 23, 2009

Mr. John Templeton
Mississippi Power
P.O. Box 4079
Gulfport, Mississippi 39502-4079

RE: Phase I Cultural Resource Survey of a 40-Mile CO2 Pipeline, MDAH Project Log #05-161-09, Lauderdale, Clarke and Jasper Counties

Dear Mr. Templeton:

We have reviewed the April 12, 2009, cultural resources survey report by Natalie P. Adams, Principal Investigator, received on May 21, 2009, for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that 22Ld755 is eligible for listing in the National Register of Historic Places and concur with the recommendation of data recovery as mitigation. We also concur that sites 22Ck653, 22Ck657, 22Ck659, 22Ck660, 22Js675, 22Js674, 22Ld743, 22Ld744, 22Ld745, 22Ld746, 22Ld748, 22Ld750 and 22Ld752 are potentially eligible for listing in the NRHP, and should be avoided. If avoidance is not possible, we concur that additional testing is appropriate. It is also our determination that the architectural resources (1, 2 and 9) are potentially eligible for listing in the NRHP, and concur that the resources will not be adversely affected by the proposed project. With these recommendations, we have no objection with the proposed undertaking.

There remains the possibility that unrecorded cultural resources may be encountered during construction. Should this occur, the applicant should immediately contact our office in order that we may offer appropriate comments under 36 CFR 800.13.

If you need further information, please let us know.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

MISSISSIPPI DEPARTMENT of ARCHIVES AND HISTORY

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

September 3, 2009

Mr. John Templeton
Environmental Specialist
Mississippi Power
P.O. Box 4079
Gulfport, Mississippi 39502-4079

RE: Addendum to Phase I Archaeological Survey of a 40-Mile CO_2 Pipeline, MDAH Project Log #08-048-09, Lauderdale, Clarke and Jasper Counties

Dear Mr. Templeton:

We have reviewed the cultural resources survey report by Natalie Adams, Principal Investigator, received on August 7, 2009, for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that sites 22Ck667 and 22Ck668 are ineligible for listing in the National Register of Historic Places, and concur that no other known cultural resources listed in or eligible for listing in the National Register of Historic Places are likely to be affected. We also concur with the recommendation for avoidance of the modern cemeteries. With that recommendation, we have no concerns with the proposed undertaking.

There remains the possibility that unrecorded cultural resources may be encountered during the project. Should this occur, we would appreciate your contacting this office immediately in order that we may offer appropriate comments under 36 CFR 800.13.

If you need further information, please let us know.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

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Ken P'Pool, director • Jim Woodrick, acting director
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601-576-6940 • Fax 601-576-6955
mdah.state.ms.us

September 4, 2009

Mississippi Power Company
2992 West Beach Blvd.
Gulfport, Mississippi 39501

RE: An Addendum to a Cultural Resource Management Survey of the Proposed New Transmission Lines Associated with the Mississippi Power Kemper County IGCC Project, MDAH Project Log #08-049-09, Kemper and Lauderdale Counties

Dear Sirs:

We have reviewed the June 2009 cultural resources survey report by Hunter B. Johnson, Principal Investigator, received on August 7, 2009, for the above referenced undertaking, pursuant to our responsibilities under Section 106 of the National Historic Preservation Act and 36 CFR Part 800. After review, we concur that no known cultural resources listed in or eligible for listing in the National Register of Historic Places are likely to be affected. Therefore, we have no objections with the proposed undertaking.

There remains the possibility that unrecorded cultural resources may be encountered during the project. Should this occur, we would appreciate your contacting this office immediately in order that we may offer appropriate comments under 36 CFR 800.13.

Please provide a copy of this letter to Mr. Johnson. If you need further information, please let us know.

Sincerely,

Jim Woodrick
Review and Compliance Officer

FOR: H.T. Holmes
State Historic Preservation Officer

c: Clearinghouse for Federal Programs

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APPENDIX N

KEMPER COUNTY IGCC PROJECT COOLING TOWER IMPACT ASSESSMENTS

AECOM Environment
2 Technology Park Drive
Westford, MA 01886
T (978) 589-3000 F (978) 589-3100 www.aecom.com

May 15, 2009

Mr. Scott McMillan
Southern Company Services
600 North 18th Street, Bin 14N-8195
Birmingham, AL 35291

Subject: Cooling Tower Analysis – Kemper County IGCC Project
Kemper County, Mississippi

Dear Mr. McMillan,

AECOM has completed modeling of the wet mechanical draft cooling towers proposed for the Kemper County IGCC Project located in Kemper County, Mississippi. The purpose of the modeling analysis was to predict salt deposition rates associated with cooling tower drift and the potential for ground-level fogging and icing associated with visible vapor plumes.

Overview of Modeling Approach

AECOM applied the Seasonal and Annual Cooling Tower Impacts (SACTI, Version 9/30/90) model to assess the potential for ground-level fogging and icing impacts as well as to predict salt deposition rates associated with the proposed wet mechanical draft cooling towers. SACTI was developed by the Electric Power Research Institute (EPRI). SACTI is a validated model designed for assessing cooling tower plume impacts and is widely accepted by state agencies for regulatory applications.

Cooling tower "fogging" occurs when the condensed water vapor plume comes in contact with the ground for short periods of time near the tower. Although this potential impact is referred to as fogging, it is not the type of area-wide atmospheric fogging that is generally thought of when the term "fog" is used. Cooling tower plume touchdown or fogging is transient and localized. The SACTI model estimates the number of hours per year that ground-level fogging will occur at specified receptor locations. Ground-level icing is predicted to occur when a visible plume touches the ground under subfreezing weather conditions. The atmospheric conditions associated with predictions of ground-level fogging are high winds (≥10 m/sec) and high relative humidity or low atmospheric saturation deficits. The high winds, which cause aerodynamic downwash of the condensed vapor plume, are the primary factor in transporting the plume to the ground.

Salt deposition refers to the salt deposited in the areas surrounding the cooling tower as a result of cooling tower operation. It results from the fallout of droplets from the cooling tower plume which contains salts in the form of dissolved solids. The droplets, primarily consisting of water, are mechanically generated in the cooling tower and are a small fraction of the tower water flow rate. The amount of salt deposition is proportional to the mass of droplets released from the tower to the atmosphere as drift and the concentration of salts in the drift droplets.

The drift deposition model in SACTI consists of four sub-models: plume dispersion, breakaway, evaporation, and deposition. During the model development phase, the model developers conducted an extensive analysis of droplet evaporation and review of existing available drift models at that time. Based on that research, the SACTI model developers developed an improved treatment of drop dynamics and thermodynamics which was incorporated into the drift model. The drift model was tested with data from the 1977 Chalk Point Dye Tracer Study. This study, which provided the best data on cooling tower drift deposition at that time, involved the use of a fluorescent dye in the cooling tower/condenser water flow so as to be able to distinguish cooling tower drift deposition at the ground from other sources such as the plant stack. The study showed that the drift model performed within a factor of 3 of observed data.

For fogging/icing, the SACTI model results consist of the number of hours/year of fogging and icing estimated by the SACTI model for the five years of meteorology modeled. The fogging/icing results are summarized in this report in a table as well as overlaid on area satellite images. The salt deposition rates estimated by SACTI are provided in units of kg/km^2-month representing the annual average monthly deposition rate for the period analyzed. The salt deposition results presented in this report were converted to lb/acre/month and shown as isopleths overlaid on area satellite images.

Model Input Data

SACTI requires hourly meteorological data including measurements of temperature, relative humidity, wind speed, and wind direction. Consistent with requirements for regulatory air quality modeling, five years of meteorological data (1991-1995) from the nearest representative National Weather Service Station (NWS), Meridian, MS were used in the SACTI modeling. The SACTI model also requires twice daily mixing heights from the closest representative upper air station, Jackson, MS (also consistent with requirements for regulatory air quality modeling).

Consistent with SACTI model requirements, the model was applied with a polar receptor grid centered with respect to the two cooling towers. The receptors were placed along 16 equally spaced radials (22.5 degree increments) at 100 meter increments out to 10 kilometers.

The cooling tower performance data required by SACTI were provide by Southern Company and are summarized in Tables 1 and 2 for the two towers.

Model Results

The cooling tower fogging results are summarized in Table 3. The table lists the annual average hours/year fogging at each receptor location based on the 5-years modeled. There were no hours of icing estimated by SACTI. The fogging results are illustrated in Figure 1 which shows the hours/year of fogging noted next to each receptor location. As shown in Figure 1, all predicted fogging occurrences are limited to receptors within the proposed facility boundary.

Seasonal salt deposition rates (in units of lb/acre/month) estimated by SACTI are illustrated as contour plots in Figures 2 through 5 defined based on meteorological convention as follows:

- Figure 2: Winter - December, January, February
- Figure 3: Spring - March, April, May
- Figure 4: Summer - June, July, August
- Figure 5: Fall - September, October, November

In addition, salt deposition rates for the worst-case month, April, are shown in Figure 6. Annual average deposition rates are shown in Figure 7.

All figures also note the location and magnitude of the maximum modeled salt deposition values which occur on the facility property for all cases.

Please contact Brian Stormwind at 978-589-3154 or Thomas Pritcher at 919-872-6600 if you have any questions or comments concerning this report.

Yours sincerely,

Brian Stormwind

Brian Stormwind
Senior Air Quality Meteorologist
brian.stormwind@aecom.com

Thomas Pritcher

Thomas Pritcher, P.E
Air Quality Program Manager
thomas.pritcher@aecom.com

Table 1: Gasification Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	270	
Width of Tower (Feet)	123	
Exit Diameter of a Single Fan Stack (Feet)	40	
Number of Cells	10	
Total (All Cells) Heat Rejection Rate (Btu/hr) (1)	1,140 x 10^6	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) (1)	56,000,000	
Total Water Circulation Rate (gallons per minute)	120,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) (2)	1,500	
Drift Rate (gallons per minute)	0.60	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (μm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(1) Representative of full load operation.
(2) Concentration in blow-down based on 5 cycles of concentration.

Table 2: Combined Cycle Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	323	
Width of Tower (Feet)	123	
Exit Diameter of a Single Fan Stack (Feet)	40	
Number of Cells	12	
Total (All Cells) Heat Rejection Rate (Btu/hr) (1)	1,650 x 10^6	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) (1)	67,200,000	
Total Water Circulation Rate (gallons per minute)	150,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) (2)	1,500	
Drift Rate (gallons per minute)	0.75	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (μm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
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(3) Representative of full load operation.
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Table 3: Ground-level Plume Fogging (Hours/Year) – Annual Average Based on 5-years Modeled

Distance (meters) (1)	Plume Heading															
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
100	2.5	1.0	0.4	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.8
200	3.4	0.4	0.7	0.0	0.1	0.0	0.1	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.1	1.5
300	0.6	0.2	0.3	0.0	0.1	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.0	0.3
400	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
500	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
600	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
700	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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1400	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(1) Relative to the center location of the cooling towers.

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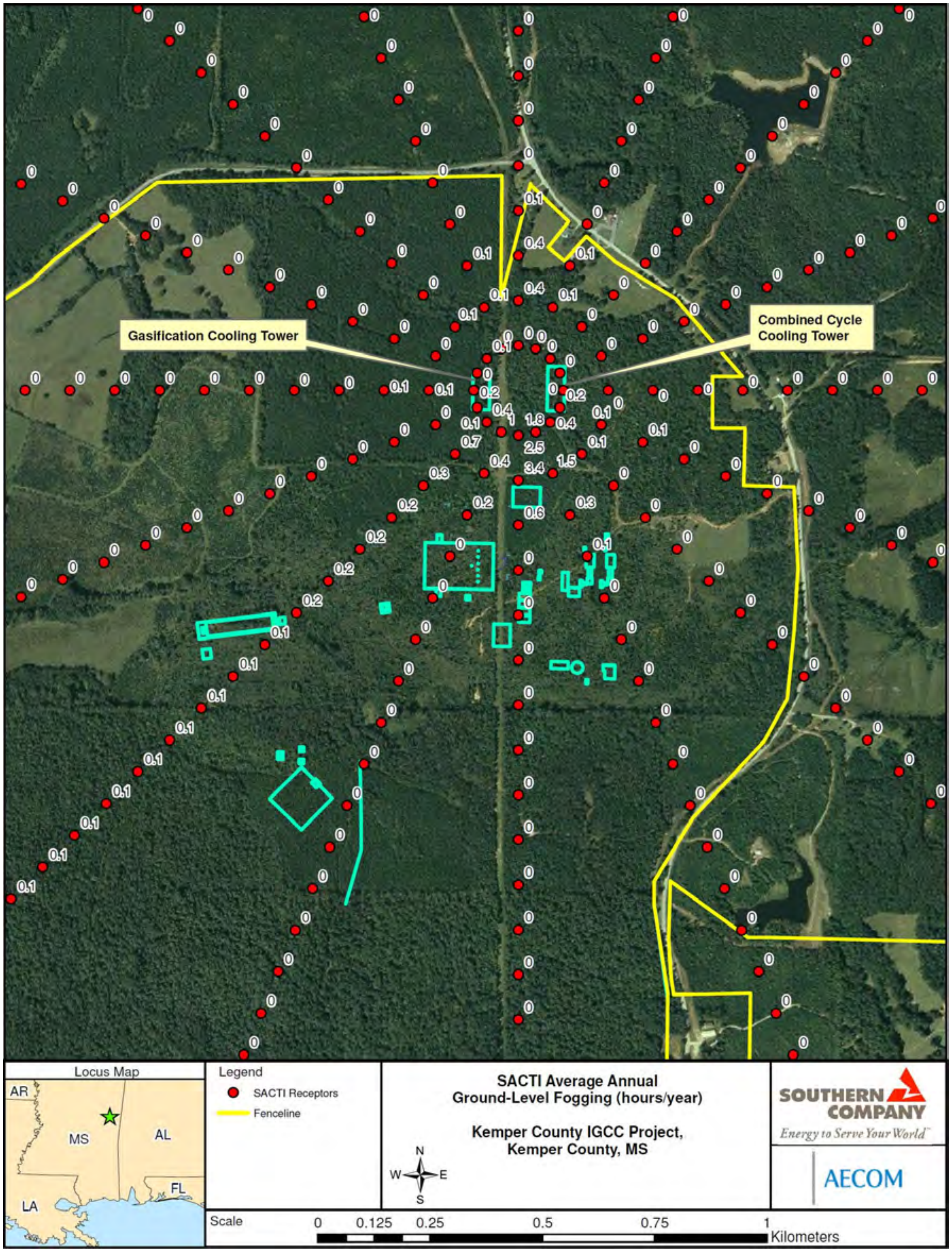
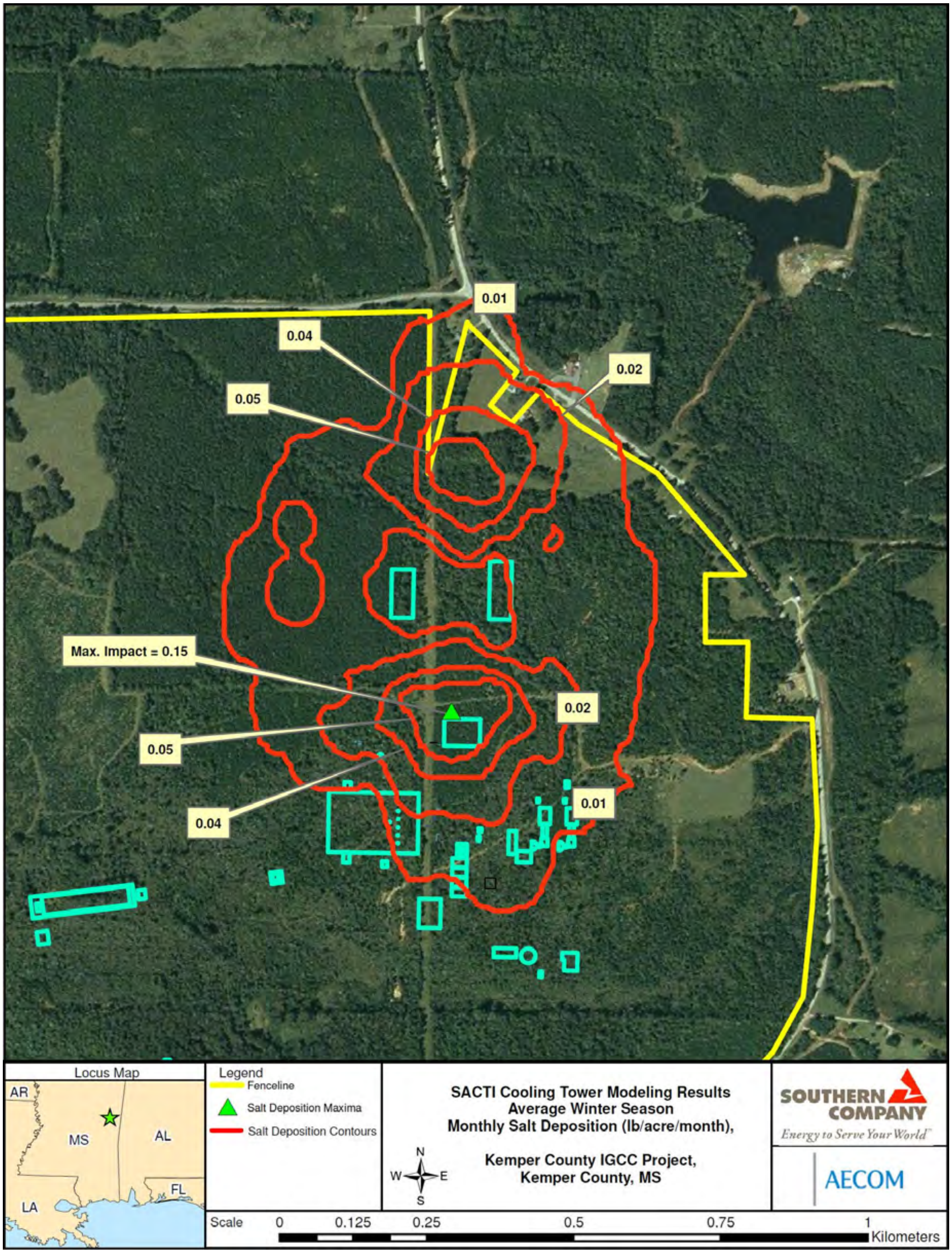


Figure 2: Salt Deposition - Winter



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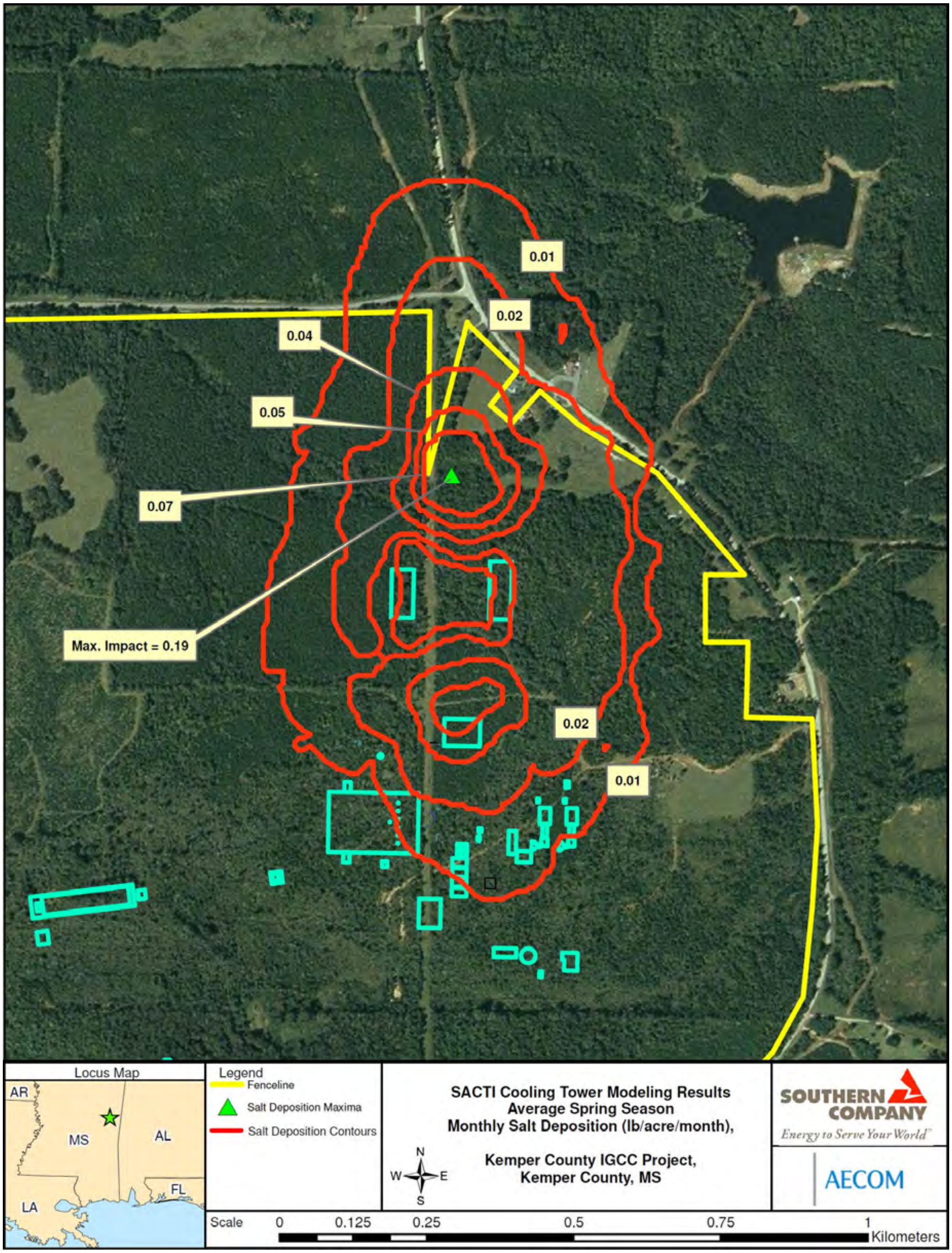


Figure 4: Salt Deposition - Summer

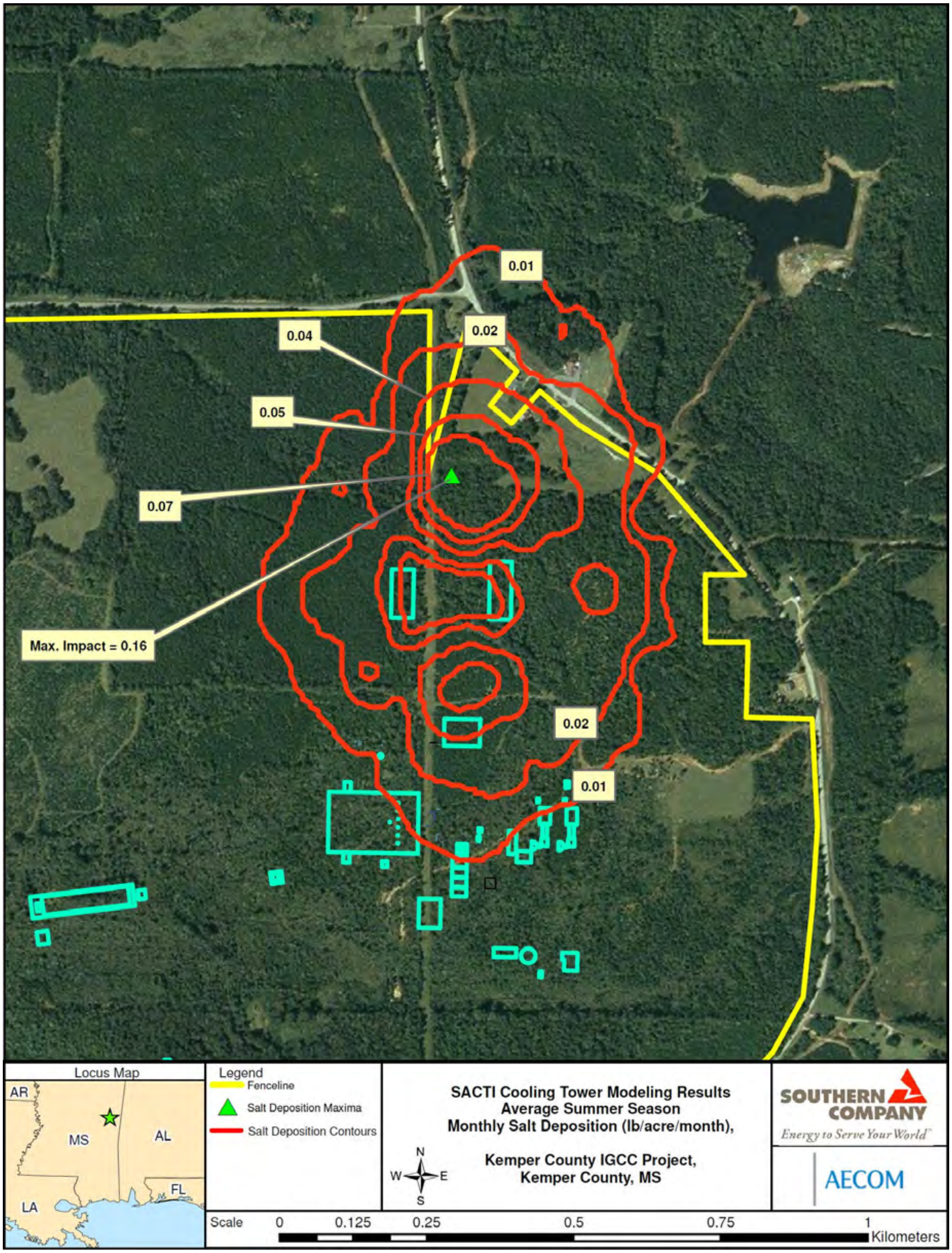


Figure 5: Salt Deposition - Fall

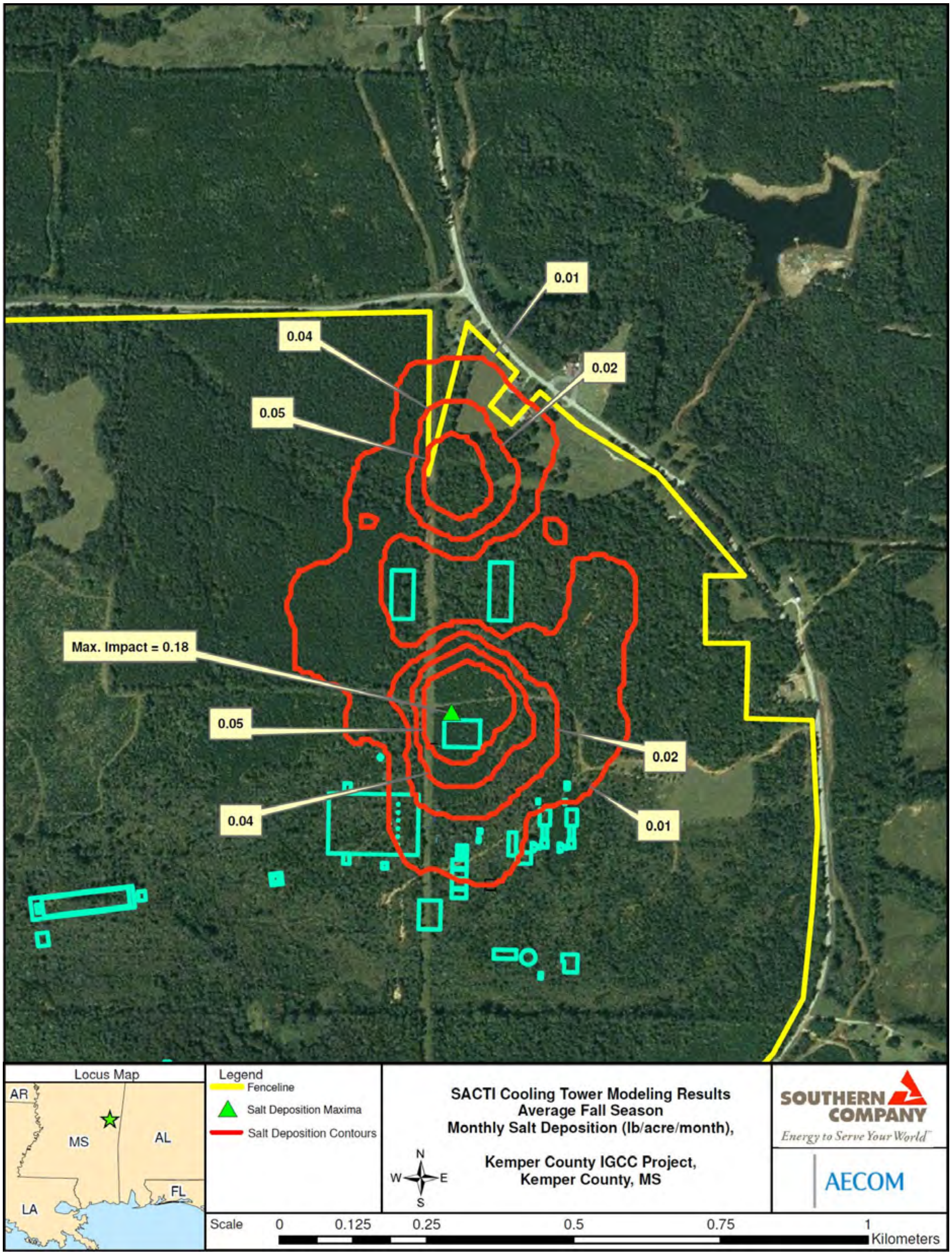


Figure 6: Salt Deposition – April (Worst-case Month)

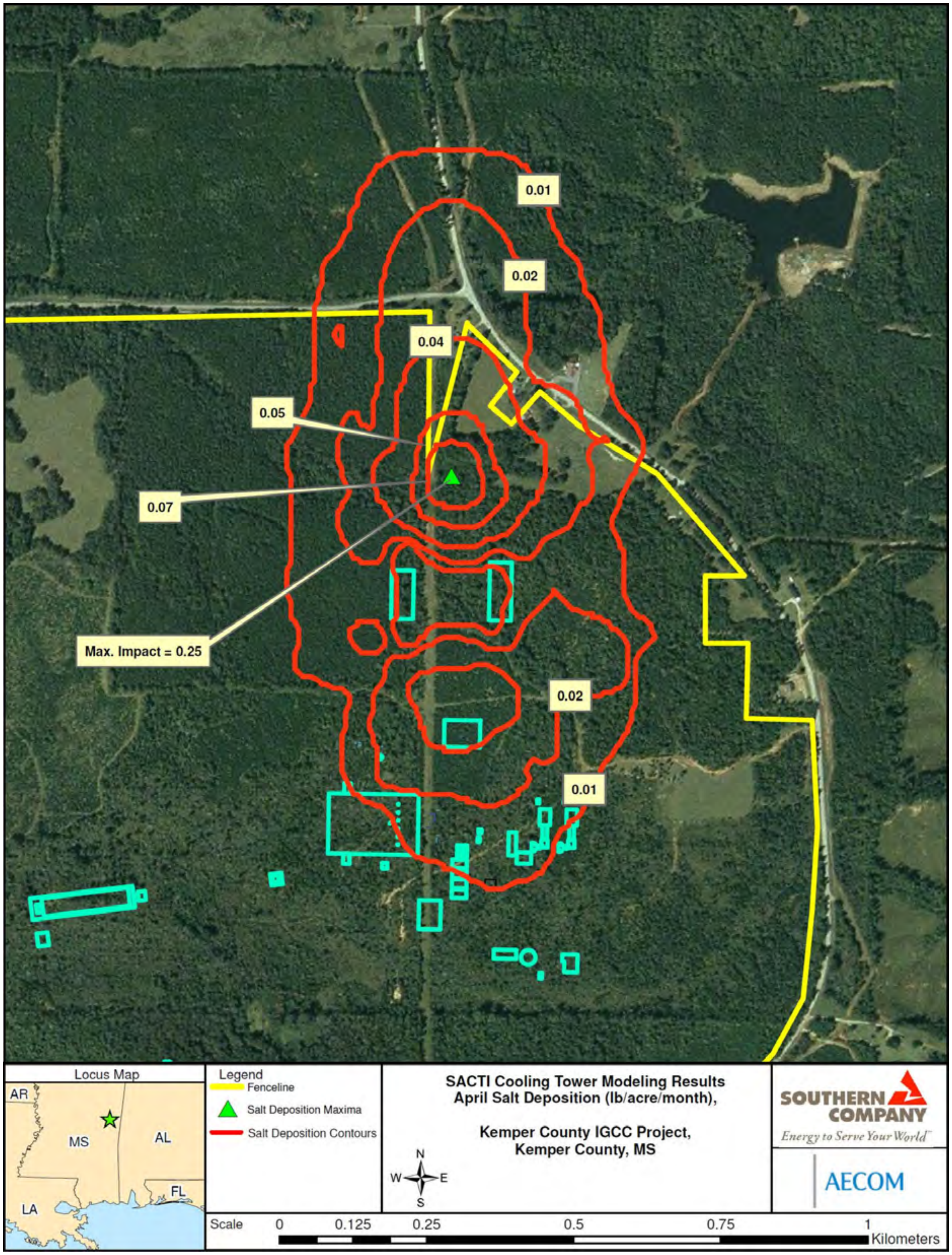
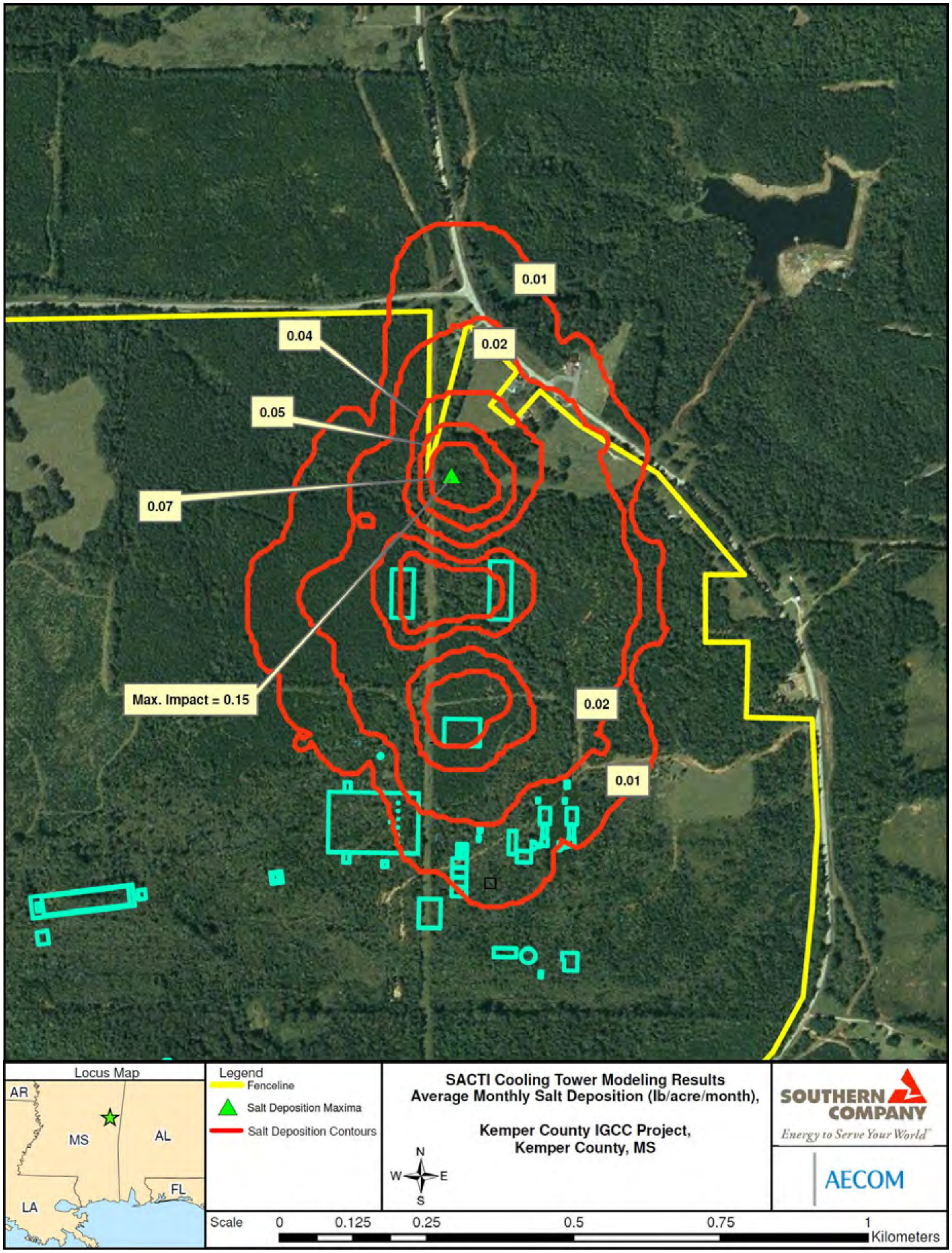


Figure 7: Salt Deposition – Annual (Average All Seasons)



AECOM Environment
2 Technology Park Drive
Westford, MA 01886
T (978) 589-3000 F (978) 589-3100 www.aecom.com

May 15, 2009

Mr. Scott McMillan
Southern Company Services
600 North 18th Street, Bin 14N-8195
Birmingham, AL 35291

Subject: Cooling Tower Analysis – Kemper County IGCC Project
Kemper County, Mississippi

Dear Mr. McMillan,

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Please contact Brian Stormwind at 978-589-3154 or Thomas Pritcher at 919-872-6600 if you have any questions or comments concerning this report.

Yours sincerely,

Brian Stormwind

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Brian Stormwind
Senior Air Quality Meteorologist
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Air Quality Program Manager
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500	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
600	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
700	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(1) Relative to the center location of the cooling towers.

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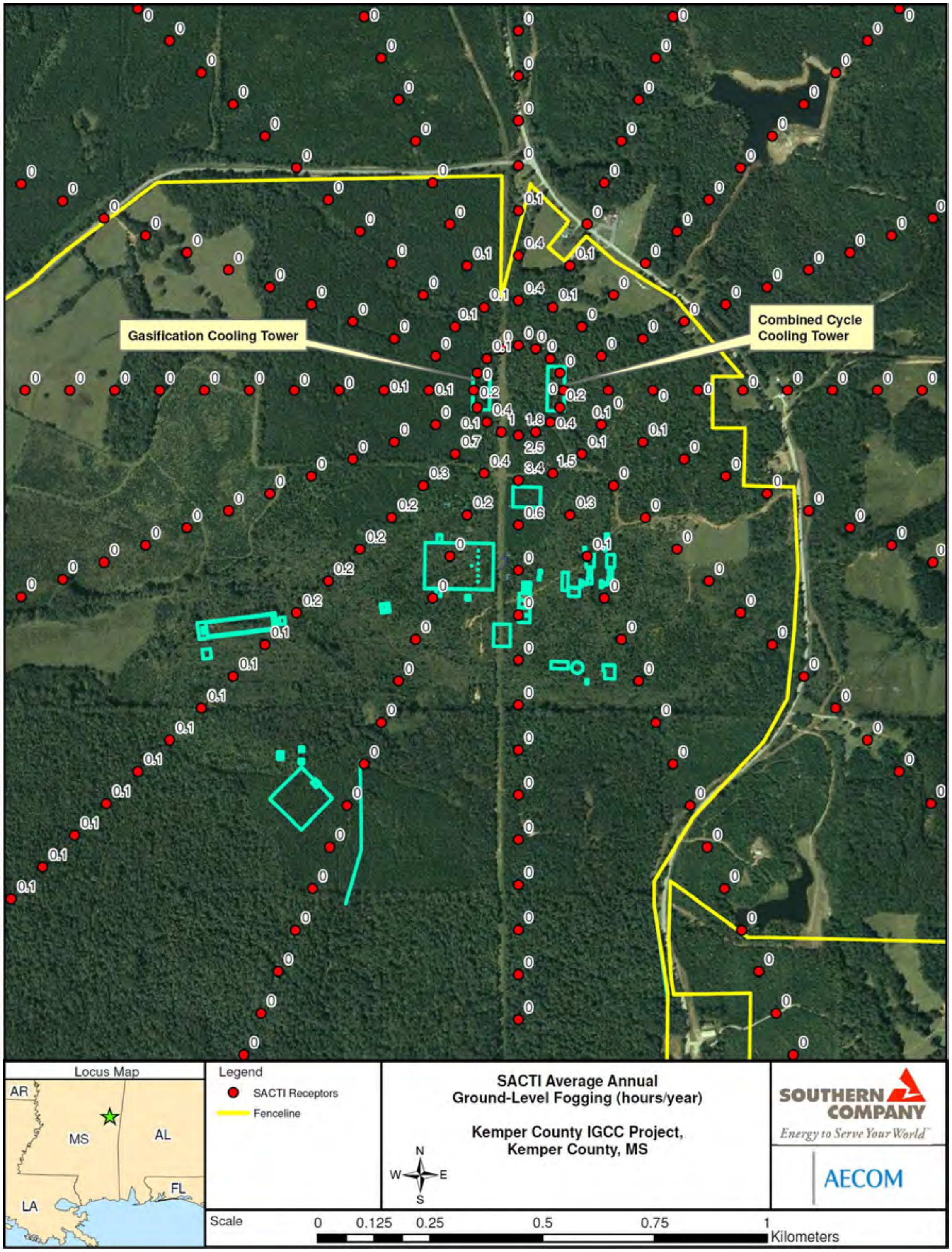


Figure 2: Salt Deposition - Winter

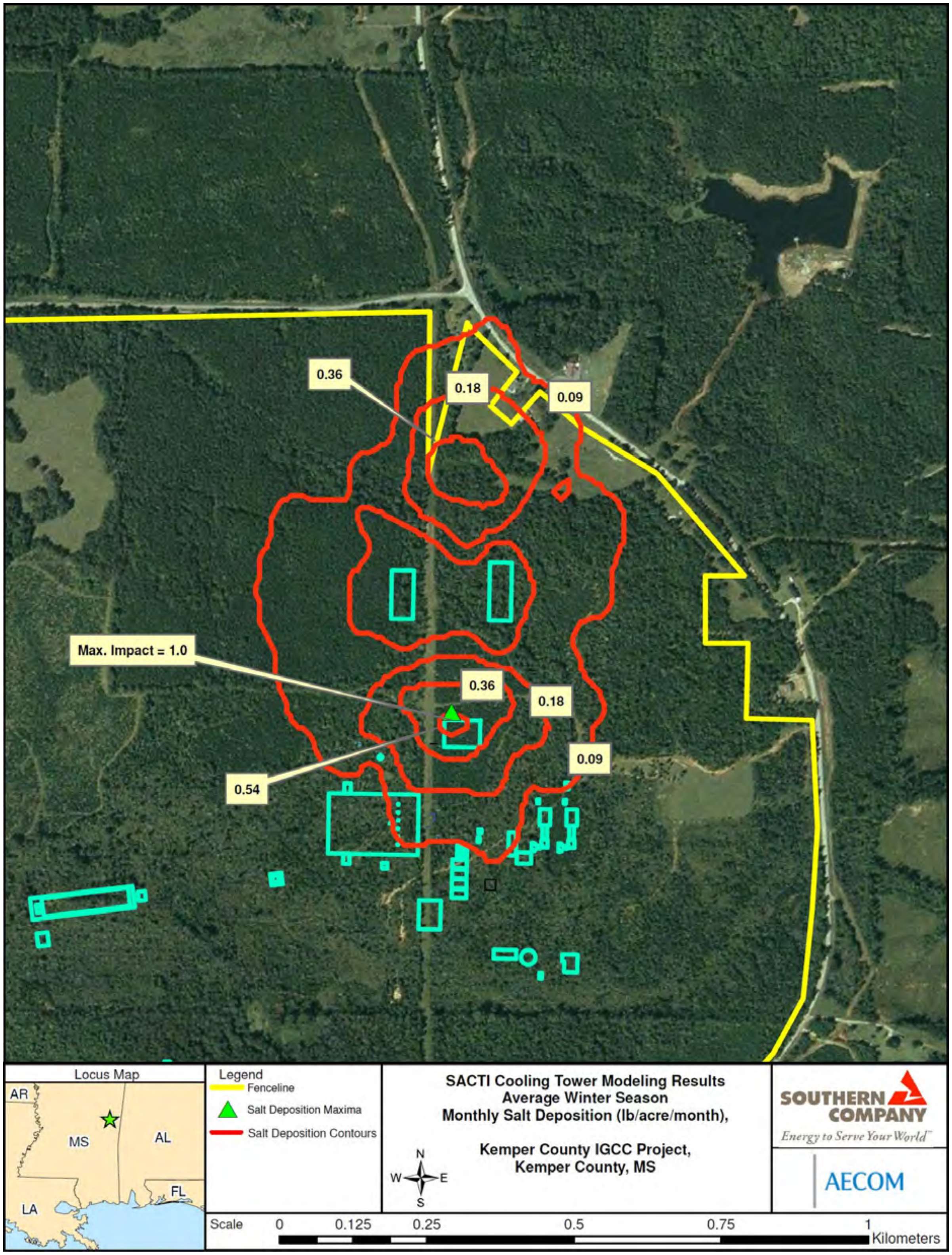


Figure 3: Salt Deposition - Spring

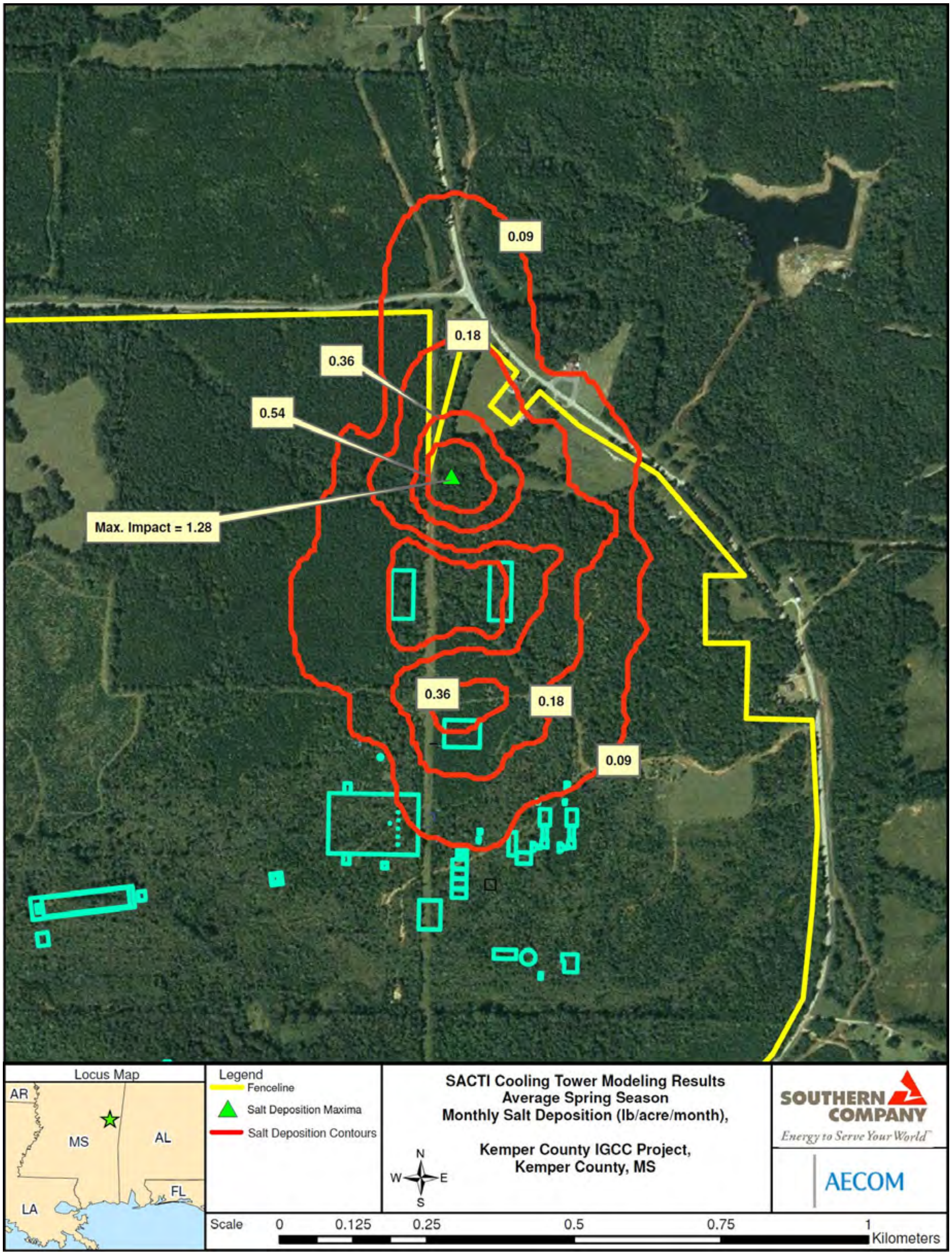


Figure 4: Salt Deposition - Summer

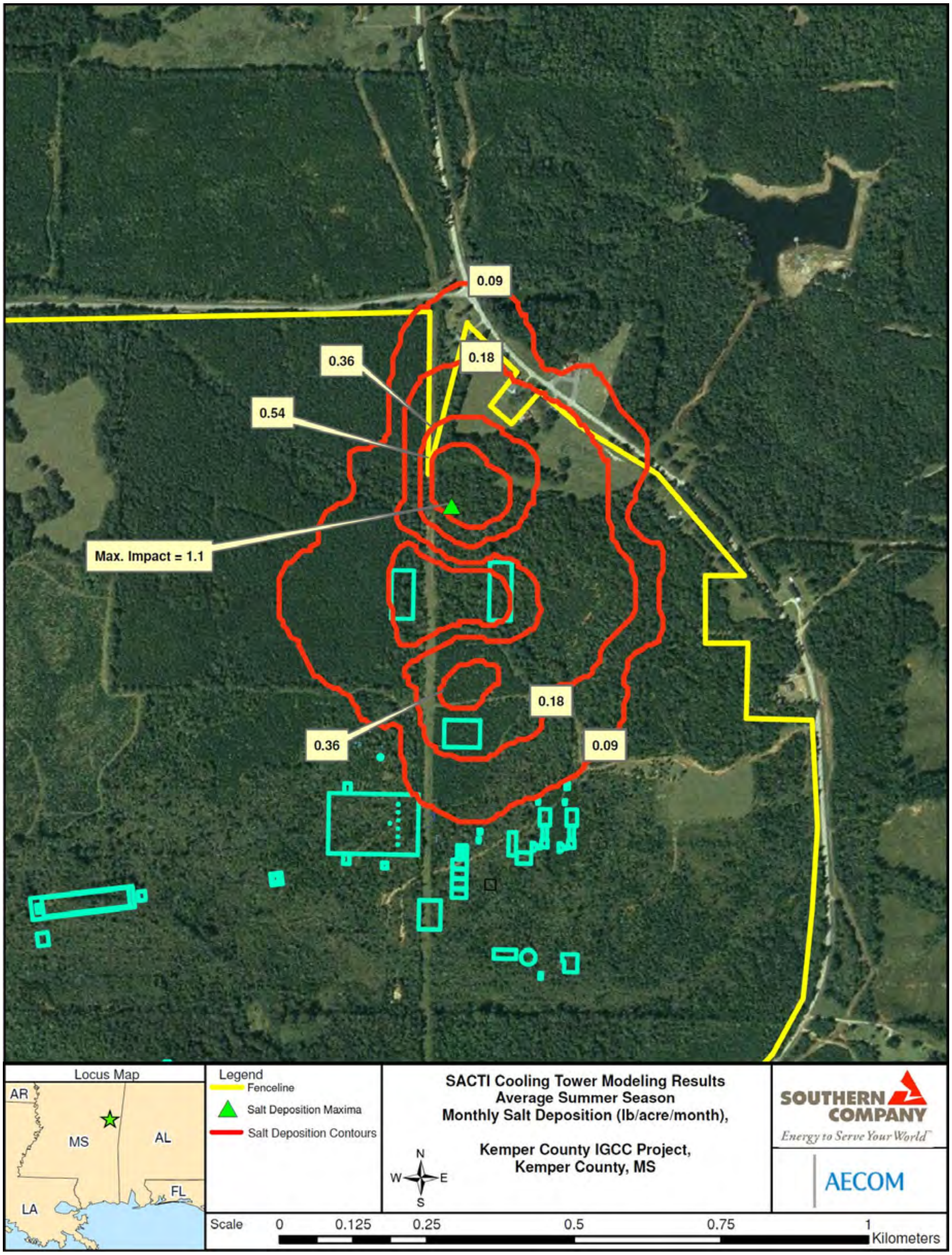
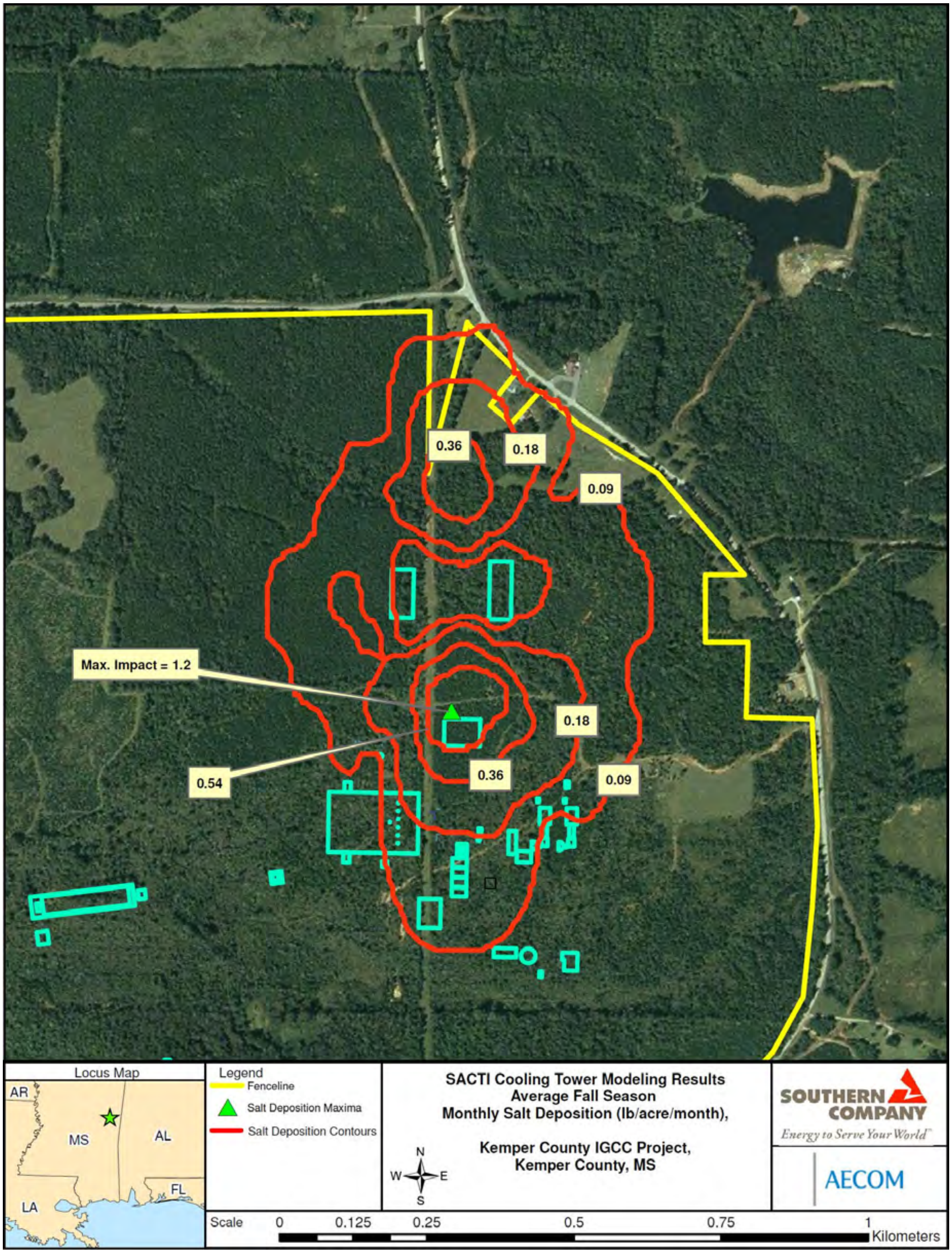


Figure 5: Salt Deposition - Fall



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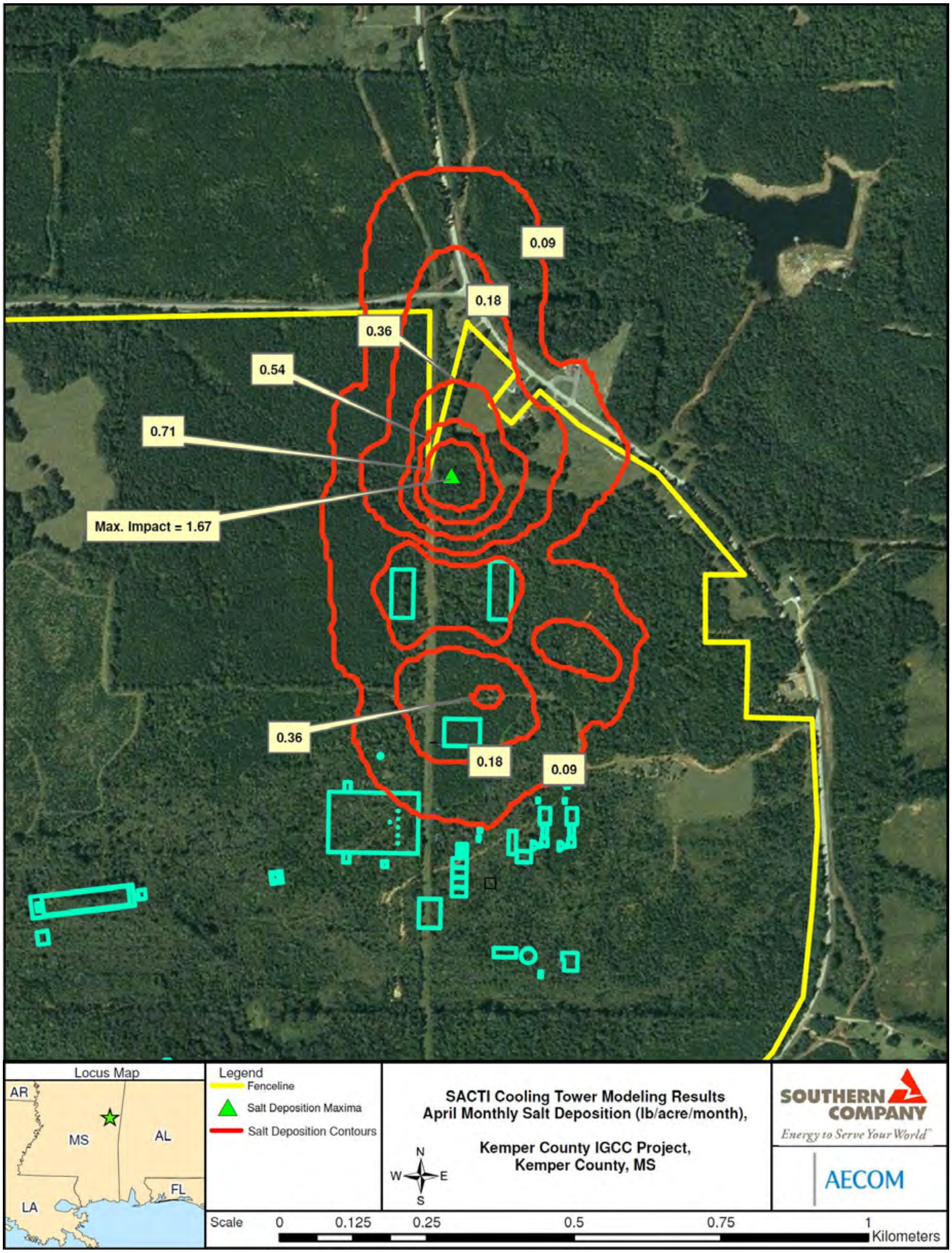
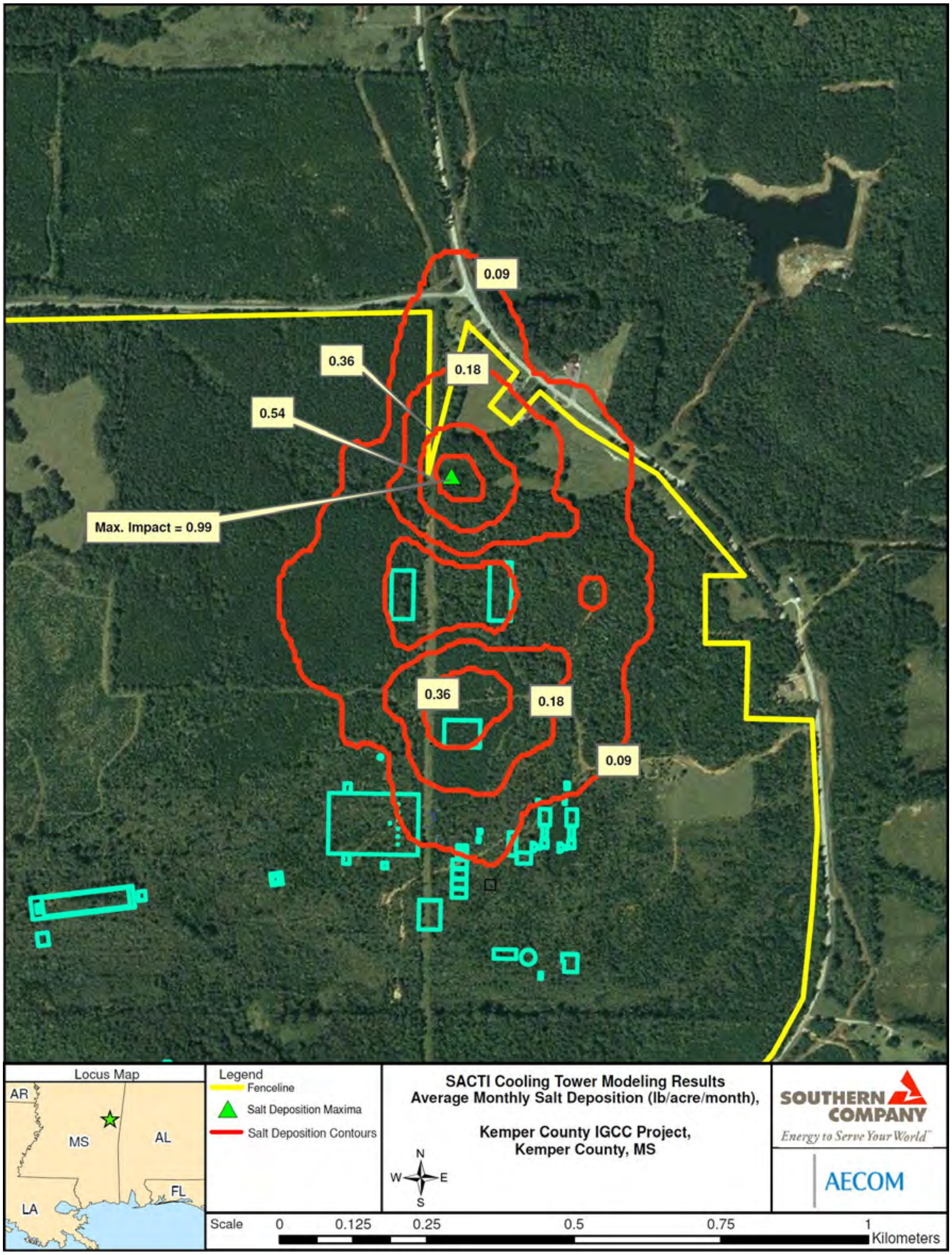


Figure 7: Salt Deposition – Annual (Average All Seasons)



AECOM Environment
2 Technology Park Drive
Westford, MA 01886
T (978) 589-3000 F (978) 589-3100 www.aecom.com

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Cooling Water Total Dissolved Solids (ppm) (2)	85,000	
Drift Rate (gallons per minute)	0.60	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (μm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(1) Representative of full load operation.
(2) Concentration in blow-down based on 5 cycles of concentration.

Table 2: Combined Cycle Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	323	
Width of Tower (Feet)	123	
Exit Diameter of a Single Fan Stack (Feet)	40	
Number of Cells	12	
Total (All Cells) Heat Rejection Rate (Btu/hr) (1)	1,650 x 10^6	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) (1)	67,200,000	
Total Water Circulation Rate (gallons per minute)	150,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) (2)	85,000	
Drift Rate (gallons per minute)	0.75	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (µm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(3) Representative of full load operation.
(4) Concentration in blow-down based on 5 cycles of concentration.

Table 3: Ground-level Plume Fogging (Hours/Year) – Annual Average Based on 5-years Modeled

Distance (meters) (1)	Plume Heading															
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
100	2.5	1.0	0.4	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.8
200	3.4	0.4	0.7	0.0	0.1	0.0	0.1	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.1	1.5
300	0.6	0.2	0.3	0.0	0.1	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.0	0.3
400	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
500	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
600	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
700	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(1) Relative to the center location of the cooling towers.

Figure 1: Ground-level Fogging Results

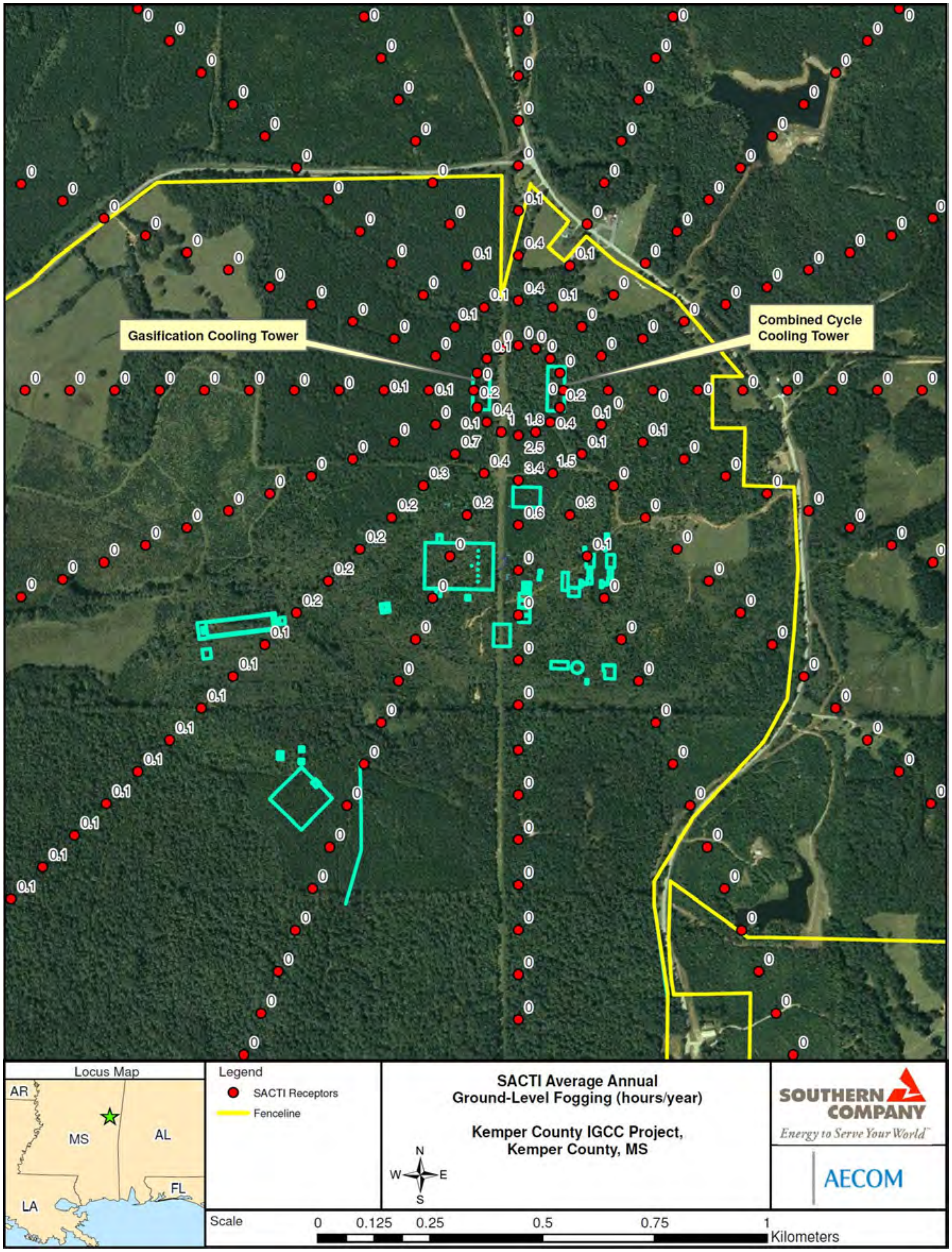


Figure 2: Salt Deposition - Winter

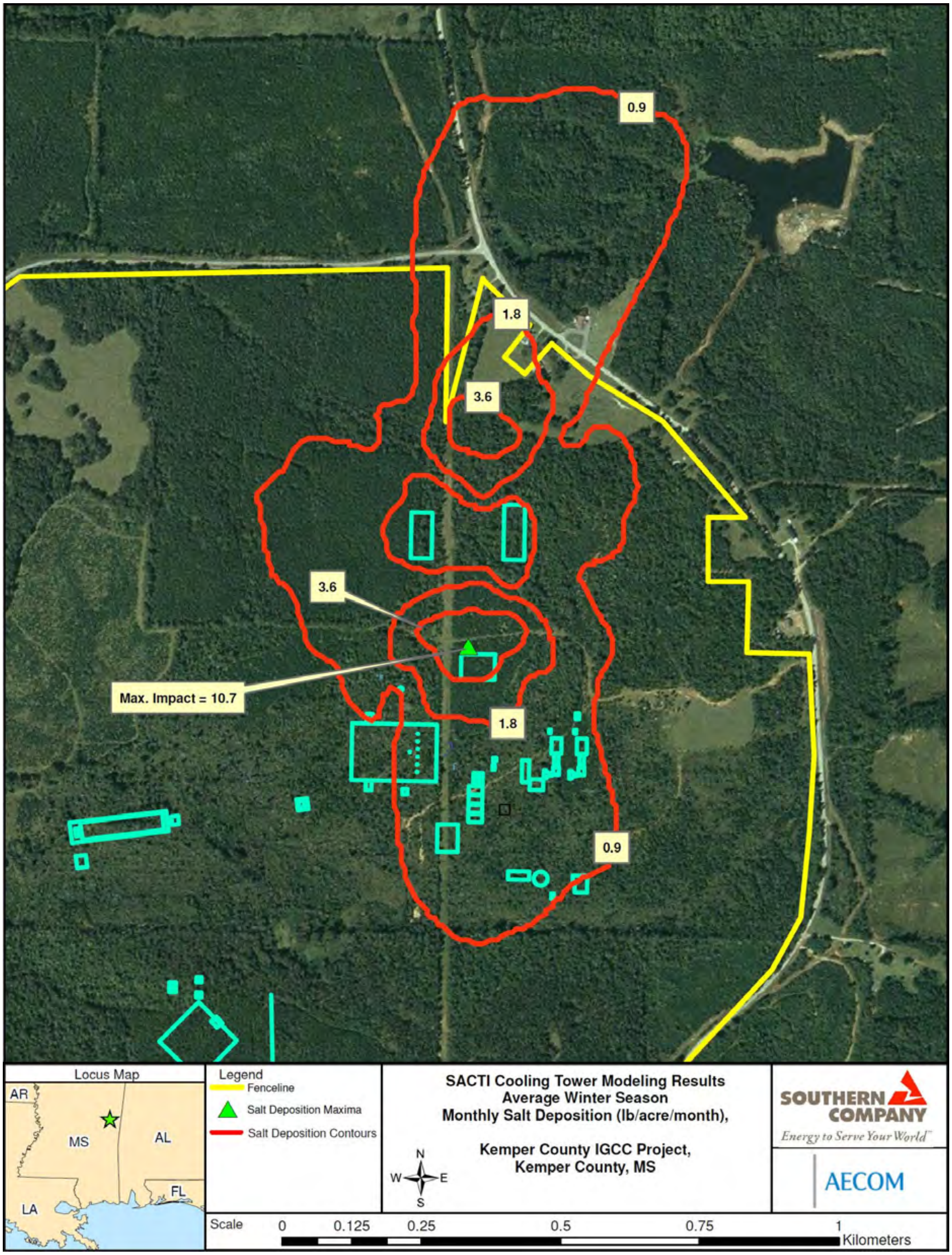


Figure 3: Salt Deposition - Spring

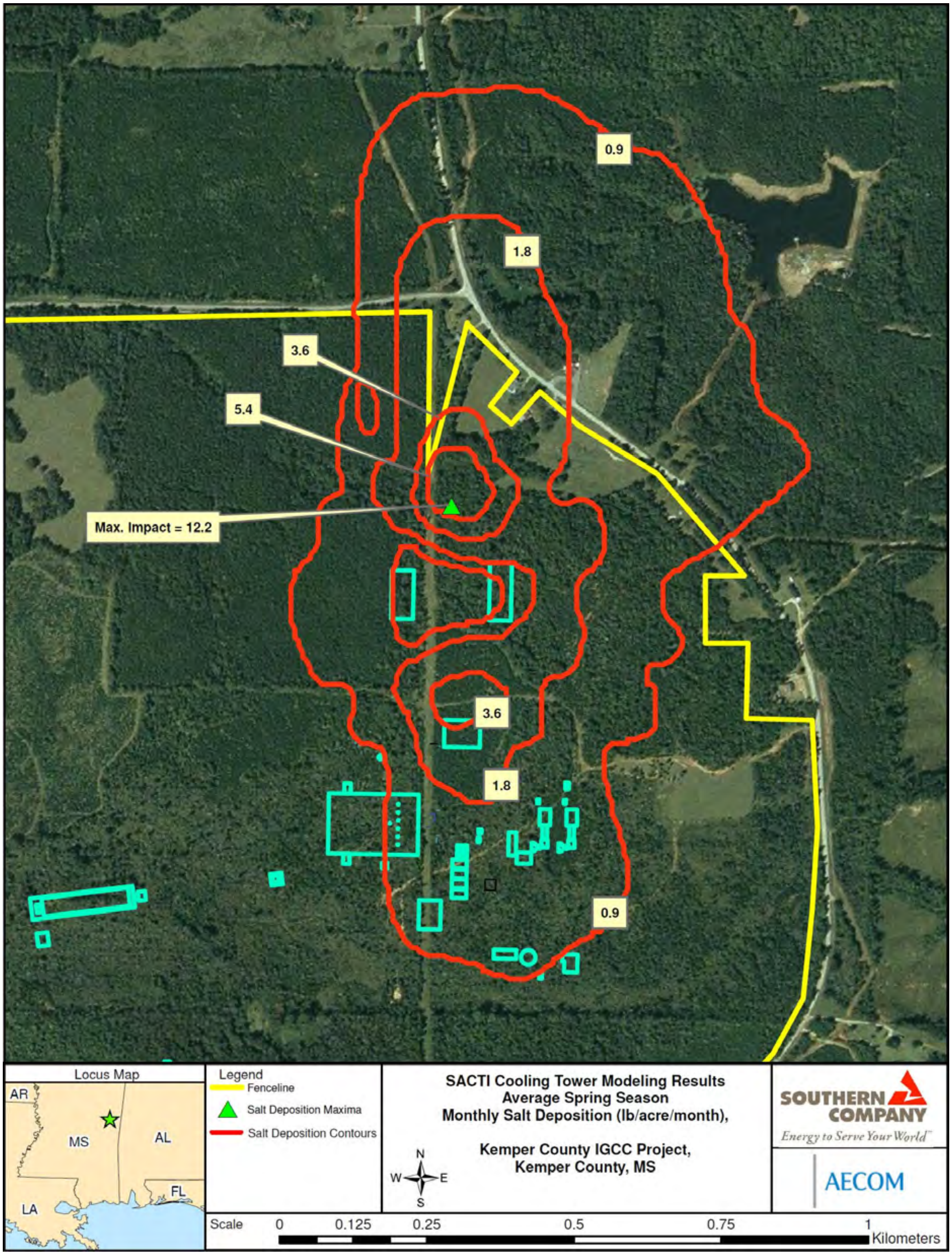


Figure 4: Salt Deposition - Summer

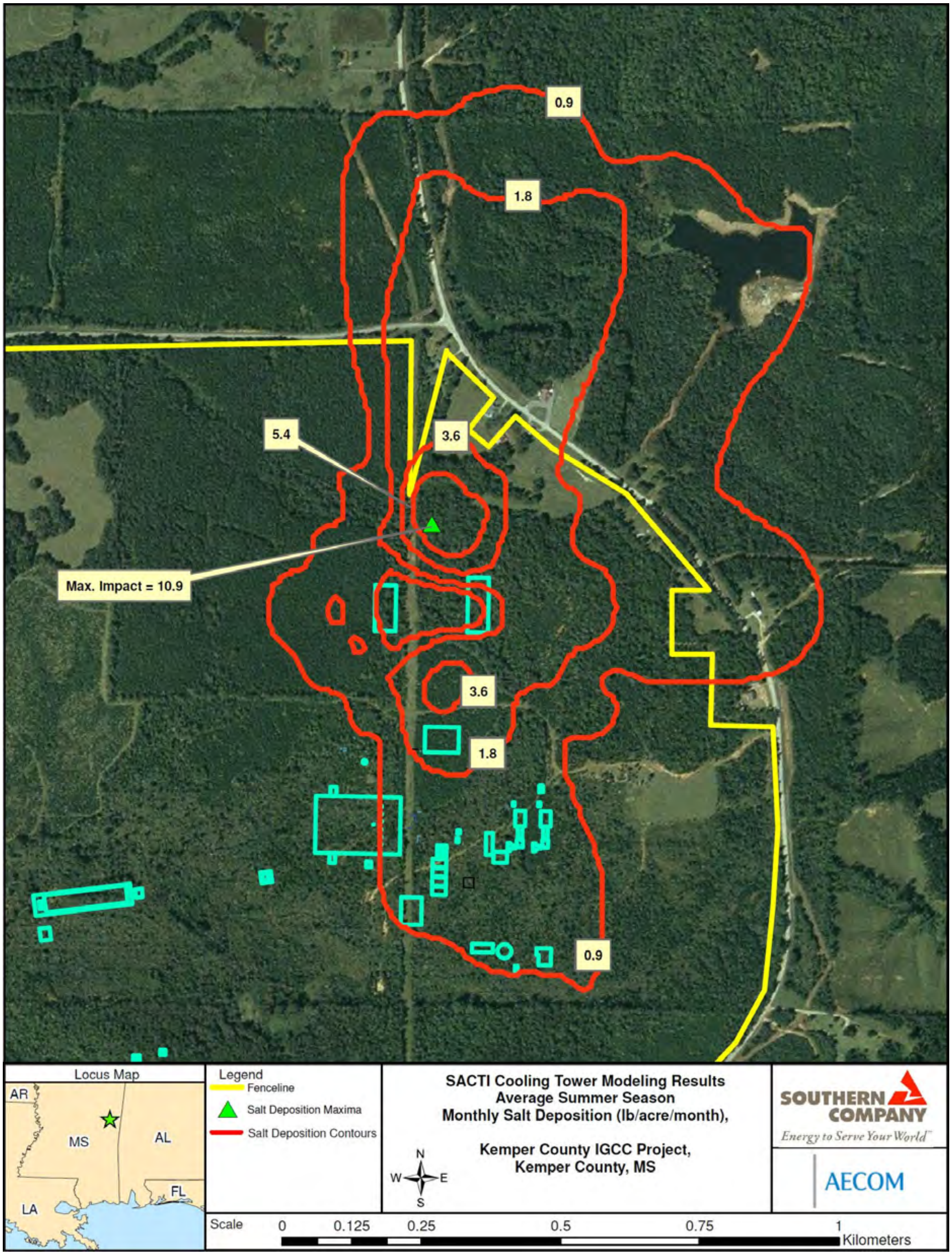


Figure 5: Salt Deposition - Fall

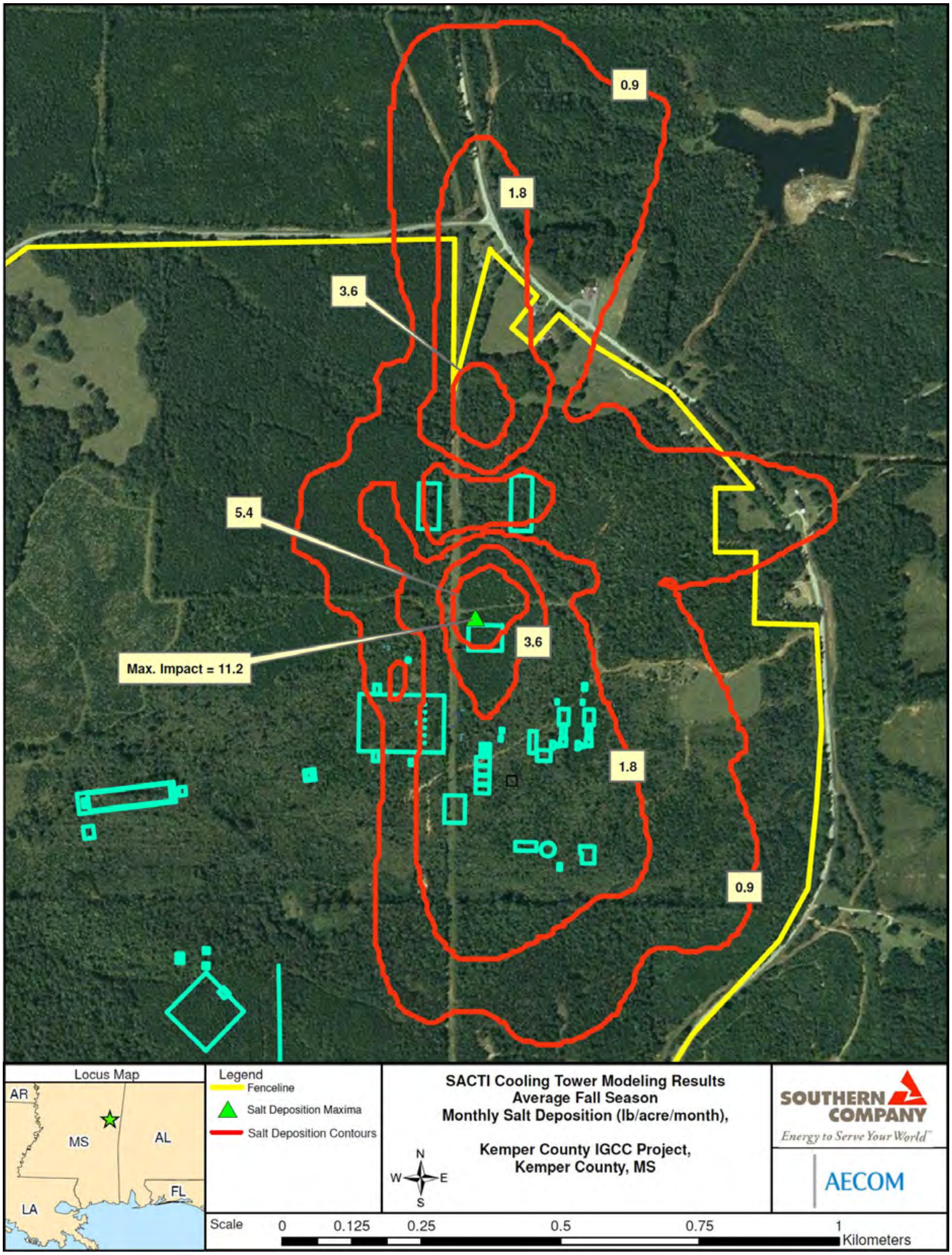


Figure 6: Salt Deposition – April (Worst-case Month)

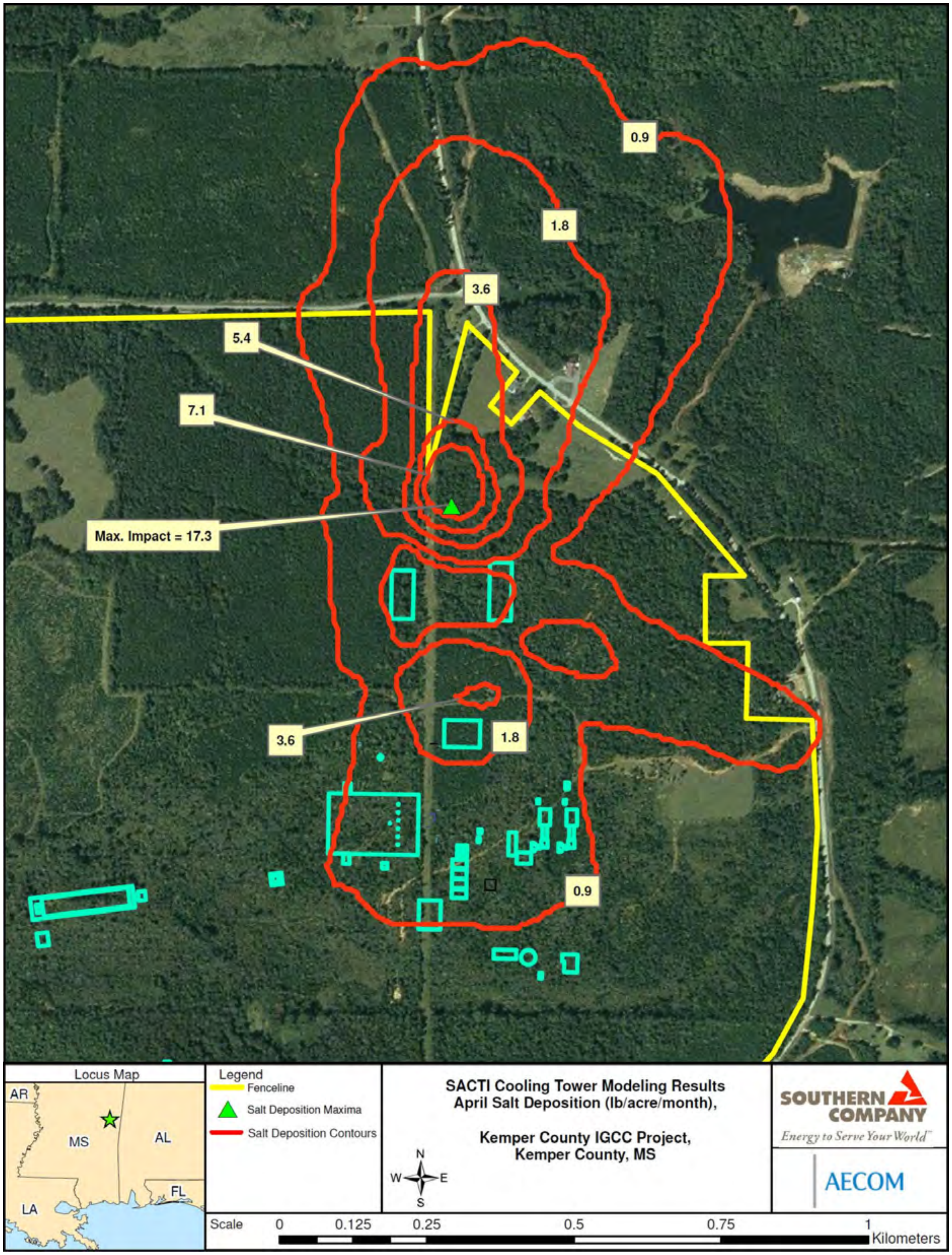
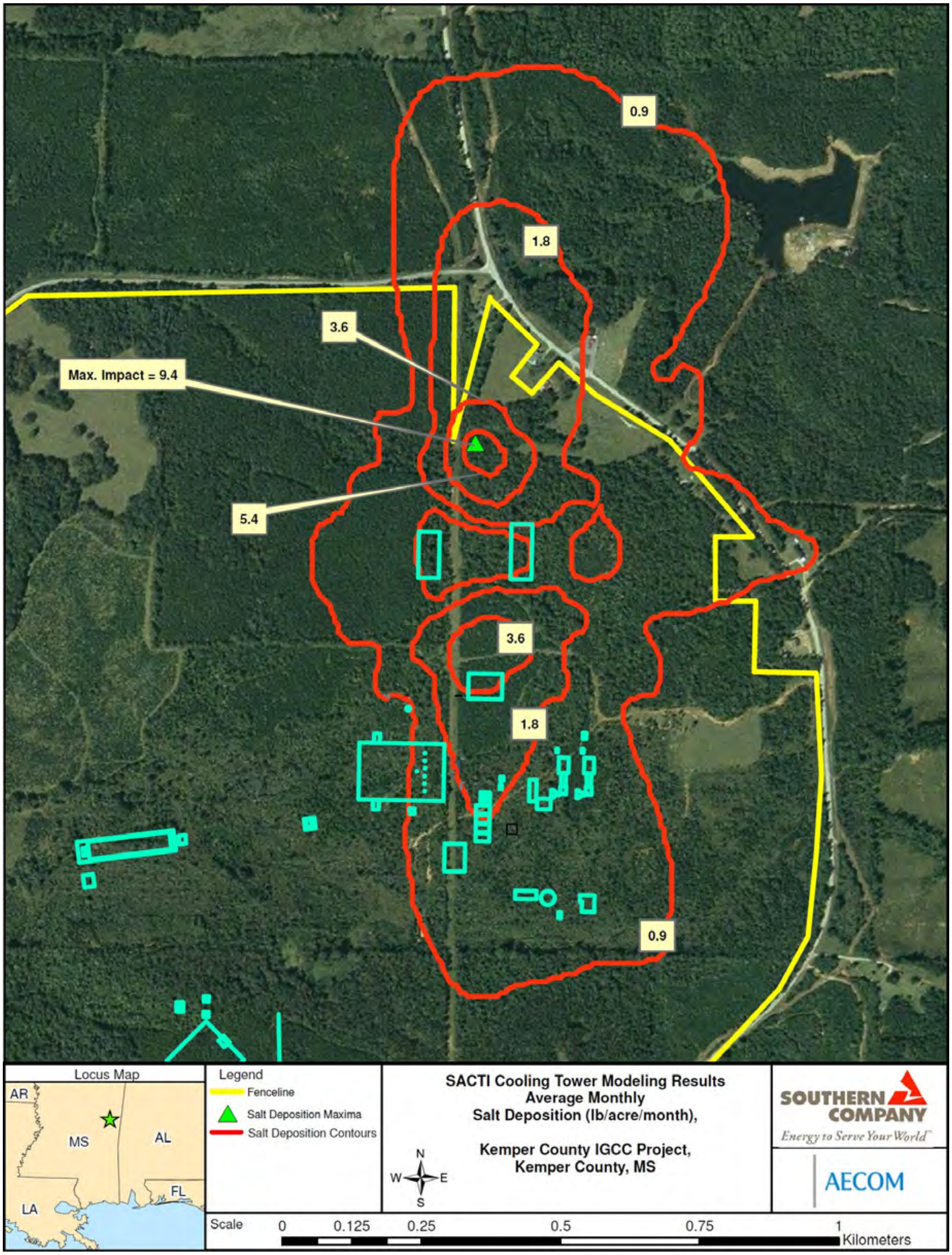


Figure 7: Salt Deposition – Annual (Average All Seasons)



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APPENDIX O

KEMPER COUNTY IGCC PROJECT GROUND WATER WITHDRAWAL IMPACT ASSESSMENT

KEMPER COUNTY IGCC PROJECT

DESCRIPTION OF THE GROUND WATER FLOW MODEL SIMULATIONS

Prepared by:

ECT

Environmental Consulting & Technology, Inc.
115A West Main Street
Benton Harbor, Michigan 49022

ECT No. 080295-0700

June 2009

KEMPER COUNTY IGCC PROJECT
DESCRIPTION OF THE GROUND WATER FLOW MODEL SIMULATIONS

Mississippi Power Company (Mississippi Power) plans to obtain water for use at the Kemper County Integrated Gasification Combined-Cycle (IGCC) Project power plant primarily from two Meridian, Mississippi, publicly owned treatment works (POTWs). Up to 1 million gallons per day (MGD) of ground water withdrawn from deep onsite wells might also be used on an as-needed basis. As an alternative, the use of ground water to fully supply the water requirements for the proposed IGCC facility was also considered.

Ground water flow modeling was performed by Environmental Consulting & Technology, Inc. (ECT), to facilitate evaluation of potential impacts from the withdrawal of 1 MGD of ground water from the Massive Sand aquifer for a backup well field. Two wells withdrawing at a rate of 0.5 MGD each were simulated in cells R182 C92 and R183 C92 of the model. An alternative simulation, in which cooling water was obtained from a primary well field withdrawing ground water at a rate of 6.5 MGD, was also completed. In this alternative case, two wells withdrawing at a rate of 3.25 MGD each were simulated in cells R182 C92 and R183 C92 of the model.

The quasi three-dimensional Modular Three-Dimensional Finite Difference Ground Water Flow Model (MODFLOW) developed at the U.S. Geological Survey (USGS) by McDonald and Harbaugh (1988, 1996) was applied for this ground water modeling as presented herein. Ground Water Vistas, a pre- and postprocessing MODFLOW graphical design interface, was used to complete this modeling effort.

MODEL AREA

The ground water flow model was based on a 34,960-square-mile (mi^2) area in northeastern Mississippi modeled by Eric W. Strom of USGS as described in the USGS Water Resources Investigations Report 98-4171 (i.e., the Strom Model). The model includes the extent of aquifers in the Cretaceous- and Paleozoic-age sediments that are used as a source of fresh water. The Strom Model is within the Gulf Coastal Plain physiographic province on the eastern flank of the Mississippi embayment. The main surface water drainage affecting the ground water flow in the area aquifers are the Tombigbee and Black Warrior Rivers along the northeastern edge of the model (Strom, 1998).

HYDROGEOLOGY

The hydrogeology of the site area was conceptualized as a three-dimensional, six-layered system consisting of eight aquifers. The eight aquifers, from youngest to oldest, are the Coffee Sand, Eutaw-McShan, Gordo, Coker, Massive Sand, Lower Cretaceous, Paleozoic Iowa, and Devonian. The Coffee Sand, Eutaw-McShan, and Gordo aquifers are represented in the model by Layers 1, 2 and 3, respectively. The Coker and Iowa aquifers are jointly represented by Layer 4. The Massive Sand and Devonian are both represented by Layer 5 since their lateral boundaries do not coincide. Layer 6 represents the lower Cretaceous. Strom's Figure 18 (Strom, 1998) depicts a map illustrating the areal extent and overlap of the fresh water aquifers in the modeled area. (Referenced copies of the Strom Model report figures are presented in Appendix A of this report.)

Geologic and hydrogeologic data used by Strom to create the model was obtained from more than 600 borehole geophysical logs and drillers' logs combined with other published stratigraphic information (Strom, 1998). Hydraulic data in the Strom Model was based on the analyses of borehole geophysical and lithologic logs of water wells, test holes, and aquifer tests. Figure 1 depicts a generalized hydrogeologic cross-section representative of the model area. The sediments include gravel, sand, clay, chalk, and marl of fluvial-deltaic, continental, and marine shelf origins. Cretaceous sediments generally dip toward the axis of the Mississippi embayment at the rate of 40 feet per mile (ft/mi), while the Paleozoic sediments dip toward the south-southwest at rates ranging from 25 to 50 ft/mi. The thickness of these sediments also tends to increase in the down dip directions (*ibid.*).

COFFEE SAND AQUIFER—LAYER 1

The Coffee Sand aquifer outcrops in northeastern Mississippi and eastern Tennessee (Figure 6, Strom, 1998) and is composed of fine- to medium-grained, calcareous to glauconitic sand with lenses of silty sand and clay. Well logs indicate that the Coffee Sand

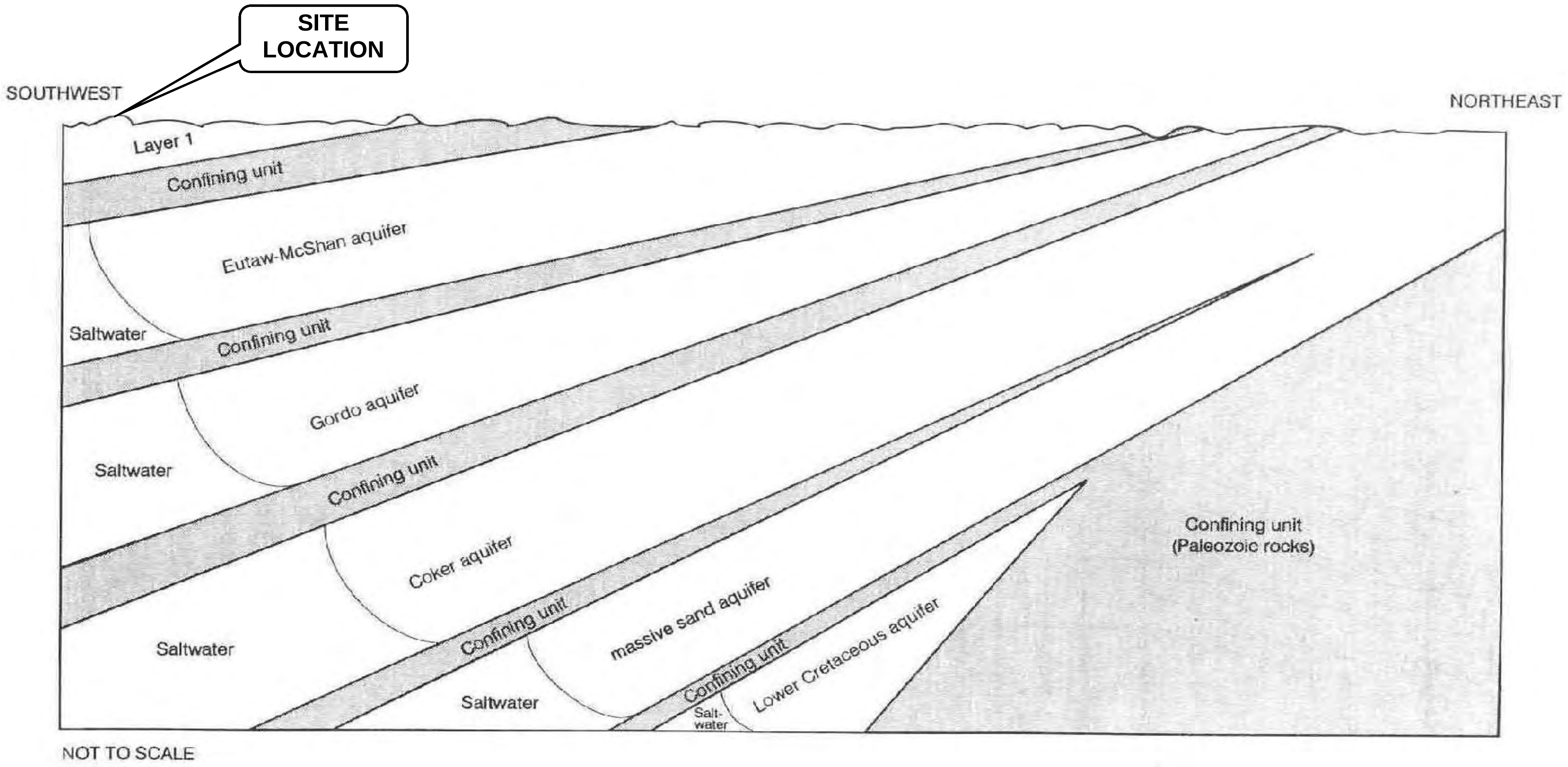

FIGURE 1.

HYDROGEOLOGIC CROSS-SECTION SCHEMATIC

Source: Strom and Mallory, 1995.

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ranges in thickness from 1 foot (ft) near the eastern outcrop to more than 200 ft in the western model area.

Horizontal hydraulic conductivity ranges from 10 to 40 feet per day (ft/day). Recharge to the aquifer results primarily from precipitation in the outcrop area. A thick overlying chalk layer confines the aquifer (Strom, 1998).

EUTAW-MCSHAN AQUIFER—LAYER 2

The Eutaw and McShan are considered a single aquifer because the sands are hydraulically connected. This aquifer outcrops in northeastern Mississippi and northwestern Alabama. The upper portions of the aquifer are finer grained and contain a high silt content. The lower portions of the aquifer consist of thin beds of glauconitic sand. Sand thickness ranges from 1 ft in the eastern outcrop area to more than 300 ft to the southwest (Figure 7, Strom, 1998). Data collected from the onsite test well (Earth Science & Environmental Engineering [ES&EE], 2007) indicate that the Eutaw-McShan aquifer and confining unit are 360 ft thick at the site with a total sand thickness of 150 ft.

Strom reports an average horizontal hydraulic conductivity of 12 ft/day was used in the model based on 50 aquifer tests. Recharge to the aquifer is primarily due to precipitation in the outcrop area. The Eutaw-McShan is separated from the overlying Coffee Sand by the Mooreville Chalk to the south. Where the chalk is absent to the north, the Eutaw-McShan is in contact with the Coffee Sand. However, the fine sediments of the upper portion of the Eutaw-McShan function as an aquitard, hydraulically separating it from the overlying Coffee Sand (Strom, 1998). Model transmissivity at the site location ranges between 1,924 and 1,982 square feet per day (ft^2/day).

GORDO AQUIFER—LAYER 3

The Gordo aquifer outcrops in extreme northeastern Mississippi and northwestern Alabama (Figure 8, Strom, 1998). The upper portion of the aquifer is interbedded sand and clay, while the lower sections are composed of coarse-grained quartz sand and chert gravel (Strom, 1998). Total sand thickness based on well log data ranges from 1 ft in the eastern outcrop area to approximately 300 ft to the west (Figure 8, Strom, 1998). Recent data collected from the onsite ES&EE test well indicate that the Gordo aquifer and confining unit are 470 ft thick at the site with a total sand thickness of 230 ft.

The average hydraulic conductivity defined in the Strom Model is 48 ft/day. This value was reportedly based on 33 aquifer tests. The Gordo aquifer receives recharge from precipitation in the outcrop area. Recharge has also been reported from the overlying and underlying aquifers according to Strom. The Gordo also is believed to discharge to topographic lows in the outcrop, the Coker in the updip area and the Eutaw-McShan in portions of the down-dip area. A clay and silt layer (up to 175 ft thick in the southernmost area of the model) separates the Gordo from the overlying Eutaw-McShan aquifer. (Strom, 1998).

COKER AQUIFER—LAYER 4

The Coker aquifer does not outcrop in Mississippi, but does outcrop in northwestern Alabama (Figure 9, Strom, 1998). The Coker consists of interbedded gray shale and lenticular beds of fine- to medium-grained sand. Strom reports that the total thickness of the Coker aquifer based on well log data ranges from 1 ft in the outcrop area to more than 300 ft in the western portion of the model area. Data collected from the ES&EE onsite test well indicate that the Coker aquifer and confining unit are 520 ft thick at the site with a total sand thickness of 120 ft. Model transmissivity at the site location in the Coker aquifer ranges between 6,990 and 7,120 ft^2/day.

Recharge to the Coker enters the aquifer from precipitation in the outcrop and from ground water seepage from the overlying and underlying aquifers. The Coker may discharge ground water to the Gordo in the down-dip area and to the massive sand in the updip area. A clay and silt layer, up to 175 ft thick in the west, acts as an aquitard between the Coker and the overlying Gordo aquifer.

MASSIVE SAND AQUIFER—LAYER 5

The Massive Sand of the Tuscaloosa Group (Upper Cretaceous) has been selected as a source of nonpotable water for the backup water supply for the facility. The Massive Sand aquifer does not outcrop and is reported to be in contact with the Coker in the easternmost areas of the model (Figure 10, Strom, 1998). A clay confining unit appears between the Coker and Massive Sand aquifers to the west that hydraulically separates the aquifers. The Massive Sand consists of nonmarine medium- to coarse-grained, brown to white sand with a lower zone of chert and quartz pea gravel. Sand thickness reported by Strom based on well log data ranges from 1 ft in the eastern portion of the model to more than 300 ft to the south. Data collected from the ES&EE onsite test well indicate that the Massive Sand aquifer and confining unit are 290 ft thick at the site with a total sand thickness of 260 ft.

A horizontal hydraulic conductivity of 60 ft/day was used for the Massive Sand aquifer in the down-dip portion of the model and approximately 120 ft/day in the up-dip areas (Strom, 1998).

Aquifer testing in the upper portion of the Massive Sand aquifer was performed by ES&EE at the power plant site. The test well has an 80-ft screen interval set from 3,362 to 3,442 feet below land surface (ft bls). Step drawdown and constant rate aquifer pumping tests were conducted in this well. The constant rate aquifer test was performed for 48 hours at a pumping rate of 800 gallons per minute (gpm). A transmissivity estimate of 2,900 ft^2/day was derived using the Hantush and Jacob (1955) analytical method. In addition, the results of the step drawdown test analysis yielded a transmissivity estimate of 4,400 ft^2/day using the Hantush (1962) analytical method (ES&EE, personal communication, October 2008). These transmissivity results are reflective of the upper 80 ft of the Massive Sand aquifer, whereas the total thickness of the Massive Sand aquifer is approximately 290 ft at the power plant site.

Using the total Massive Sand thickness of 260 ft, as determined in the test well, and the 60-ft/day horizontal hydraulic conductivity value representative of the entire Massive Sand aquifer used by Strom (1998), an estimated transmissivity of 15,600 ft^2/day is calculated for the site location. The site area was originally defined in the Strom Model as no-flow cells. Therefore, transmissivity values for the extended Massive Sand area were defined based on transmissivity information published in Strom and Mallory, 1995, and the ES&EE onsite well tests. Slightly conservative transmissivity values of 15,200 and

15,300 ft^2/day were assigned to the model cells representing the location of the proposed withdrawal wells.

LOWER CRETACEOUS AQUIFER—LAYER 6

The Lower Cretaceous aquifer does not outcrop in the model area. The aquifer pinches out toward the northeast and thickens toward the southeast (Figure 11, Strom, 1998). The Lower Cretaceous aquifer consists of shale, clay, sand, gravel, and calcareous sediments. Aquifer thickness based on well log data ranges from 1 ft in the northeast to more than 1,000 ft to the southwest (Figure 11, Strom 1998). The total thickness of the Lower Cretaceous at the site location is approximately 1,500 ft with a total sand thickness of 1,000 ft.

The Lower Cretaceous aquifer is believed to have similar hydraulic properties as the Massive Sand. An average hydraulic conductivity of 125 ft/day is estimated by Strom. The model cells corresponding to the site location are defined as no-flow cells in the Lower Cretaceous (Layer 6). Model transmissivity in this layer increases going southwestward from the outcrop area and ranges between 94,510 to 104,800 ft^2/day at the edge of the active model cells to the northeast of the site.

The Lower Cretaceous likely receives recharge from the Massive Sand aquifer in the up-dip area and discharges to the Massive Sand aquifer down-dip. A confining unit consisting of clay and silt up to 150 ft in the south has been identified above the Lower Cretaceous aquifer (Strom, 1998).

PALEOZOIC AQUIFER

For descriptions of the Iowa and Devonian aquifers, which are located in the northernmost portion of the model area, refer to Strom (1998).

MODEL GRID DESIGN

The Strom Model covers 34,960 mi^2 primarily in northeastern Mississippi but includes portions of northwestern Alabama, southwestern Tennessee, and eastern Alabama. The grid is oriented north-south with a 5,280- by 5,280-ft grid spacing. The lateral anisotropy used in the simulation was one. Each of the six grid layers consists of 230 rows and 152 columns (Figure 17, Strom, 1998).

GROUND WATER FLOW MODEL

ECT obtained a copy of the original Strom Model MODFLOW files that were used as the base for an *expanded* model. The original 1998 model files were imported into the ground water modeling software program Ground Water Vistas, where the simulations were run using the 1988/1996 version of MODFLOW.

The Strom Model is a transient model constructed with six layers, with each layer representing a regional aquifer as follows:

- Layer 1 is the Coffee Sand aquifer.
- Layer 2 is the Eutaw-McShan aquifer.
- Layer 3 is the Gordo aquifer.
- Layer 4 is the Coker aquifer.
- Layer 5 is the Massive Sand aquifer.
- Layer 6 is the Lower Cretaceous aquifer.

In the extreme northeastern corner of Mississippi, Layers 4 and 5 represent the Iowa aquifer and the Devonian aquifer, respectively; the Coker and Massive Sand aquifers do not extend to that area. Figure 18 (Strom, 1998) from Strom's report illustrates the overlapping nature of the aquifer layers.

There is a thick, impermeable sequence comprising the Selma Group above Layer 1, the Coffee Sand aquifer; therefore, the area overlying the Coffee Sand was simulated as no-flow (black cell boundary color). Layer 1 does represent the Coffee Sand in the northern portions of the model but is also used as an upper constant head boundary (dark blue cell boundary color) for the Eutaw-McShan aquifer (Layer 2). The constant heads in this area represent the surficial water levels on the chalk and clay overlying the Eutaw-McShan. However, vertical flow is limited due to the low vertical hydraulic conductivity of the confining unit (Strom, 1998).

The boundaries for each subsequent aquifer/model layer are defined by both the depositional or erosional extent of the aquifer and by the location of the freshwater-saltwater interface in the aquifer, which is defined by Strom as a total dissolved solids (TDS) concentration of 10,000 milligrams per liter (mg/L). The freshwater-saltwater interface represents no-flow lateral boundaries in the Strom Model for all of the aquifers/layers; all model cells located beyond the boundary are defined as no-flow boundaries and therefore are *inactive*. However, the proposed well field for the power plant is located approximately 4 miles south of (beyond) the published freshwater-saltwater boundary for the Massive Sand aquifer (Layer 5) and is thus situated in an inactive portion of Layer 5. Therefore, for the *extended* model boundaries, it was necessary to modify the Strom Model in only one way: Layer 5 (the Massive Sand aquifer) was extended further to the southwest, as shown in Figure 2. Representative values for transmissivity, as noted previously, were also defined for the extended Massive Sand aquifer area. No other changes were made to model boundaries or cell input parameters relative to the Strom Model in the initial expanded simulation.

Strom’s calibrated transient model includes pumping stresses for numerous wells from 1900 through 1995, which is the last year modeled by Strom. The extended model continues the 1995 pumping stresses forward in time (1996 through 2010) and then adds a constant 1-MGD ground water withdrawal from the Massive Sand aquifer equally split between two wells pumping at a rate of 66,850 cubic feet per day (ft^3/day) at the power plant site for a 40-year period, while continuing the 1995 withdrawal rates at the numerous other wells (per Strom’s model). As such, the expanded model was used to simulate the effects of the proposed 1-MGD ground water withdrawal over the projected 40-year life of the facility. All wells are entered into the models as cells representing well boundary conditions (red cell boundary).

RECHARGE

Based on reports from the National Oceanic and Atmospheric Administration (NOAA) included in the Strom (1998) report, the area of northeastern Mississippi can receive an average of 52 inches of precipitation in the outcrop areas along the northeastern sections

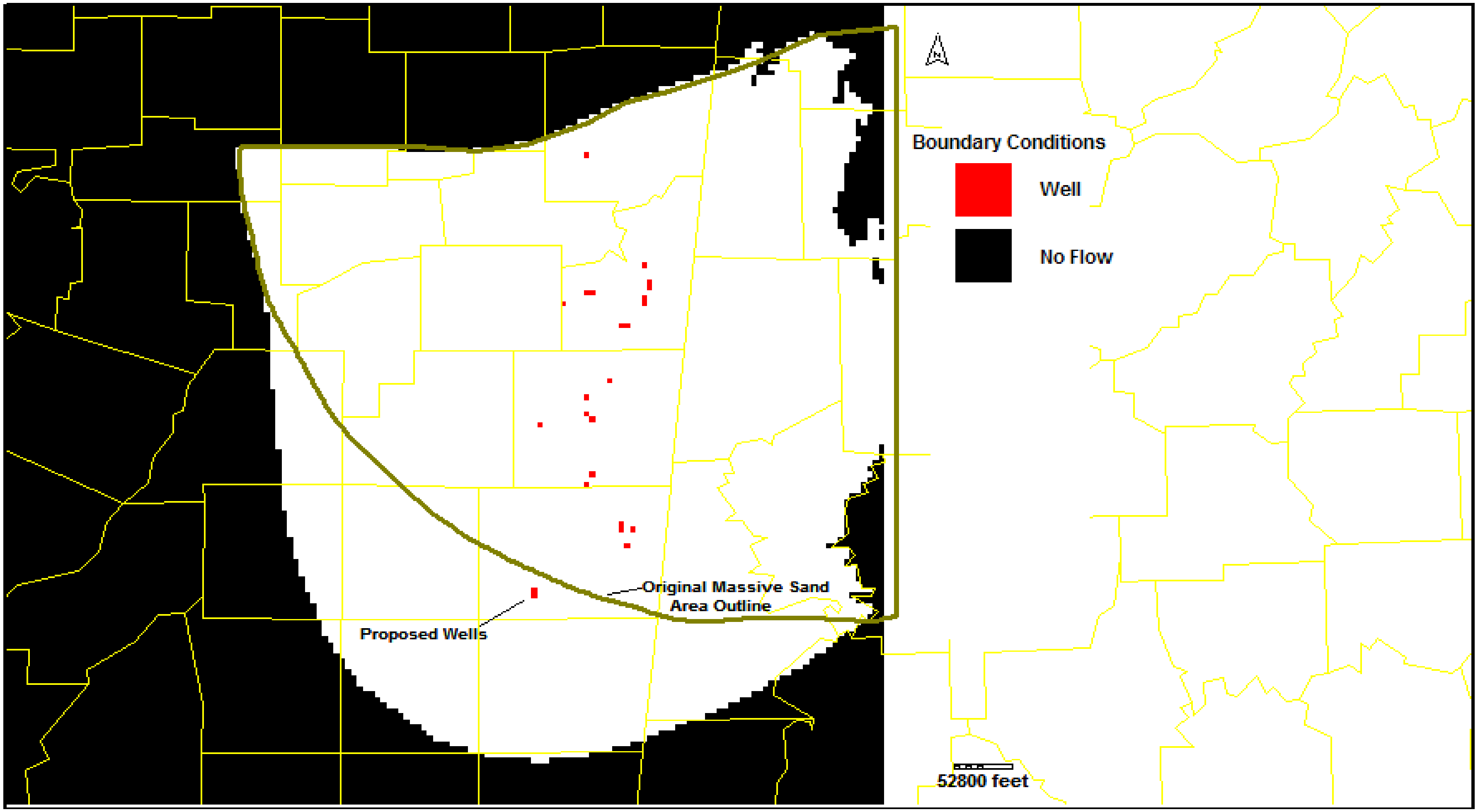

FIGURE 2.

MASSIVE SAND (LAYER 5) ACTIVE CELL EXTENSION TOWARD SW OVER SITE PROPOSED WELLS LOCATED SW OF SALTWATER-FRESHWATER BOUNDARY

Sources: Strom, 1998. ECT, 2009.

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of the Strom Model. The Strom Model simulates the intermediate and regional scale flow. The outcrop areas of the Coffee Sand, Eutaw-McShan, Gordo, and Coker aquifers were simulated with head-dependant flux boundaries (green cell boundary) using the river package in MODFLOW. Strom reports that the large base flows observed in even the small streams in the outcrop area indicate that recharge from precipitation-rich environment is sufficient to provide all the recharge that the aquifers can accept and much of the recharge is redirected as runoff.

STROM MODEL PARAMETERS AND CALIBRATION

The Strom Model calibration was based on transient conditions because of the lack of water level data in the predevelopment stage. Initial transmissivity grids were created by multiplying sand thickness data from well logs information with hydraulic conductivity data collected from aquifer tests. The Strom Model initial transmissivity grids were modified within a range of expected values during model calibration. Contour maps for the transmissivity values used in the Strom Model are illustrated on Strom's Figures 20 through 24 (Strom, 1998). Contour maps of the confining unit thickness are illustrated on Strom's Figures 27 through 31 (*ibid.*). A constant storage coefficient of 0.0001 was used for all aquifers with the exception of the Gordo, which used a constant value of 0.001 to represent the coarser grained material. There was no water level data in the Lower Cretaceous for calibration (*ibid.*).

An examination of the original Strom Model files indicated that the leakance value between the each confining unit and underlying aquifer was defined as 5.0×10^{-9} in the vicinity of the site location. As defined, the leakance values are two orders of magnitude lower than defined in an earlier model completed in the same area (Strom and Mallory, 1995) with the exception of the leakance between the Coffee Sand confining unit and the underlying Eutaw-McShan. As noted previously, the only changes made to the Strom Model were associated with the extension of the active cell area toward the southwest in the Massive Sand aquifer (Layer 5). However, an additional 1.0-MGD test simulation was run to check the sensitivity of the drawdown predictions to the leakance values. For the test simulation, the Strom Model leakance values in the vicinity of the site were revised from 5.0×10^{-9} in Layers 2, 3, 4, and 5 to 2.0×10^{-7}, 1.0×10^{-7}, 3.0×10^{-7}, 5.0×10^{-7}, respectively.

MODEL RESULTS

The 1.0-MGD model was first run without the addition of the two proposed pumping wells. Wells withdrawing at a rate of 0.5 MGD each were added in model cells R182 C92 and R183 C92, and the simulation was rerun. Drawdown was then computed by subtracting the head data from the initial simulation from the head data generated from the second simulation containing the proposed well withdrawals. The resulting drawdown after 40 years of pumping was contoured.

Figure 3 depicts the potentiometric surface drawdown estimated in the Massive Sand aquifer after 40 years of constantly pumping at the 1-MGD rate. The estimated drawdowns are widespread, yet of a low magnitude. The expanded model estimates approximately 6 ft of drawdown at the nearest existing user of the Massive Sand aquifer, which is located approximately 9.5 miles northeast of the proposed power plant in the town of De Kalb. The Mississippi Department of Environmental Quality (MDEQ) water well database (MDEQ, August 2008) suggests that several wells using the Massive Sand aquifer exist near the towns of Electric Mills and Scooba. Those wells are located approximately 21 to 22 miles east-northeast of the power plant site, and less than 5 ft of drawdown is predicted in the Massive Sand (Layer 5) at those well locations. These estimated drawdowns (6 ft or less) are not expected to cause any adverse impact to existing users of the water from the Massive Sand aquifer.

Smaller drawdowns would occur in the underlying and overlying aquifers. The expanded model estimated maximum drawdowns are 3.5 ft or less drawdown in the underlying Lower Cretaceous aquifer (Layer 6) as shown on Figure 4. Less than 3 ft of drawdown is predicted in the overlying Coker aquifer (Layer 4), as shown on Figure 5. A maximum of 1.5 ft of drawdown is predicted in the Gordo aquifer (Layer 3), with the highest drawdown observed along the western edge of the aquifer (Figure 6). A similar drawdown pattern is displayed for the Eutaw-McShan aquifer (Layer 2), with a maximum of 1.5 ft or less of drawdown (see Figure 7). Less than 1 ft of drawdown is predicted in the

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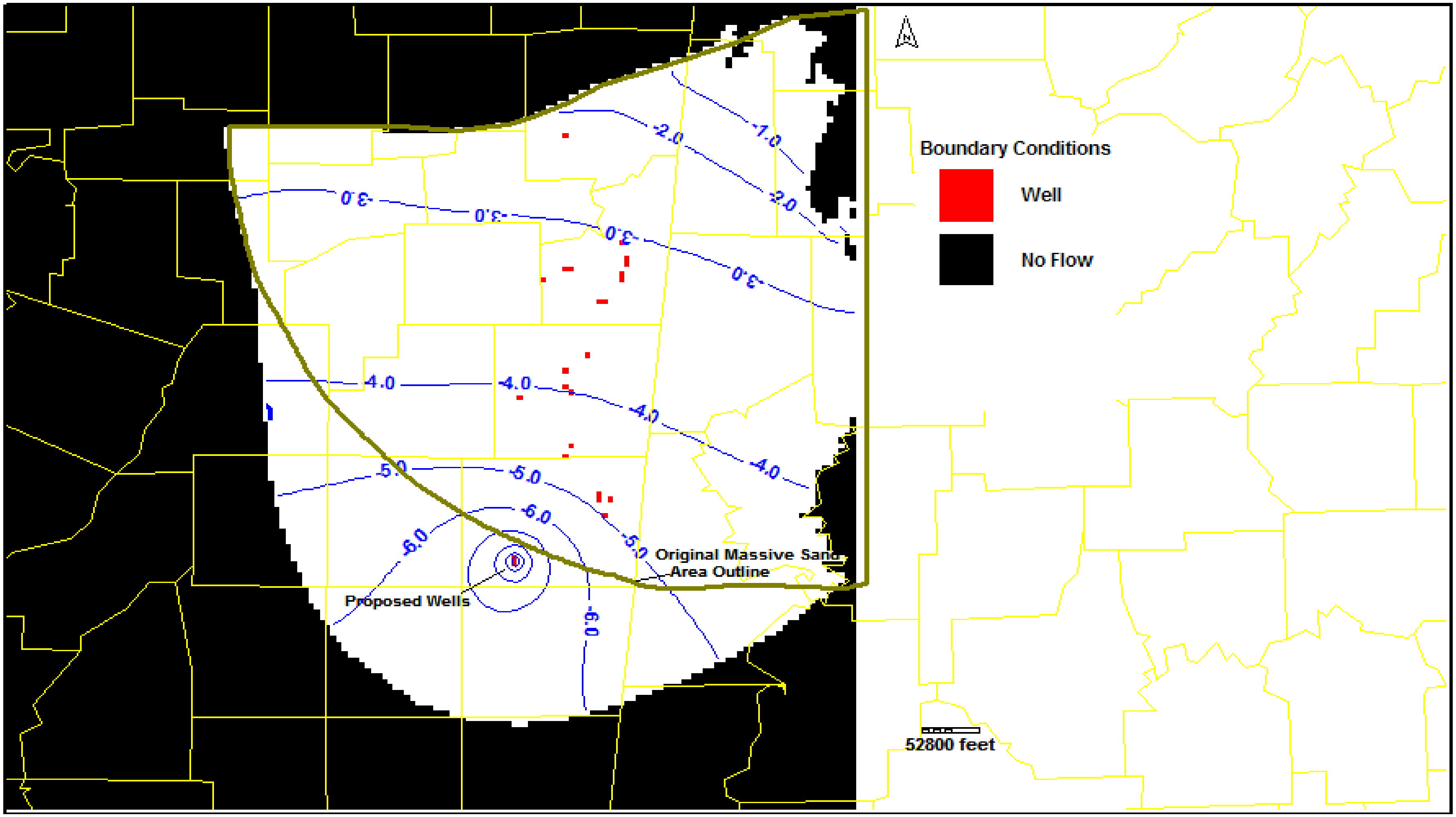

FIGURE 3.

PREDICTED DRAWDOWN IN MASSIVE SAND (LAYER 5) AT END OF 40 YEARS OF PUMPING BASED ON 1.0-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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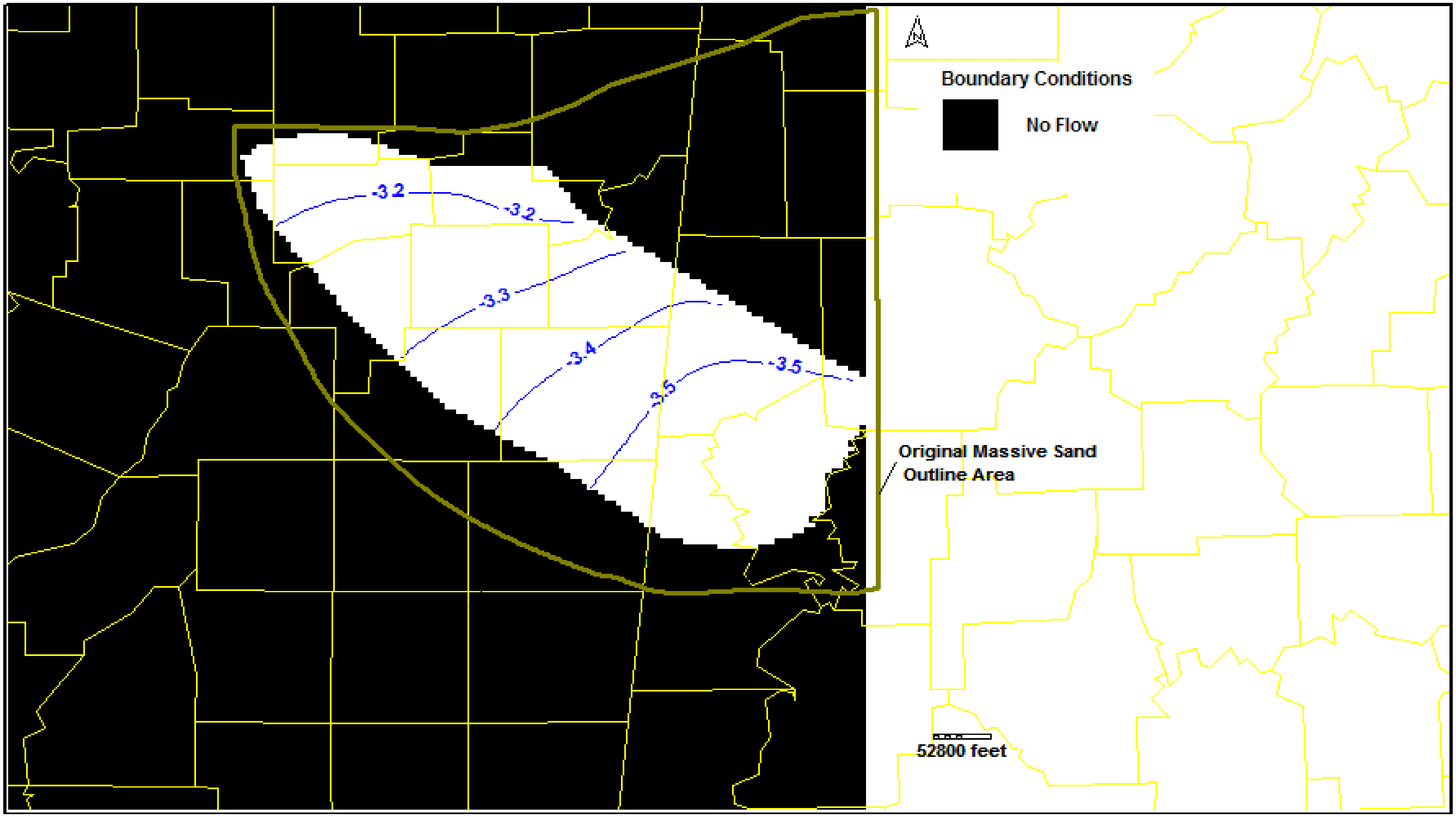

FIGURE 4.

PREDICTED DRAWDOWN IN LOWER CRETACEOUS AT END OF 40 YEARS OF PUMPING BASED ON 1.0-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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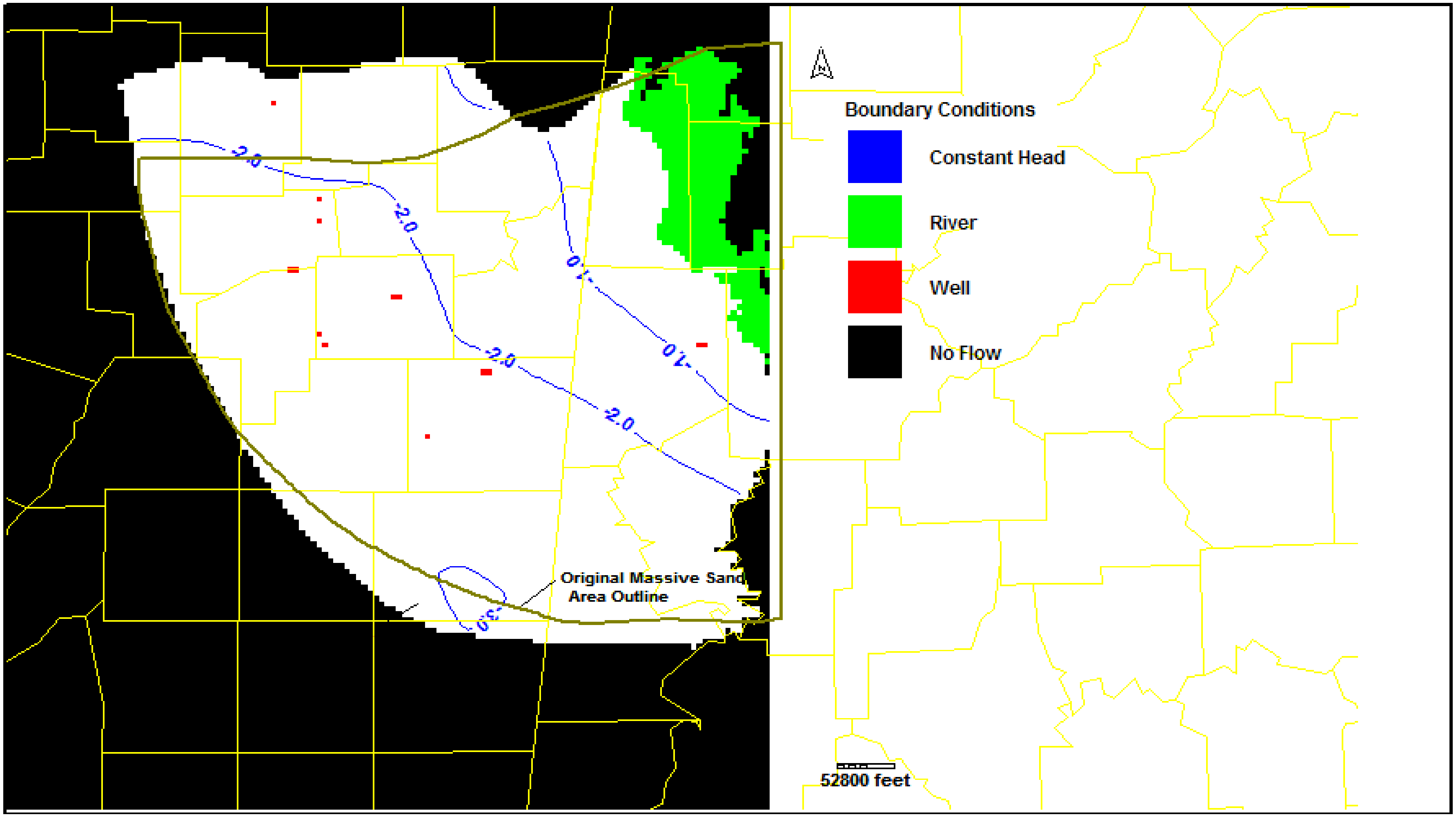

FIGURE 5.

PREDICTED DRAWDOWN IN COKER (LAYER 4) AT END OF 40 YEARS OF PUMPING BASED ON 1.0-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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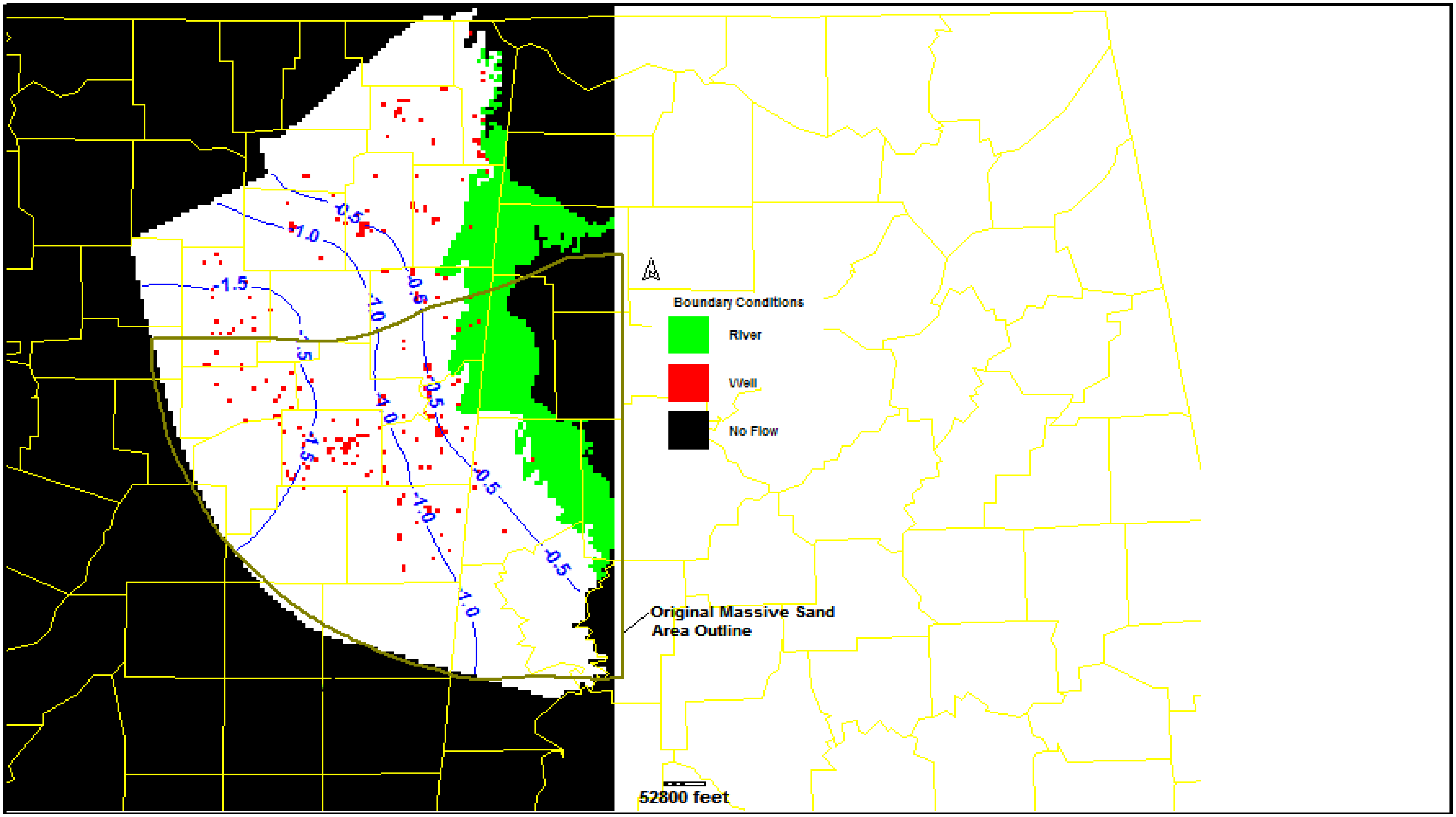

FIGURE 6.

PREDICTED DRAWDOWN IN GORDO (LAYER 3) AT END OF 40 YEARS OF PUMPING BASED ON 1.0-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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Environmental Consulting & Technology, Inc.

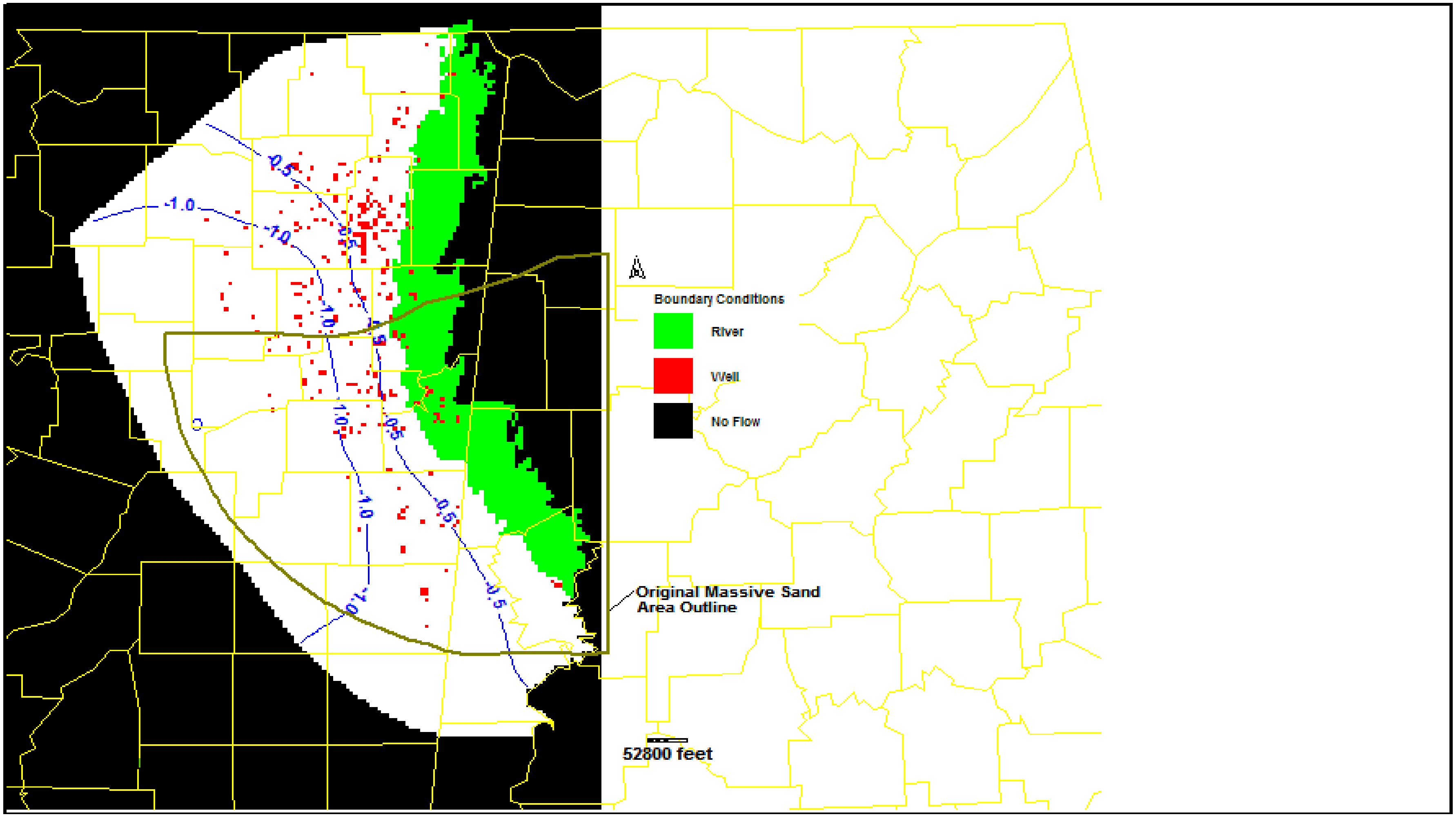

FIGURE 7.

PREDICTED DRAWDOWN IN EUTAW-McSHAN (LAYER 2) AT END OF 40 YEARS OF PUMPING BASED ON 1.0-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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simulation for the upper layer (Layer 1), the Coffee Sand (Figure 8). Generally, there is an increase in drawdown in the Coker, Eutaw-McShan, Gordo, and Coffee aquifers to the southwest, away from the recharge areas in the northeast portion of the model. The MDEQ water well database (MDEQ, August 2008) suggests that, within 20 miles of the proposed power plant site, no existing users of the water are present in the overlying Coker aquifer or the underlying Lower Cretaceous aquifer.

The results of the test simulation, conducted to investigate the sensitivity of the model to the lower leakance values defined in the vicinity of the site, did not indicate any change to the drawdown predicted in the Coffee Sand aquifer, Eutaw-McShan aquifer, or Gordo aquifer (Layers 1, 2, and 3, respectively). A slight decrease of 0.3 ft and 0.1 ft was observed in the Massive Sand aquifer (Layer 5) and the Lower Cretaceous aquifer (Layer 6), respectively. The drawdown changes in the Massive Sand aquifer (Layer 5) were limited to the area immediately adjacent to the proposed well and the southwestern freshwater-saltwater boundary.

Consideration was also given to the potential effects of the proposed withdrawal of 1 MGD on ground water quality. The Massive Sand aquifer at the site is known to be saline (e.g., the TDS concentration is 23,000 mg/L); as such, the site is situated on the saltwater side of the freshwater-saltwater interface as defined by 10,000 mg/L TDS. The estimated drawdowns do not suggest the likelihood for inducing any measurable saltwater migration into freshwater potions of any aquifer.

Based on the modeling assumptions and the fact that the actual ground water withdrawals will be on an as-needed basis, the 1-MGD model drawdown predictions are conservative. Therefore, the modeling results suggest that the withdrawal of 1 MGD of ground water from the Massive Sand aquifer will not cause any adverse impact to existing users of the water from the various underlying and overlying aquifers.

ALTERNATIVE 6.5 MGD SIMULATION

To evaluate the effect of using the well field to supply the entire 6.5-MGD water requirement of the facility, an additional simulation was run keeping all other parameters

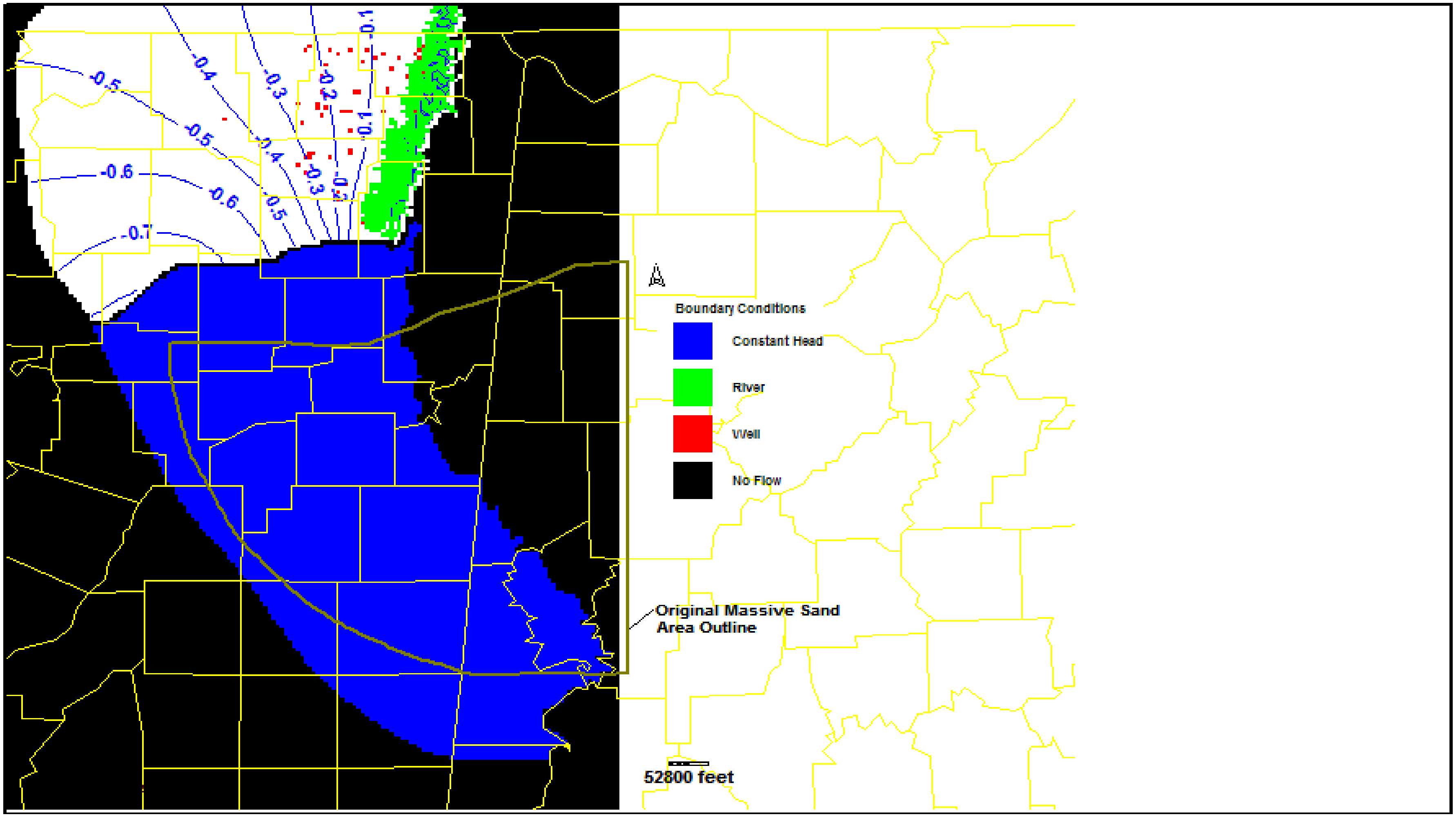

FIGURE 8.

PREDICTED DRAWDOWN IN COFFEE SAND (LAYER 1) AT END OF 40 YEARS OF PUMPING BASED ON 1.0-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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unchanged with the exception of increasing the total withdrawal rate to 6.5 MGD or 434,462 ft^3/day for each well. Drawdown after 40 years of pumping was calculated as described previously and contoured.

Figure 9 depicts the potentiometric surface drawdown predicted in the Massive Sand aquifer (Layer 5) after 40 years of constant pumping at the 6.5-MGD rate. The resulting estimated drawdown in the Massive Sand aquifer were widespread and of relatively high magnitudes. Predicted drawdown in the Massive Sand (Layer 5) after 40 years of constant pumping ranges between 28 to 70 ft in Kemper County, for example. The 6.5-MGD model predicts approximately 40 ft of drawdown at the nearest existing user of the Massive Sand aquifer, which is the town of De Kalb located approximately 9.5 miles northeast of the proposed power plant site. In addition, the 6.5-MGD simulation estimated approximately 31 ft or less of drawdown at the wells located in the towns of Electric Mills and Scooba, located approximately 21 to 22 miles east-northeast of the proposed power plant site. These estimated drawdowns would have the potential to cause adverse impacts to those existing users of the water from the Massive Sand aquifer (Layer 5).

The 6.5-MGD model also estimated widespread and moderate to low amounts of drawdown in the underlying and overlying aquifers. The 6.5-MGD model estimated approximately 20 to 23 ft of drawdown (Figure 10) in the underlying Lower Cretaceous aquifer (Layer 6); however, there are no water wells currently screened in that aquifer in this region, according to the MDEQ database. Approximately 18 to 20 ft of drawdown (Figure 11) was estimated in the overlying Coker aquifer (Layer 4) throughout Kemper County. Currently, there are no water wells screened in the Coker aquifer within at least 20 miles of the proposed power plant site. According to the MDEQ database, the closest well appears to exist approximately 30 miles to the north in Noxubbe County. The model estimated approximately 16 ft of drawdown at that Coker aquifer well location. Maximum drawdown estimates in the shallower Gordo aquifer (Layer 3) were 11 ft or less (Figure 12). Maximum drawdown estimates in the Eutaw-McShan aquifer (Layer 2) were 10 ft or less (Figure 13). Maximum drawdown estimates in the Coffee Sand aquifer (Layer 1) were 5 ft or less (Figure 14).

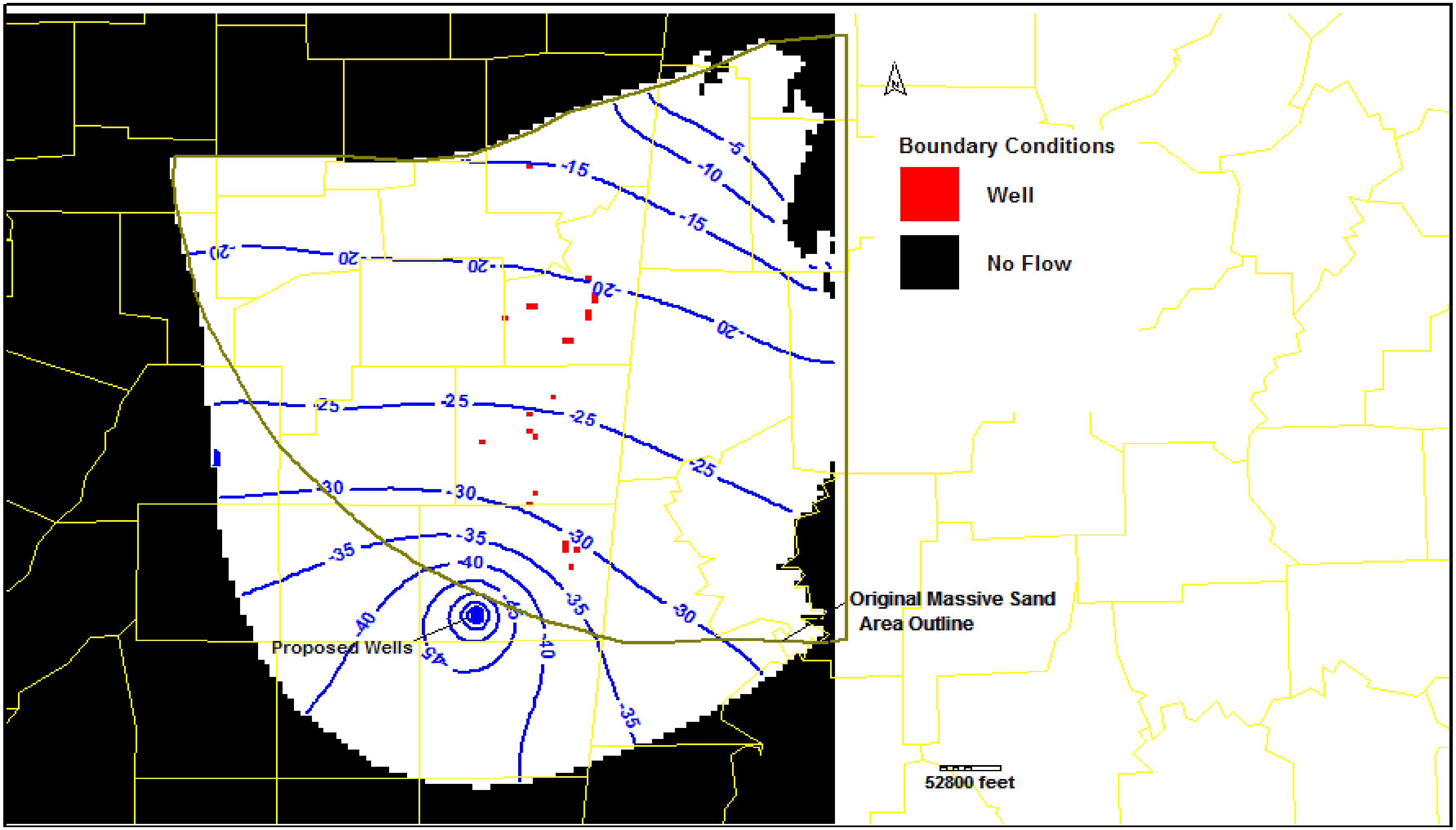

FIGURE 9.

PREDICTED DRAWDOWN IN MASSIVE SAND (LAYER 5) AT END OF 40 YEARS OF PUMPING BASED ON 6.5-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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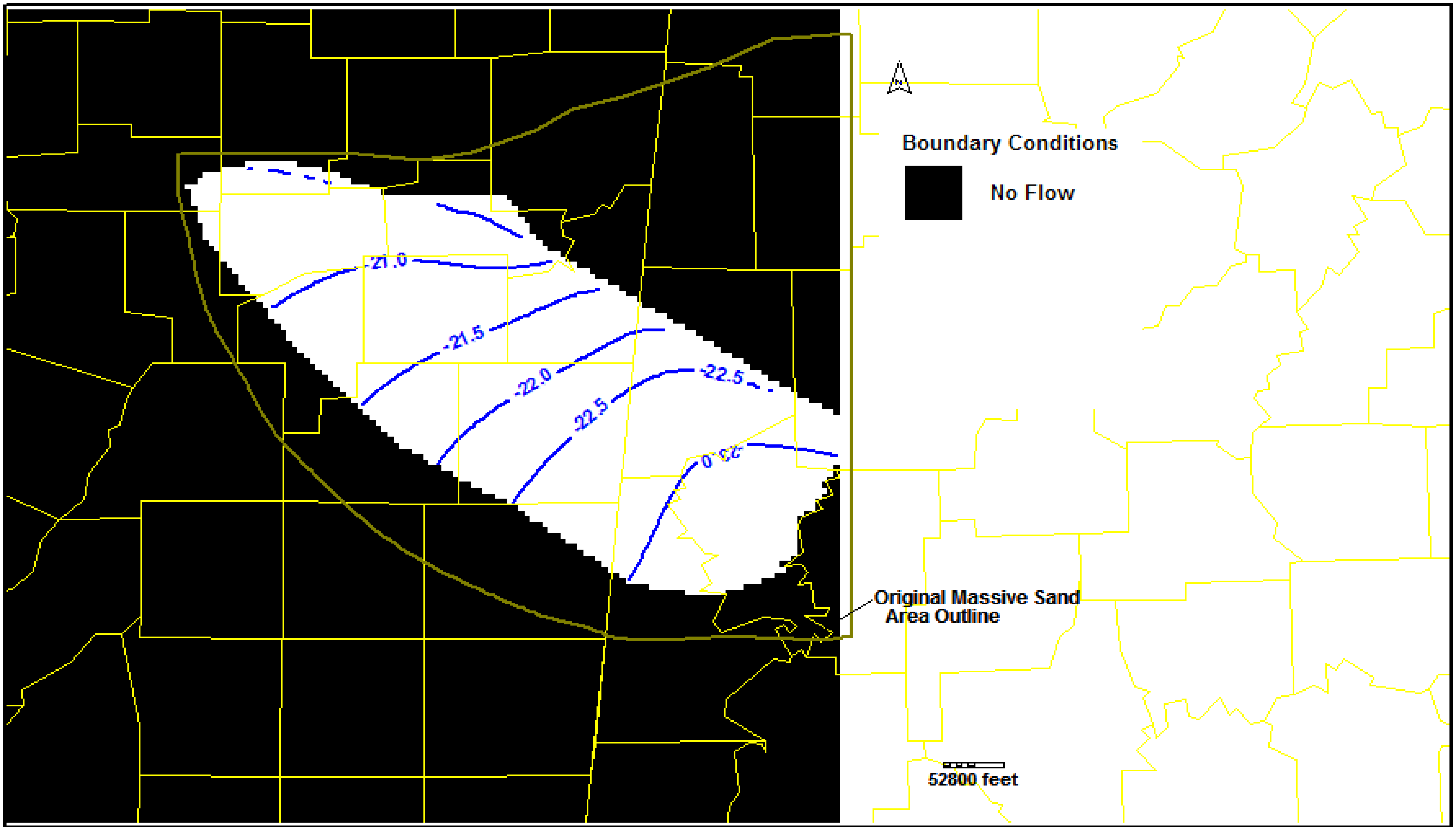

FIGURE 10.

PREDICTED DRAWDOWN IN LOWER CRETACEOUS (LAYER 6) AT END OF 40 YEARS OF PUMPING BASED ON 6.5-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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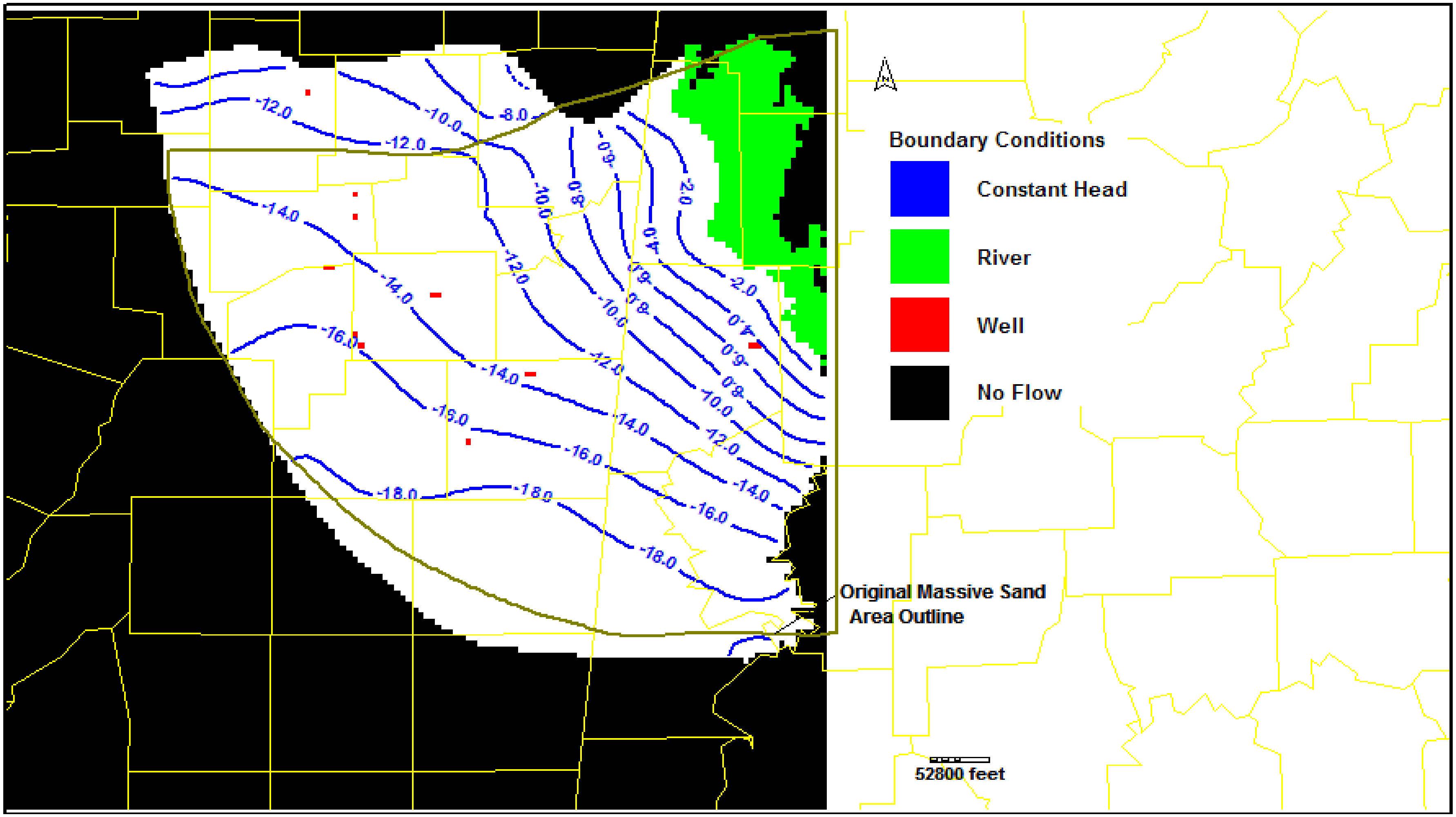

FIGURE 11.

PREDICTED DRAWDOWN IN COKER (LAYER 4) AT END OF 40 YEARS OF PUMPING BASED ON 6.5-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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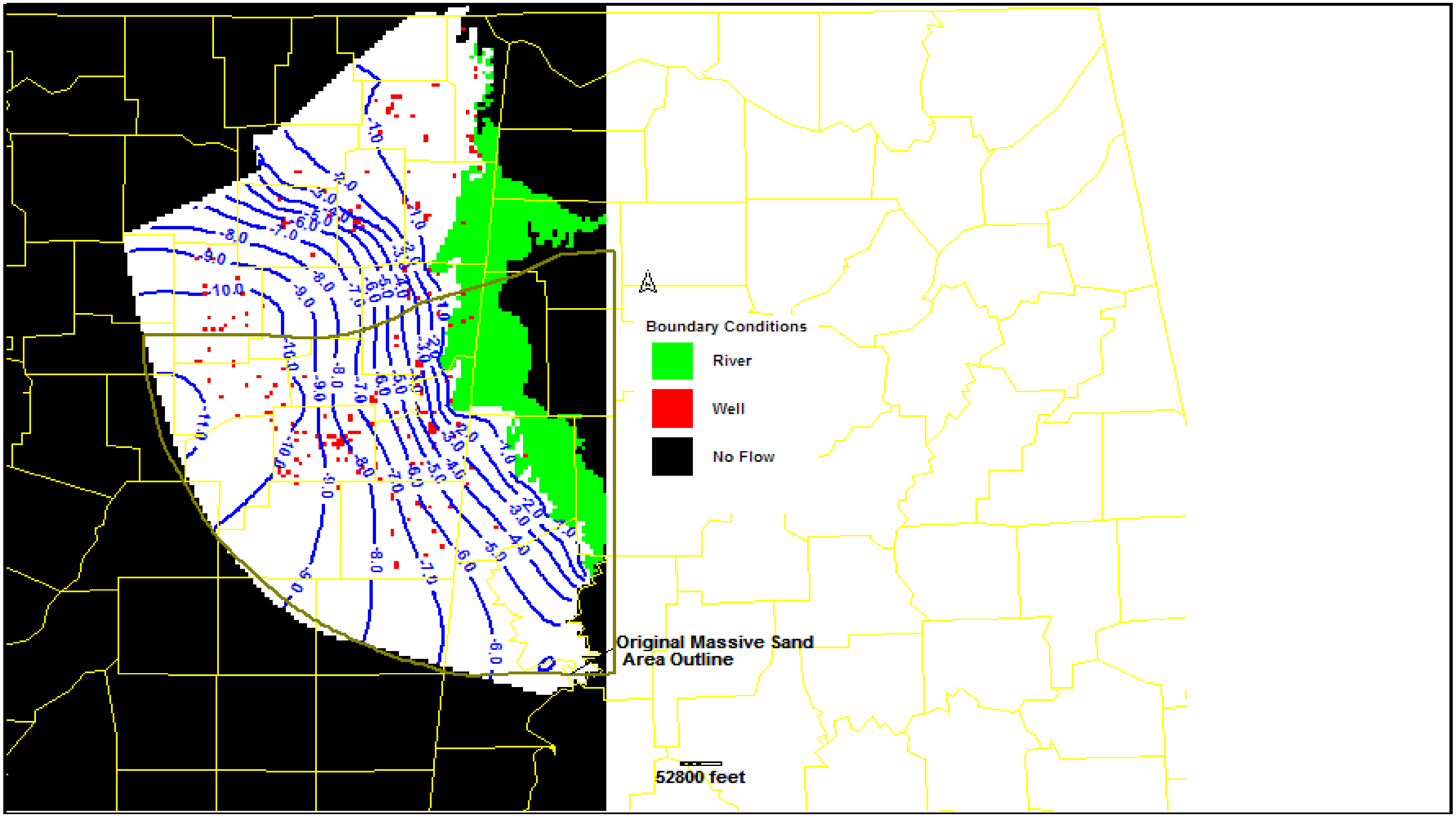

FIGURE 12.

PREDICTED DRAWDOWN IN GORDO (LAYER 3) AT END OF 40 YEARS OF PUMPING BASED ON 6.5-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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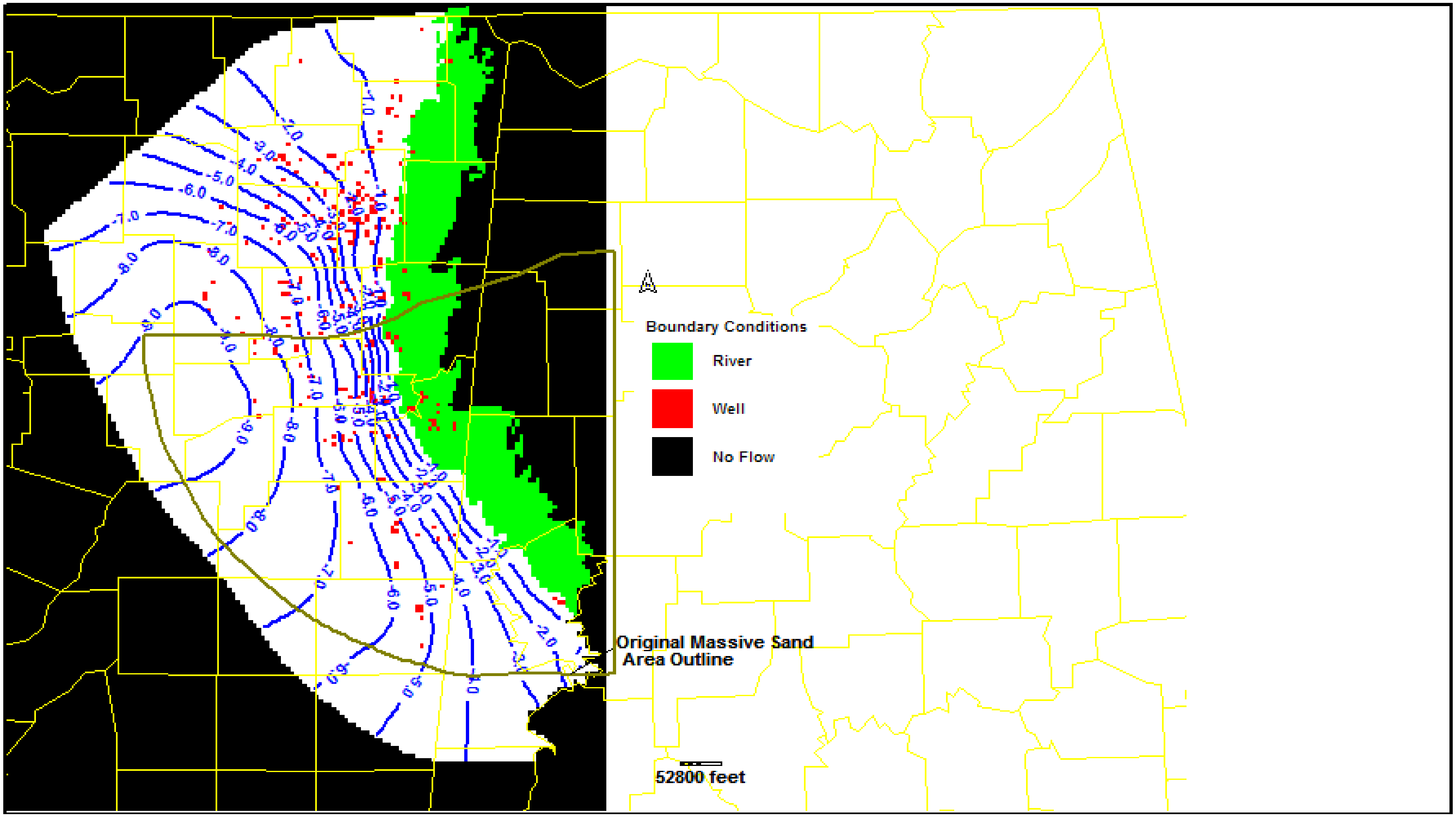

FIGURE 13.

PREDICTED DRAWDOWN IN EUTAW-McSHAN (LAYER 2) AT END OF 40 YEARS OF PUMPING BASED ON 6.5-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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Environmental Consulting & Technology, Inc.

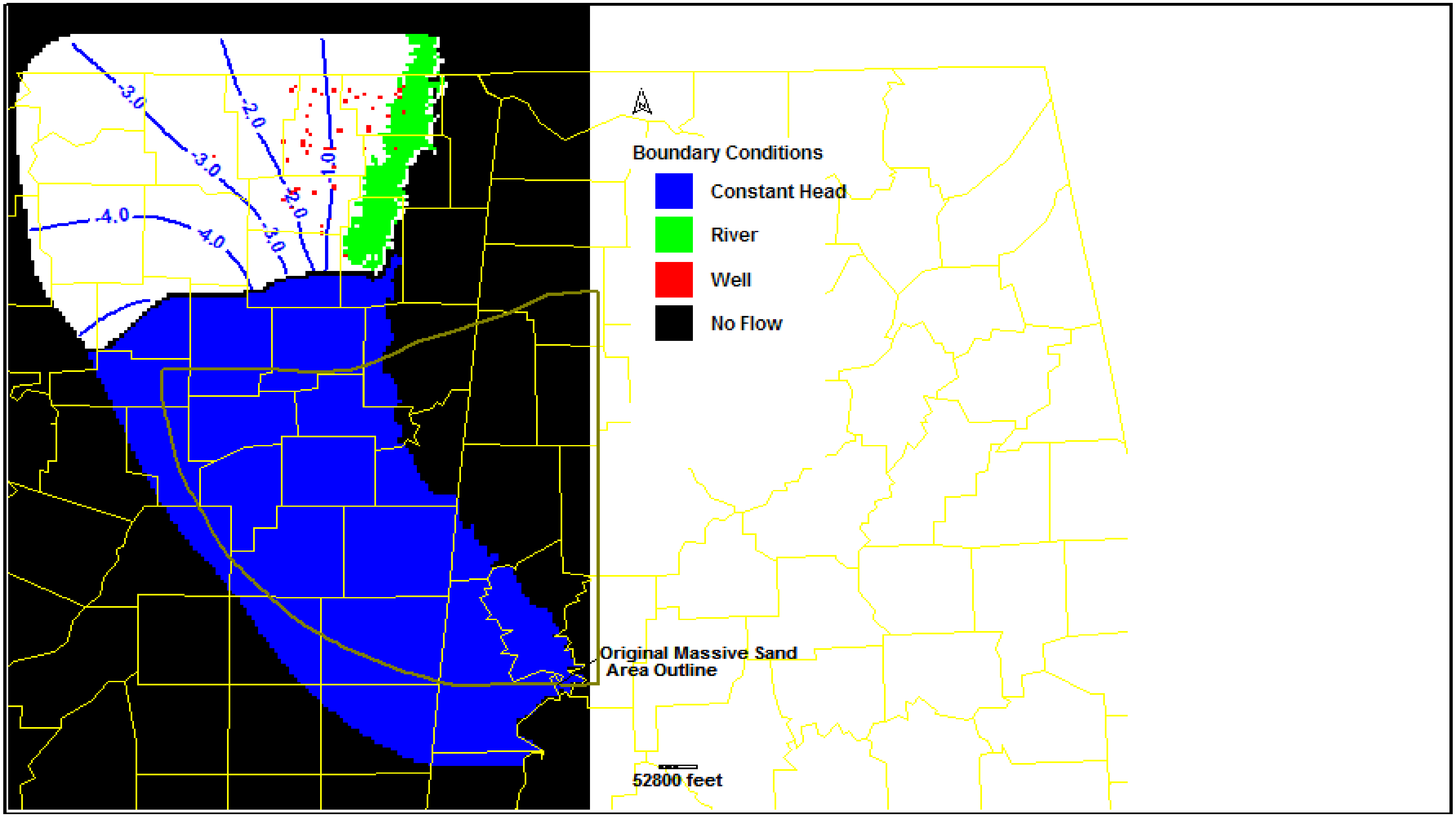

FIGURE 14.

PREDICTED DRAWDOWN IN COFFEE SAND (LAYER 1) AT END OF 40 YEARS OF PUMPING BASED ON 6.5-MGD TOTAL WITHDRAWAL FROM MASSIVE SAND

Sources: Strom, 1998. ECT, 2009.

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The 6.5-MGD simulation suggests that these estimated drawdowns have the potential to cause adverse impacts to existing Massive Sand aquifer users and would have some potential to cause minor adverse impact to existing users of ground water from the Coker and possibly the Gordo aquifers. No significant impacts would be expected relative to the existing users of ground water from the Eutaw-McShan aquifer or the Coffee Sand aquifer. Actual impacts to a water user's well are relative not only to the amount of drawdown experienced but also to the specific construction and condition of each well. However, such impacts could likely be mitigated by retrofitting and/or upgrading well pumps at impacted wells.

MODEL LIMITATIONS AND DISCUSSION

The southwest boundary of the model layers have been defined as a sharp contact representing the freshwater to the northeast of the boundary and the saline ground water to the southwest of the boundary. While this freshwater-saltwater boundary is typically represented as a sharp contact in ground water flow modeling, implying that the fluids are immiscible liquids, this is not actually correct. The transition zones between fresh and saline ground water can vary between a few tens of feet to more than a few miles.

The proposed wells will be withdrawing from the saline portion of the Massive Sand aquifer approximately 3 to 4 miles to the southwest of the freshwater-saltwater boundary defined for the area by Strom (1998). The location of the existing freshwater-saltwater boundary is based on the equilibrium of the ground water flow system. Placing pumping wells close to this boundary will change this equilibrium and likely cause a shift in the boundary location. The variable dissolved solid concentrations found in the saline ground water affects the ground water density and consequently ground water flow. MODFLOW, a single density fluid model, does not account for variable density affects that would occur in the vicinity of the freshwater-saltwater boundary. The Strom Model and expanded 1.0-MGD model, therefore, are not designed to estimate the movement of the freshwater-saltwater boundary or consider spatial variations in fluid density that can affect ground water flow and predicted drawdown.

The actual head values in the saline portion of the aquifer (at equal elevation/pressure) would be lower than predicted by the current MODFLOW simulations, which only calculate head distributions based on freshwater/low density ground water. Based on the potential gradients the actual lower head values would tend to induce and considering the modeling performed for the Red Hills Final Environmental Impact Statement (TVA, 1998) under similar circumstances of pumping, position relative to the freshwater-saltwater interface, and hydrogeologic conditions, it is likely that the boundary would migrate on the order of 1,000 to 2,000 ft to the southwest. This would expand the transition zone and/or the freshwater section of the Massive Sand aquifer toward the southwest in the vicinity of the proposed power plant. In addition, the current MODFLOW simulations will slightly overestimate the drawdown observed at greater distances from the freshwater-saltwater boundary and toward the recharge areas and underestimate the drawdown in the vicinity of the site.

The Strom Model was developed using average heads calculated for the entire 1-mi^2 cell area and therefore should be used for analyzing ground water flow on a regional scale. Transmissivity and other hydraulic properties of the aquifers modeled are assumed to be constant within each 1-mi^2 grid cell. Therefore, the expanded model is valid as a regional assessment tool.

The hydraulic property data (transmissivity, leakance, hydraulic conductivity, etc.) used to develop the Strom Model is limited to wells drilled before 1995. There are likely other new wells, in addition to the ES&EE onsite test well, that could provide updated hydraulic property data that may have an impact on the model predictions.

No-flow boundaries have been used to define the layer boundaries at the depositional edge of the aquifers and at the freshwater-saltwater boundary. In reality, the up-dip, depositional edges of the aquifers may not be isolated but rather in contact with other saturated sediments. Similarly, the fresh and saline ground waters are not truly immiscible fluids, so there will likely be some degree of flow associated with the freshwater-saltwater boundary. These conditions will tend to cause the 1.0-MGD model to slightly overestimate the predicted drawdown.

Since only the southwestern extent of the Massive Sand aquifer (Layer 5) was extended to include active cells in the area of the proposed wells, the cells in the Layers 3 and 6 above and below the extension remain no-flow cells. While active cells are present in the Coker aquifer (Layer 4) overlying the proposed site wells, they are only a few miles from the freshwater-saltwater boundary defined in that layer. This may cause a slight overestimation in the drawdown in the Massive Sand aquifer (Layer 5) and Lower Cretaceous (Layer 6) and an underestimation in the drawdown in the overlying Layers 3 and 4, the Gordo and Coker aquifers, respectively. However, at the 1.0-MGD pumping rate, the resulting effects on the predicted drawdown is expected to be insignificant.

Similarly, the low leakance values of 5.0×10^{-9}, used in the Strom Model over much of the west and southwest portion of the aquifers, is two orders of magnitude lower than would be expected based on information published leakance values for an earlier USGS MODFLOW simulation completed in the same area (Strom and Mallory, 1995). The test simulation indicates that this lower leakance value tends to overestimate the drawdown predicted in the Massive Sand aquifer (Layer 5) and Lower Cretaceous aquifer (Layer 6). The effect of the lower leakance value on the predicted drawdowns for the 1.0-MGD model is expected to be insignificant.

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APPENDIX A

STROM MODEL REPORT FIGURES

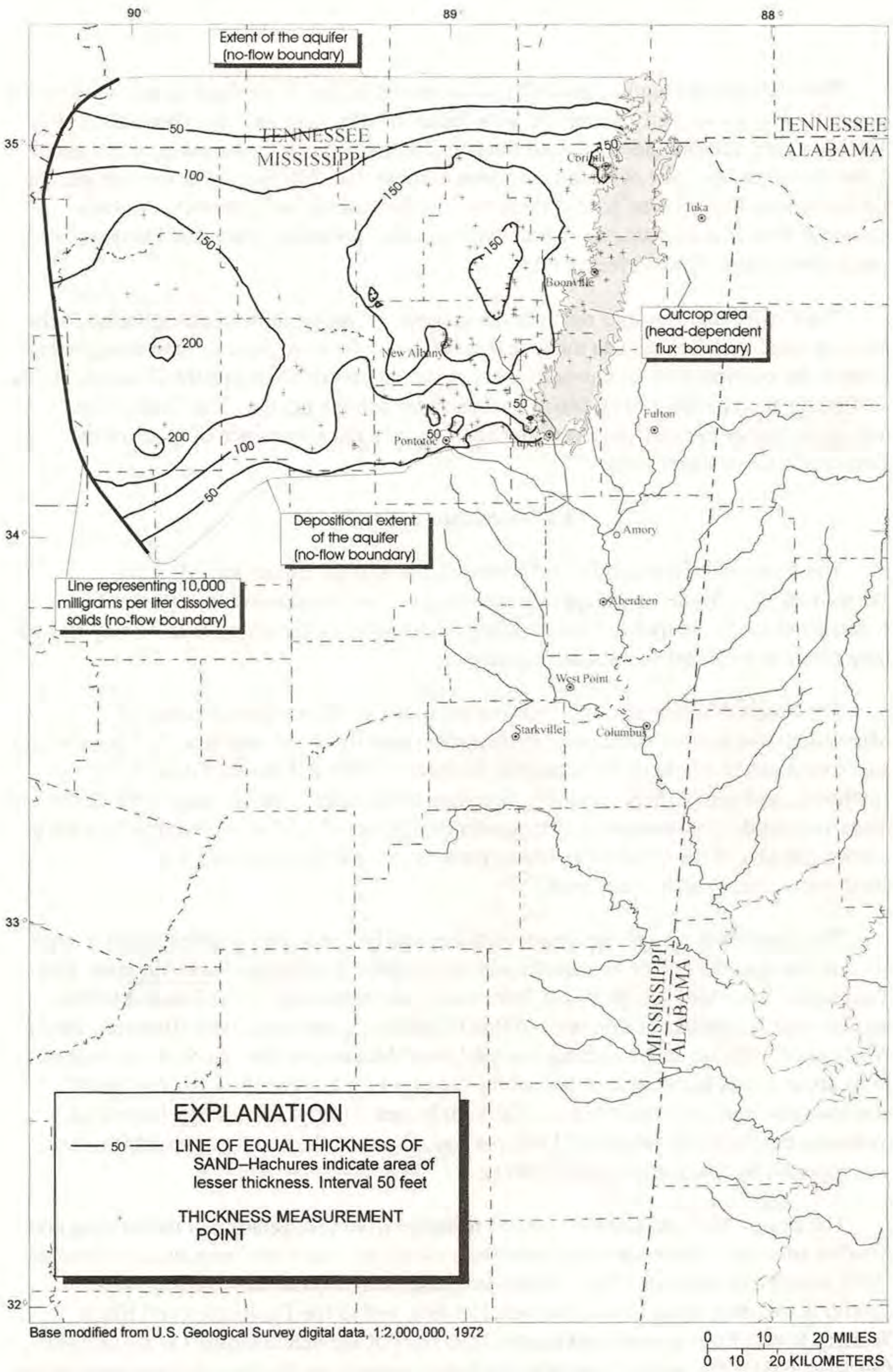
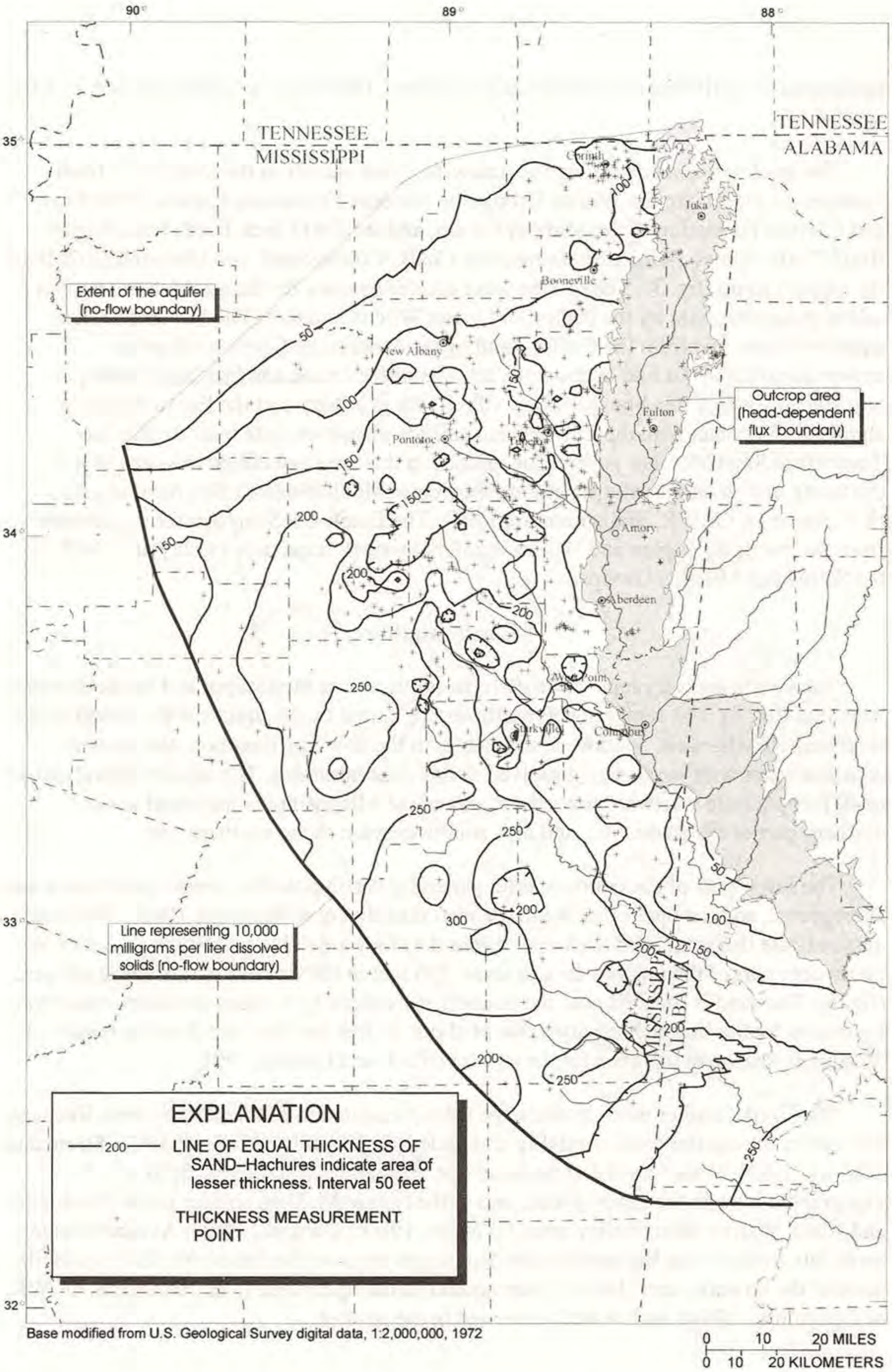
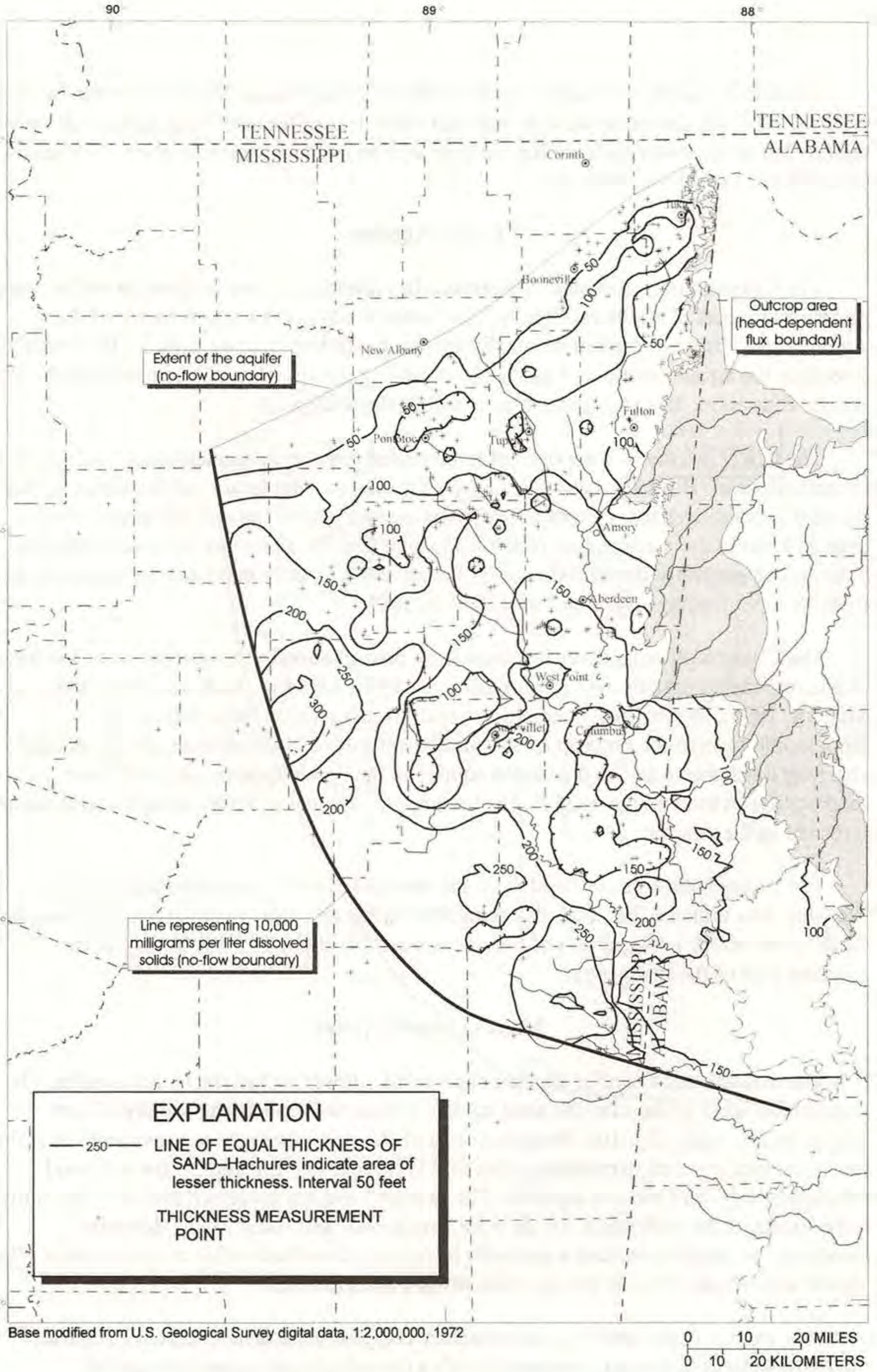


Figure 6. Extent and total sand thickness of the Coffee Sand aquifer and location of measurements.



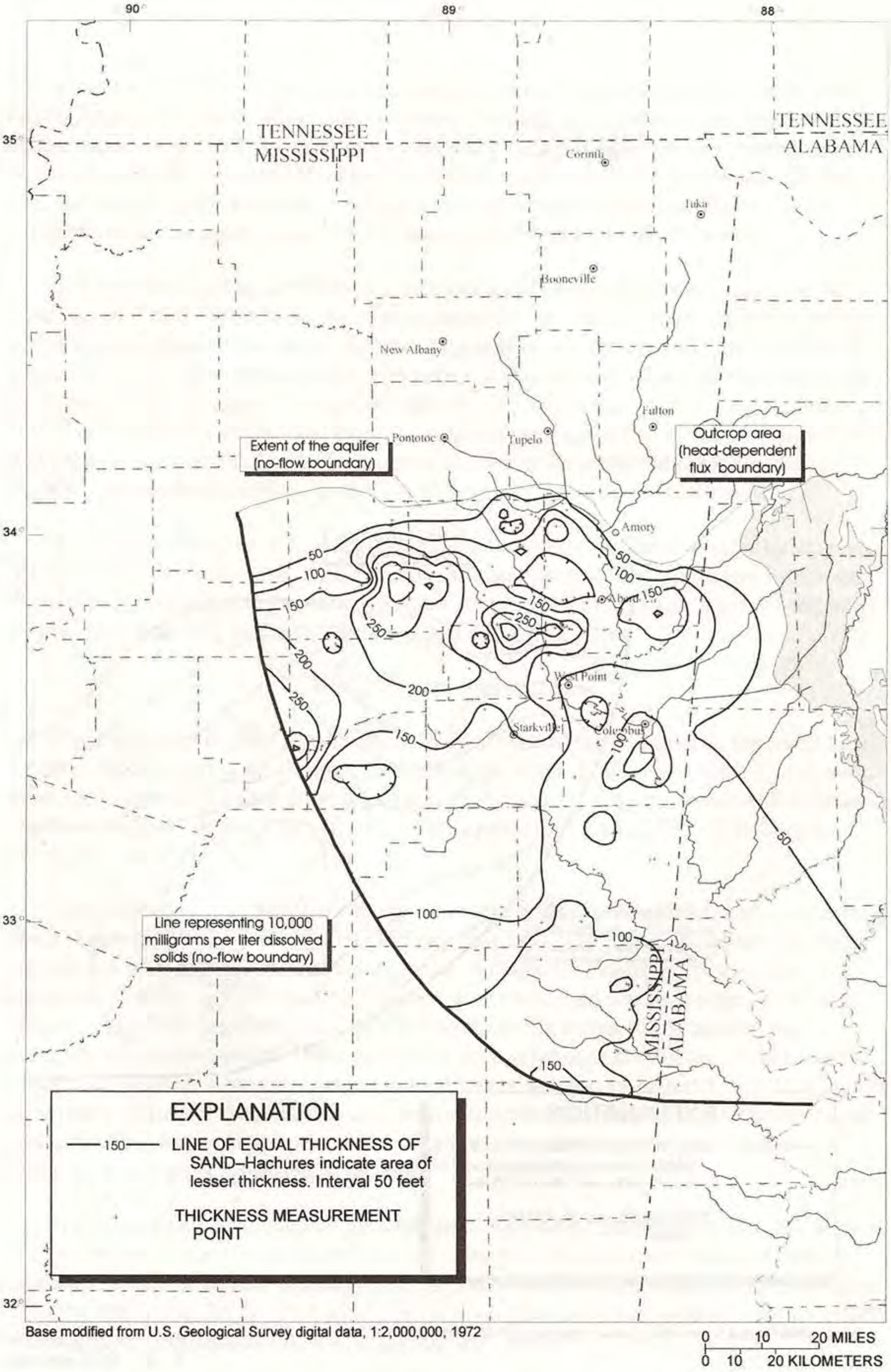
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 7. Extent and total sand thickness of the Eutaw-McShan aquifer and location of measurements.



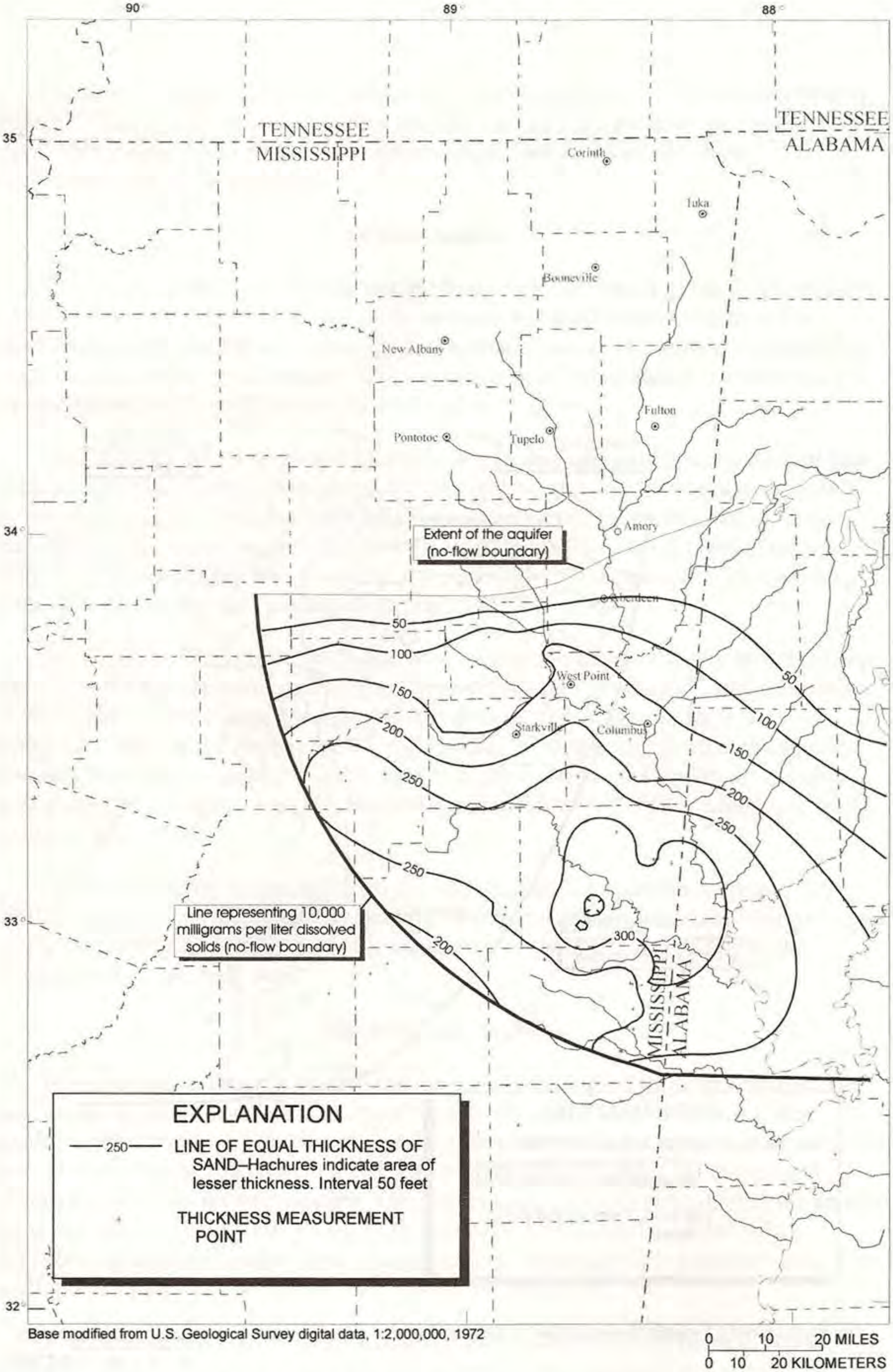
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 8. Extent and total sand thickness of the Gordo aquifer and location of measurements.



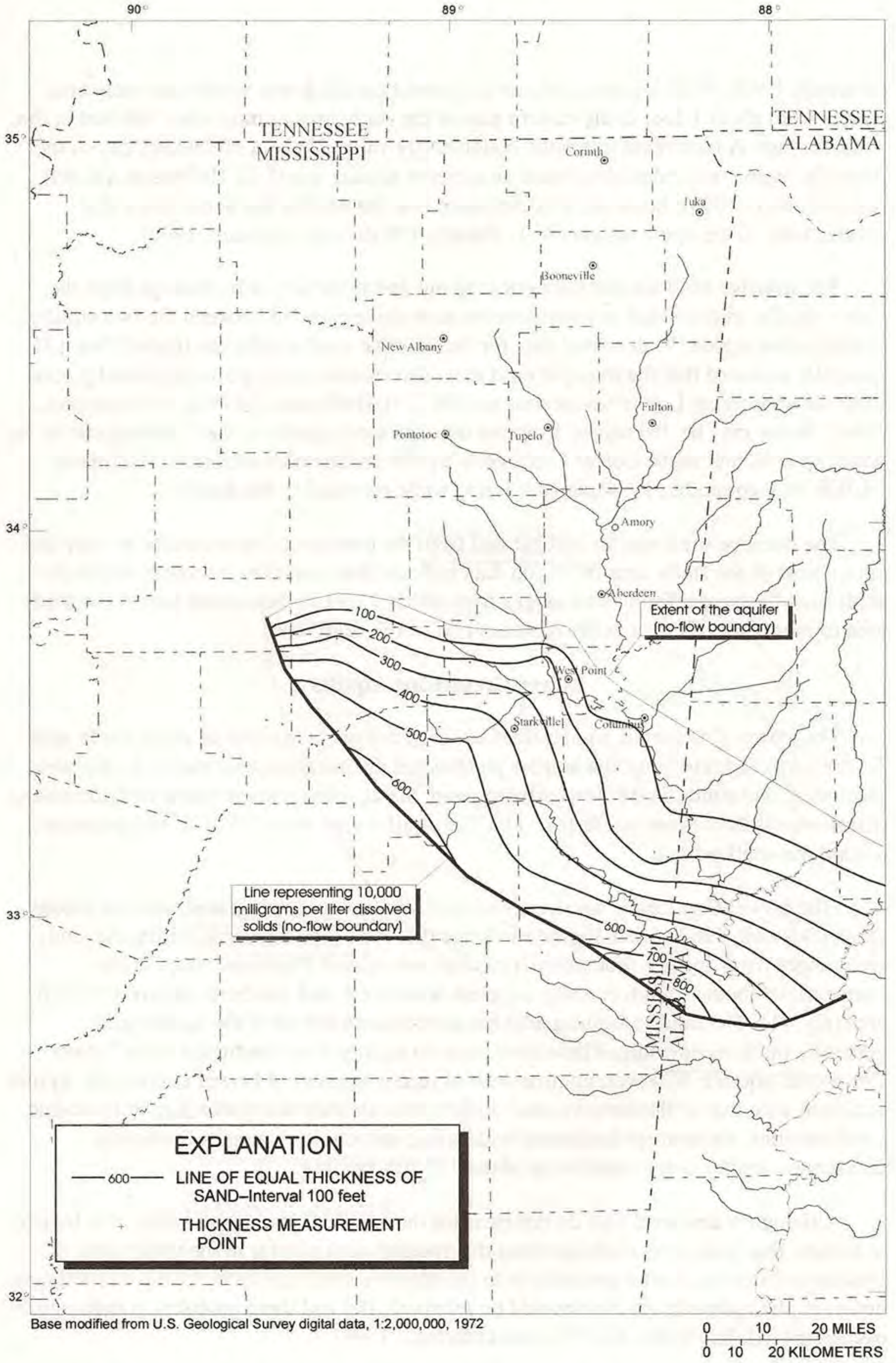
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 9. Extent and total sand thickness of the Coker aquifer and location of measurements.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 10. Extent and total sand thickness of the massive sand aquifer and location of measurements.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 11. Extent and total sand thickness of the Lower Cretaceous aquifer and location of measurements.

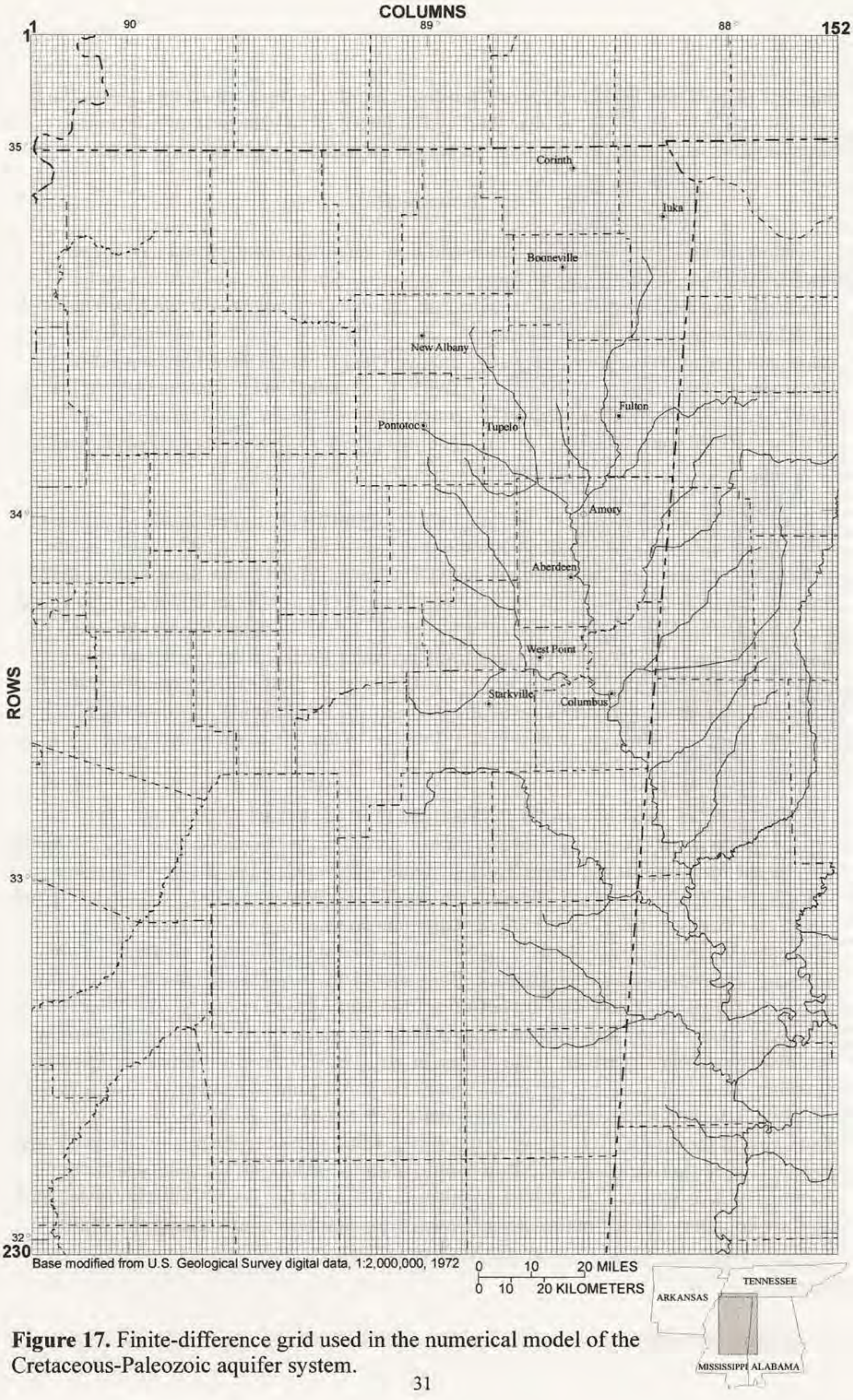
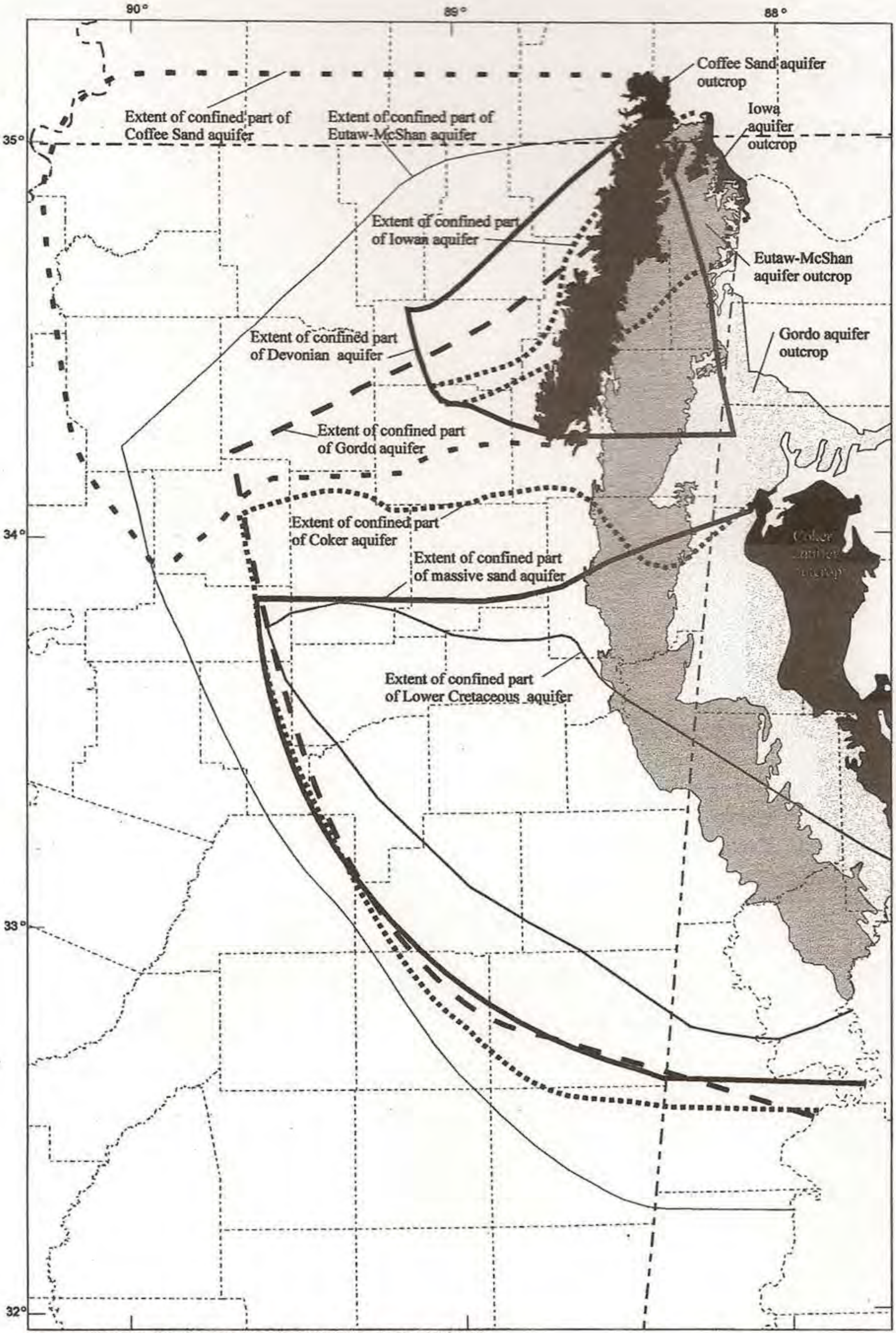


Figure 17. Finite-difference grid used in the numerical model of the Cretaceous-Paleozoic aquifer system.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 18. Overlap of areal extent of freshwater in the Cretaceous-Paleozoic aquifers in the study area.

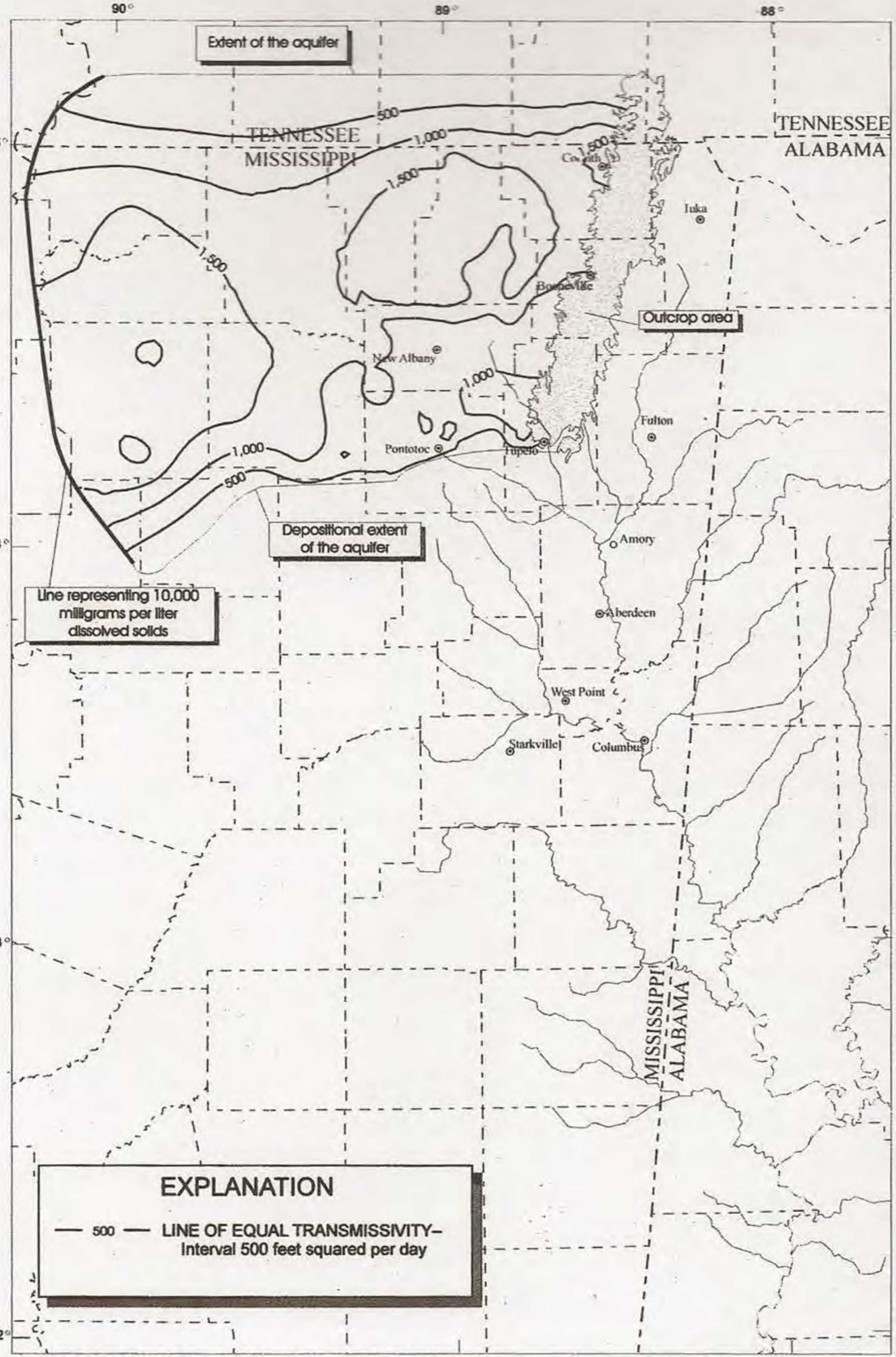
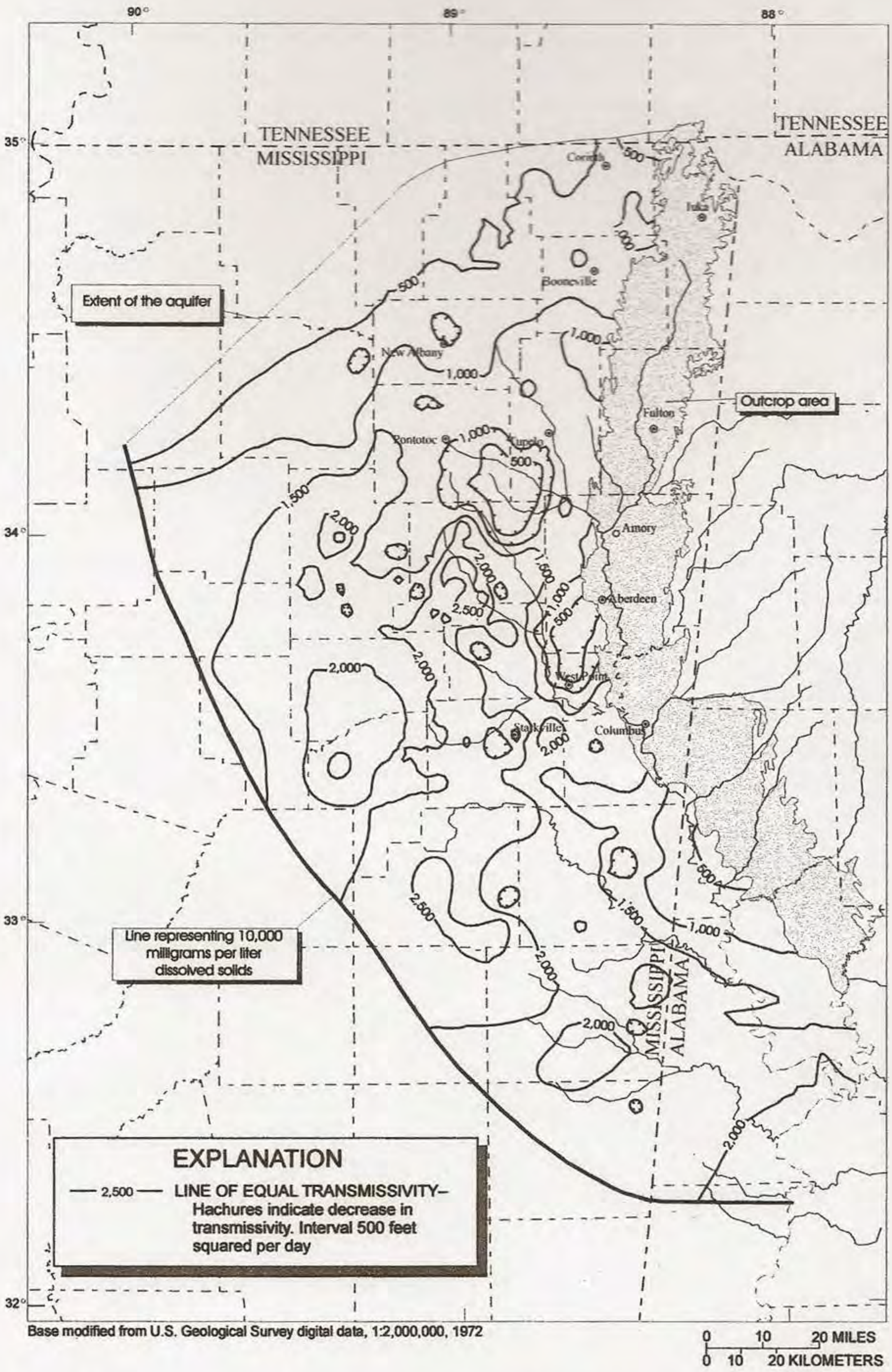


Figure 20. Transmissivity of the Coffee Sand aquifer used in model simulations.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 21. Transmissivity of the Eutaw-McShan aquifer used in model simulations.

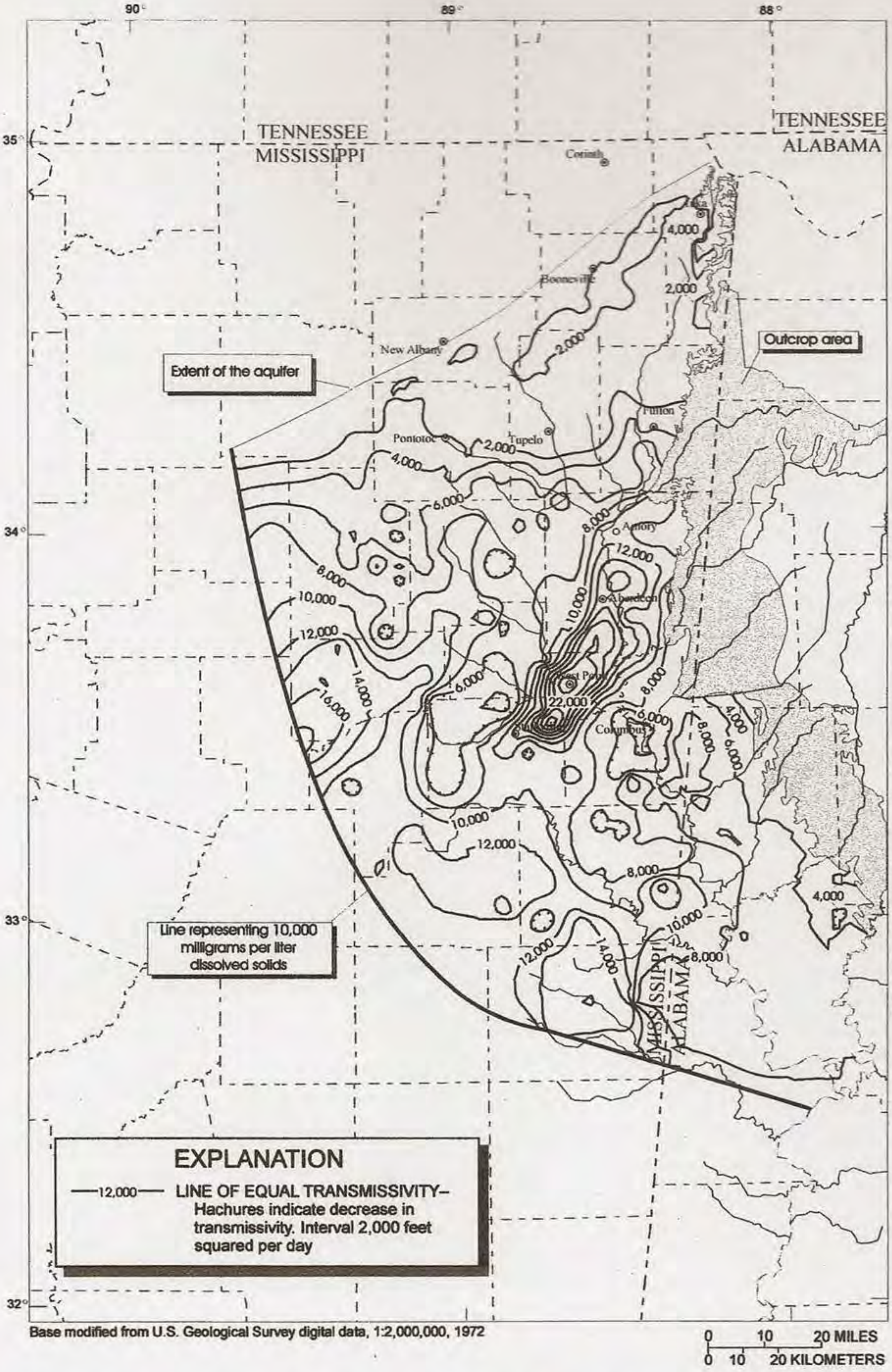
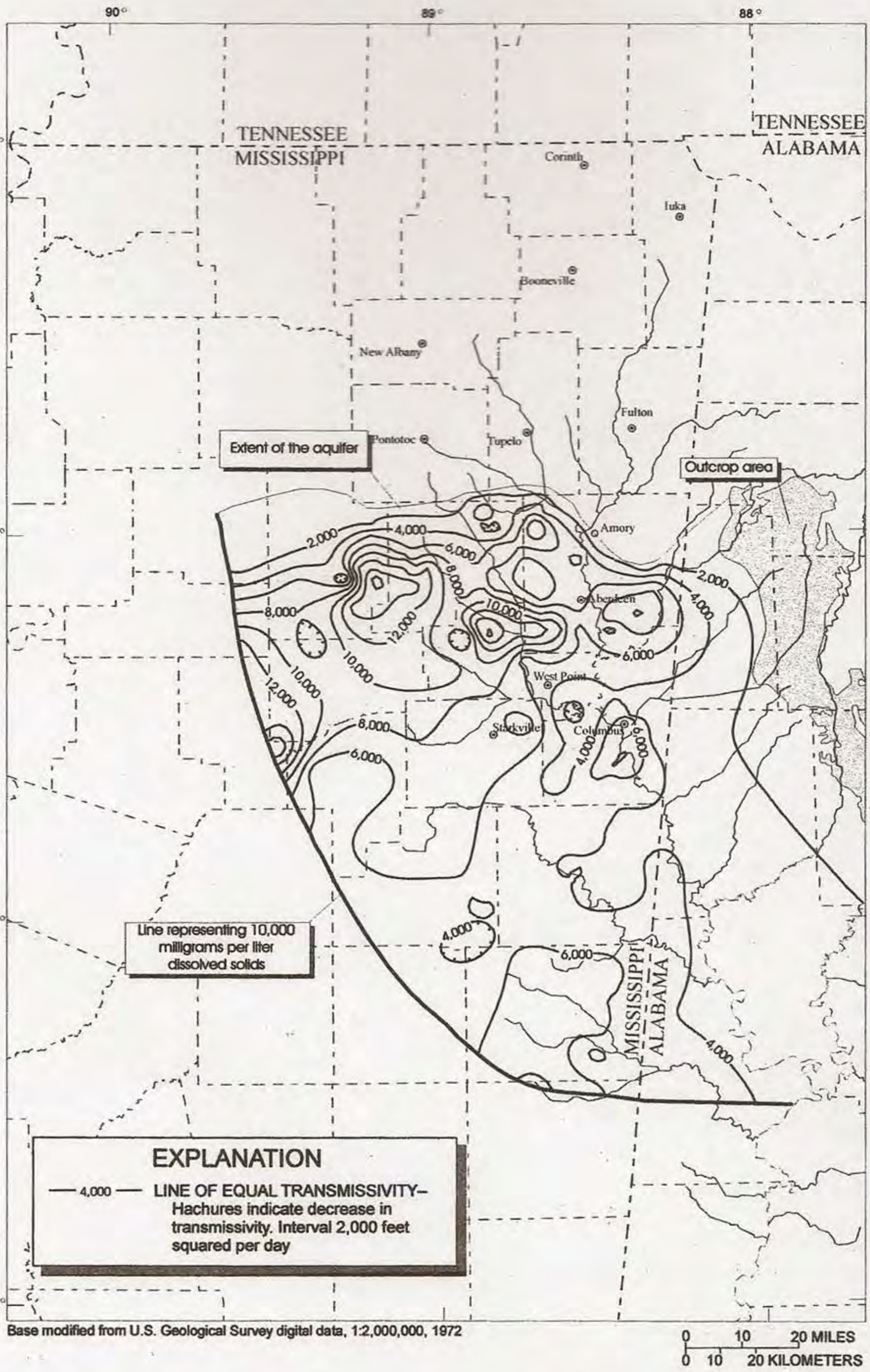
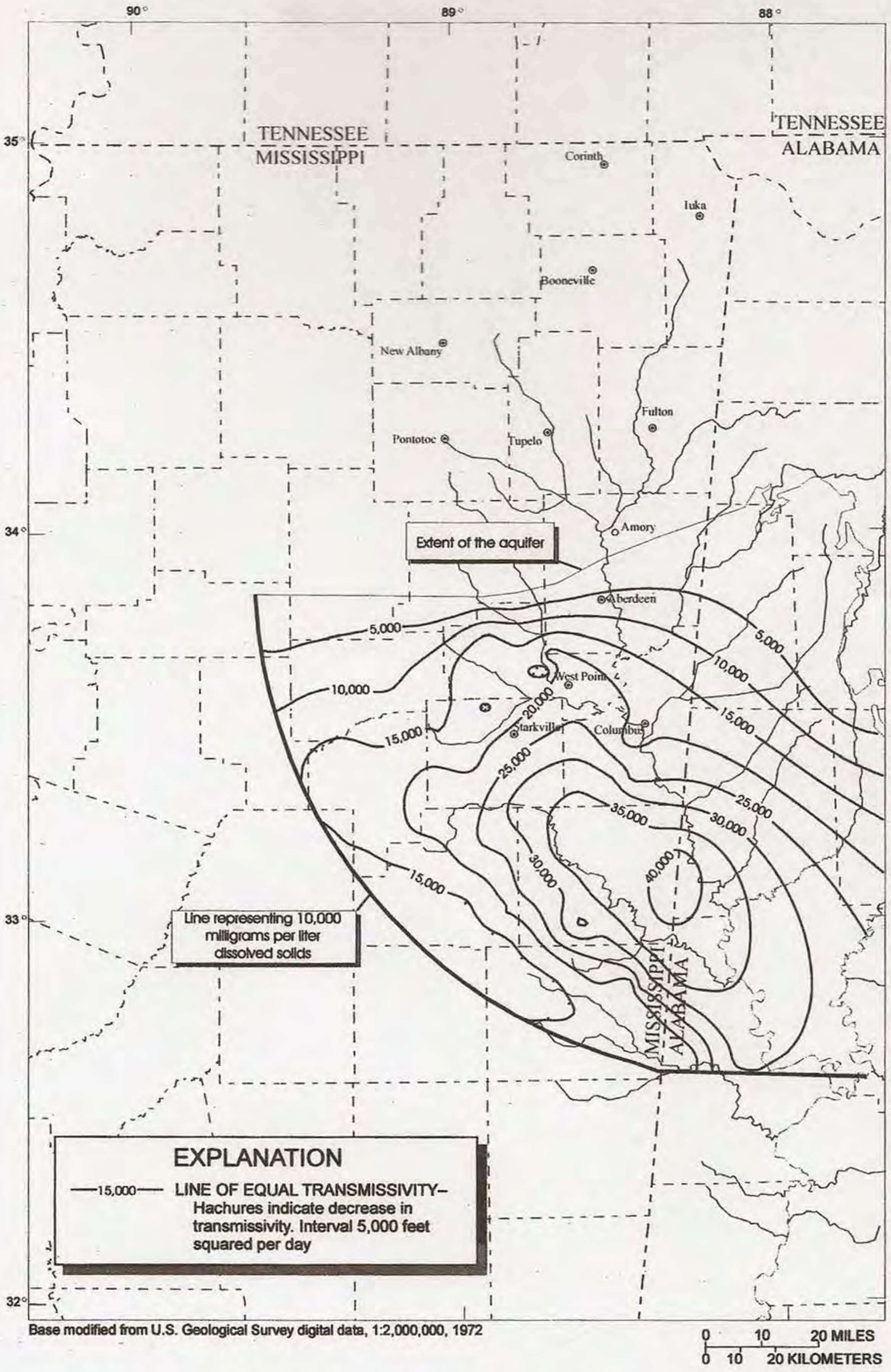


Figure 22. Transmissivity of the Gordo aquifer used in model simulations.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 23. Transmissivity of the Coker aquifer used in model simulations.



Extent of the aquifer

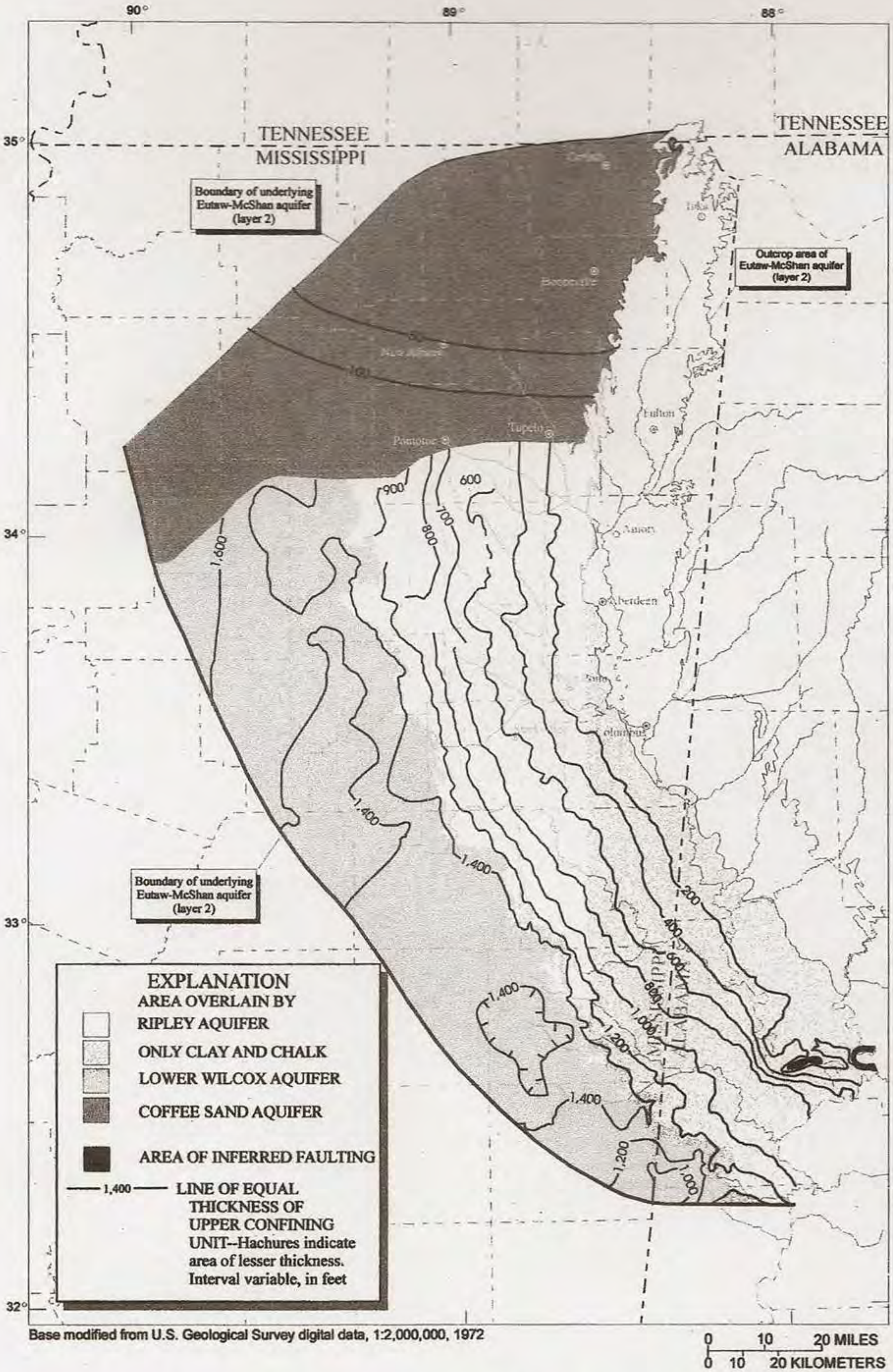
Line representing 10,000 milligrams per liter dissolved solids

EXPLANATION

—15,000— LINE OF EQUAL TRANSMISSIVITY– Hachures indicate decrease in transmissivity. Interval 5,000 feet squared per day

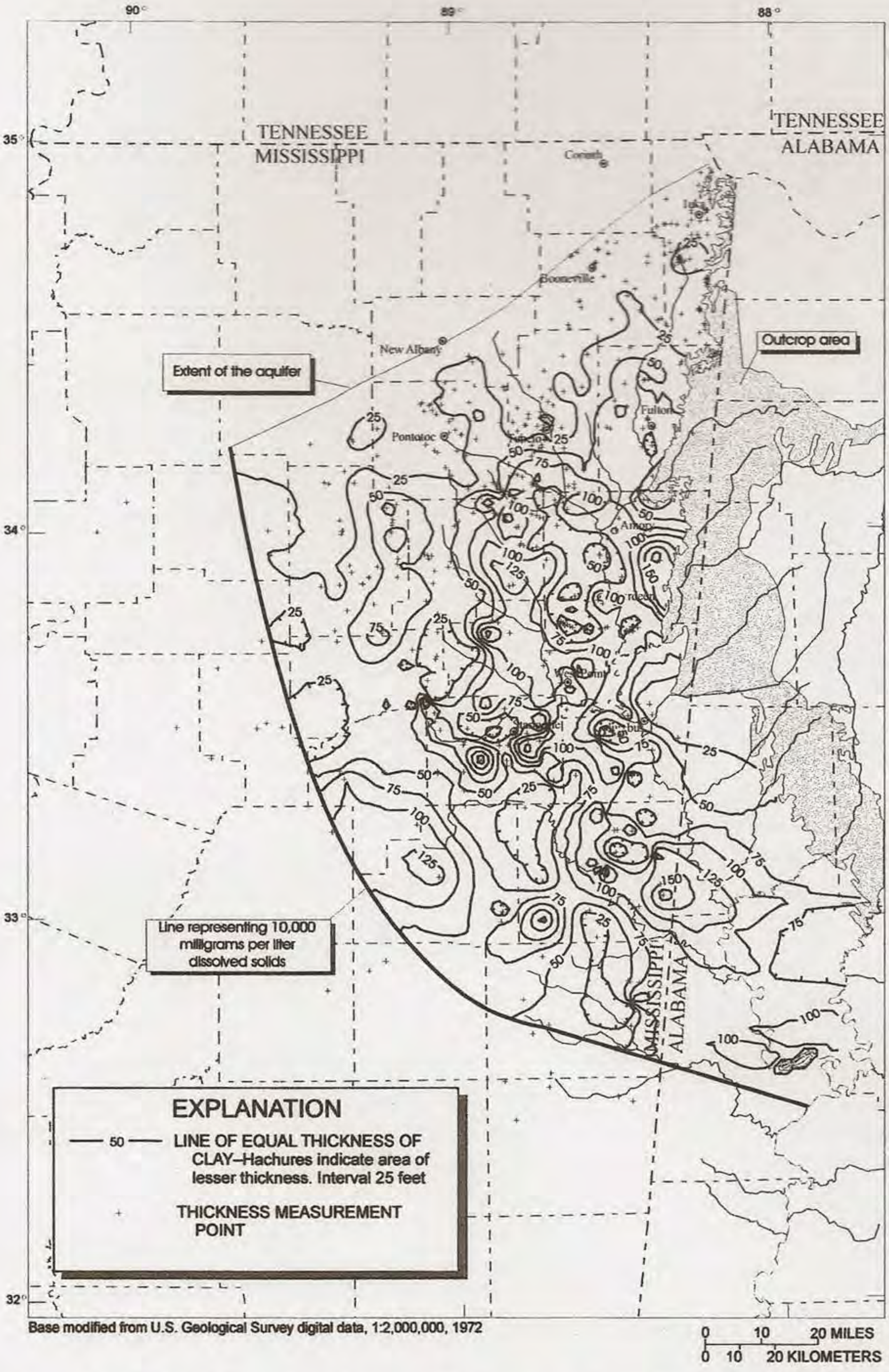
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 24. Transmissivity of the massive sand aquifer used in model simulations.



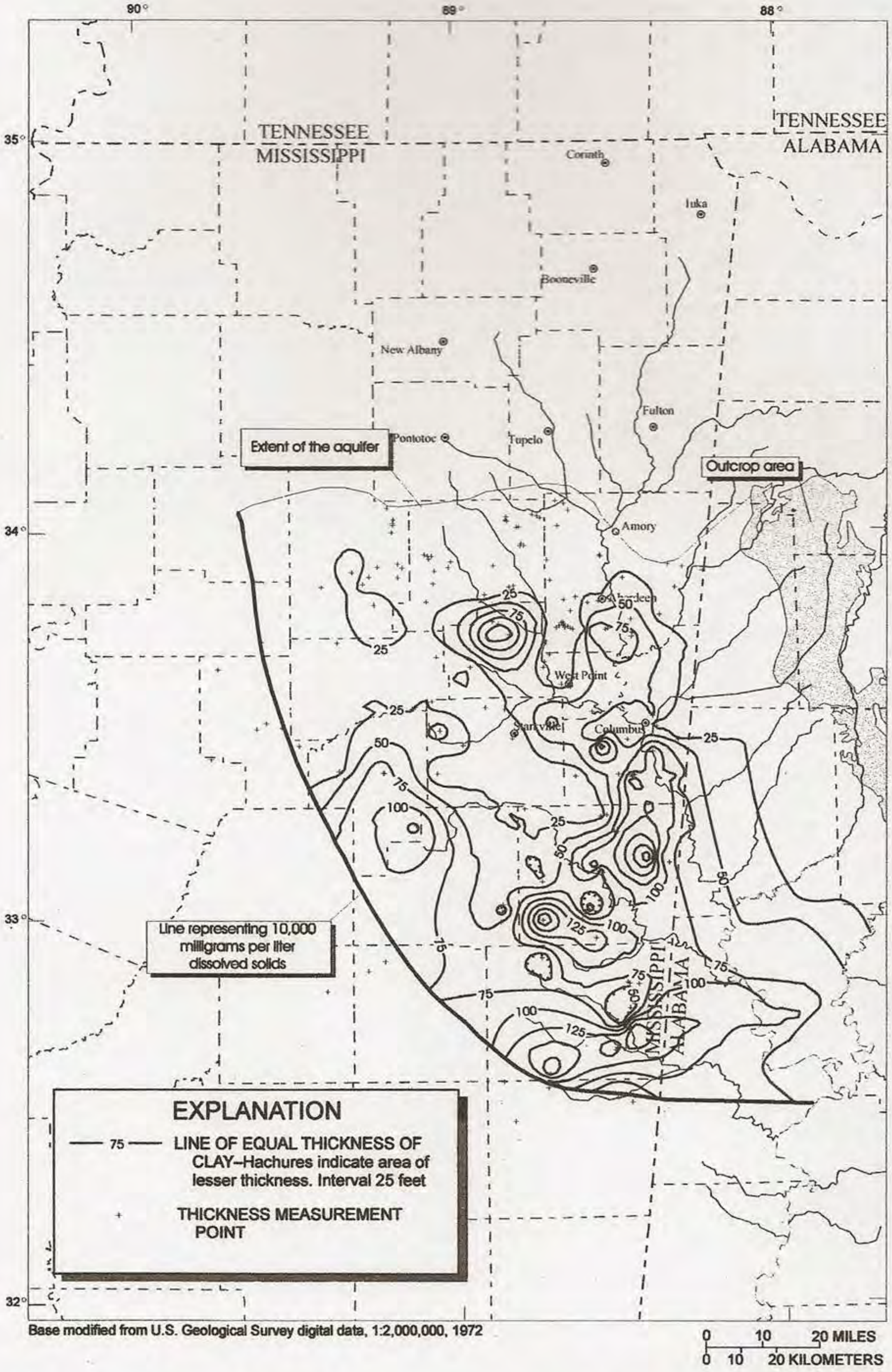
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 27. Thickness of the confining unit overlying the Eutaw-McShan aquifer used in model simulations.



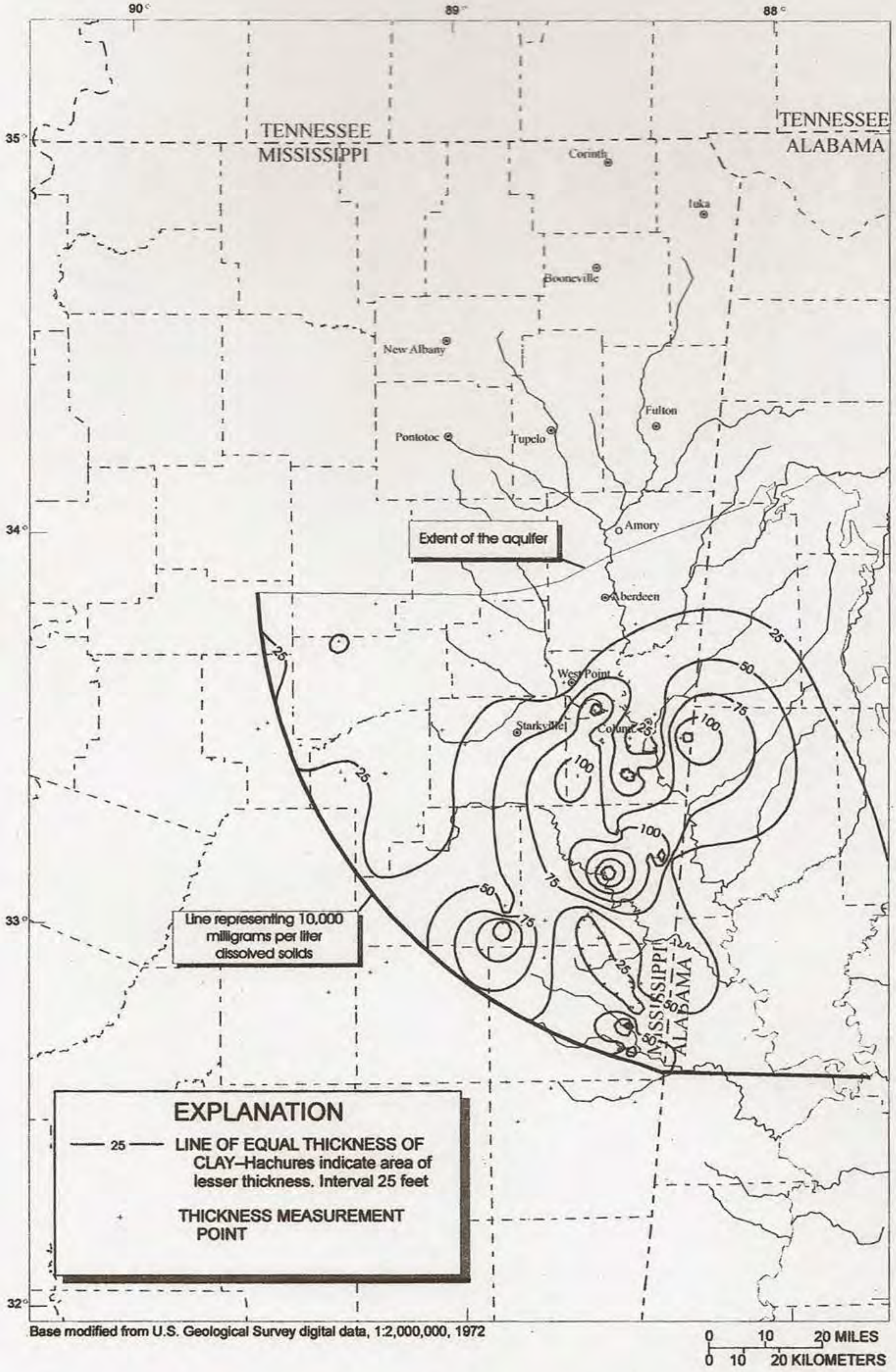
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 28. Total overlying clay thickness of the Gordo aquifer and location of measurements.



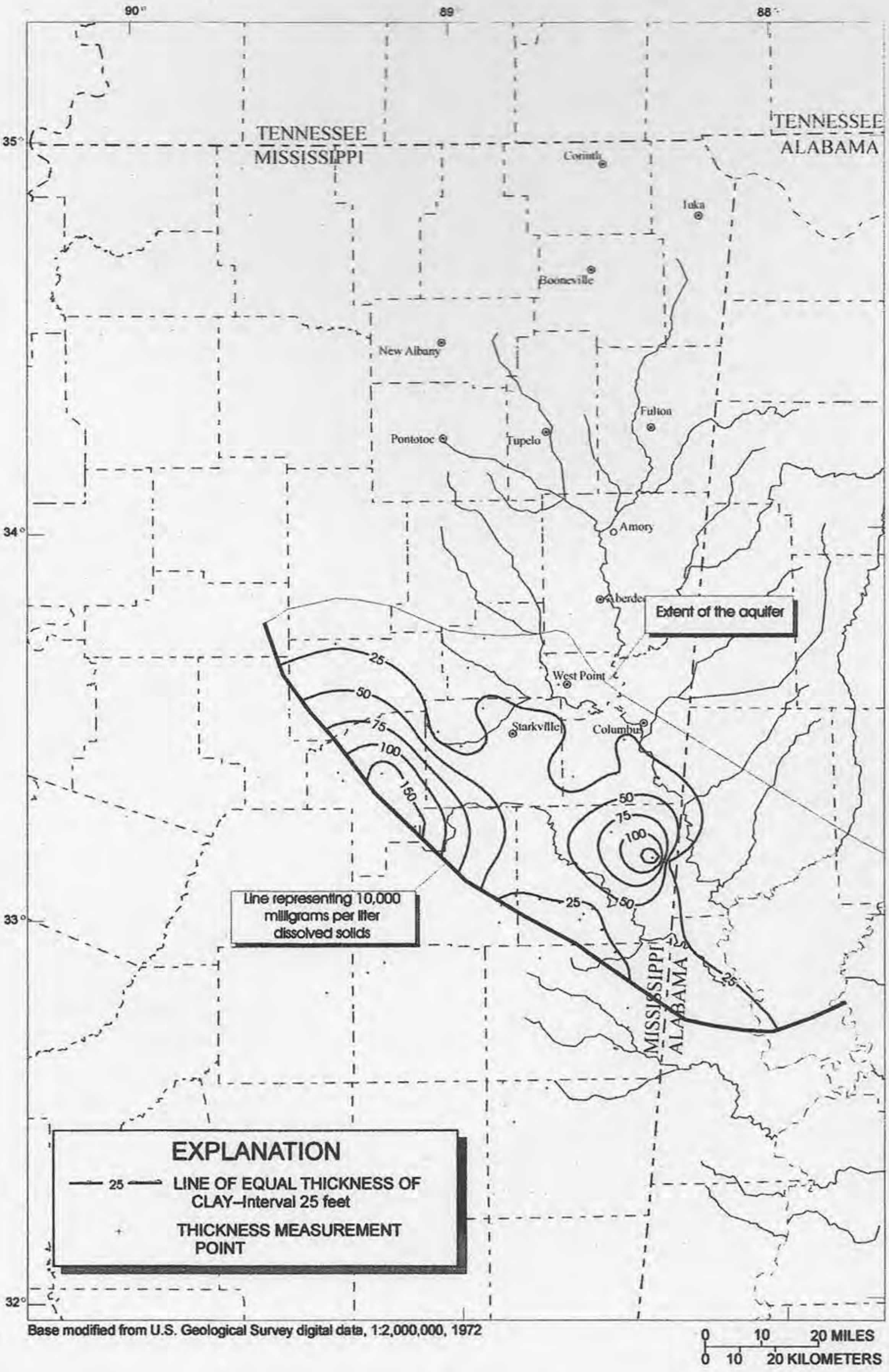
Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 29. Total overlying clay thickness of the Coker aquifer and location of measurements.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 30. Total overlying clay thickness of the massive sand aquifer and location of measurements.



Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 31. Total overlying clay thickness of the Lower Cretaceous aquifer and location of measurements.

Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Figure 52. Areas of simulated 1995 recharge and discharge in aquifer outcrops.

APPENDIX P

STREAM AND WETLAND MITIGATION PLAN FOR THE PROPOSED LIBERTY FUELS MINE

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STREAM AND WETLAND MITIGATION PLAN FOR THE PROPOSED LIBERTY FUELS LIGNITE MINE

Prepared for:

NORTH AMERICAN COAL CORPORATION
P.O. BOX 399
JOURDANTON, TEXAS 78026

Prepared by:

BARRY A. VITTOR & ASSOCIATES, INC.
8060 COTTAGE HILL ROAD
MOBILE, ALABAMA 36695

October, 2009

INTRODUCTION

This mitigation plan describes the conceptual approach to compensatory mitigation for unavoidable impacts to forested, herbaceous, and scrub-shrub wetlands, and perennial and intermittent streams that will occur as a result of the proposed Liberty Fuels lignite surface mining operation in Kemper and Lauderdale Counties, Mississippi. The project will encompass the construction of an advanced technology coal power plant by Mississippi Power Company, and the North American Coal Corporation (NACC) lignite coal surface mining operation that will fuel it. The project was chosen under DOE's Clean Coal Power Initiative (CCPI) to demonstrate Integrated Gasification Combined-Cycle (IGCC) technology.

STREAM MITIGATION

Existing Condition of Streams

Barry A. Vittor & Associates, Inc. conducted detailed assessments of stream habitats at eight locations in the mine study area. These assessments were designed to characterize streams with regard to structure/morphology, water quality, and biological communities; study results have been presented in a report to North American Coal Corporation. In addition, Vittor & Associates analyzed recent topographic data and aerial imagery, and information available in the MARIS website to estimate the classification and dimensions of intermittent and perennial streams within the mine study area. These information sources were compiled in GIS and were used to estimate potential mining activity impacts on streams. The proposed mining operations would result in temporary impacts to portions of six named creeks within the proposed mining area (**Figure 1**). The creeks that would be impacted are Chickasawhay Creek, Penders Creek, Dry Creek, Bales Creek, and Tompeat Creek. All of these streams are upstream of Okatibbee Lake, which is a large, man-made impoundment. Based on the 2009 Mobile District Corps of Engineers (COE) stream Standard Operating Procedures (SOP) guidelines, all perennial and intermittent streams that will be impacted are either impaired or somewhat impaired. The impacts will occur in 1st and 2nd order perennial streams, and intermittent streams that are best characterized by the Rosgen Field Guide for Stream Classification as Type F streams. Typically these streams have deeply entrenched channels (<1.4 entrenchment ratio), low gradients (generally <2%), moderate-to-high width/depth ratios (>12), low-to-moderate sinuosity (>1.2), and sandy/clay channel substrate. They have highly erodible banks and are susceptible to mass wasting in areas where riparian vegetative densities are low.

The current degraded quality of the streams is the result of extensive commercial forestry activities, the network of roads and bridges throughout the area, and the decades-old practice of channelizing, ditching, and straightening streams and converting hardwood forest and floodplain forest to pasture land or small farms by private land owners.

Stream Impacts

Primary impacts to streams will occur during excavation within a given mining block and would involve the loss of existing stream and stream riparian zones within that block on a year-by-year basis. The stream impacts within a given annual mine block will occur during the initial disturbance and will have an average duration of five to ten years. The disturbance will not be permanent. The streams and riparian zones will be restored in accordance with the overall reclamation/mitigation plan that will be implemented incrementally as mining is completed in each block. During the entire life-of-mine period approximately 230,080 linear feet of intermittent or perennial stream and 66,429 linear feet of ephemeral stream will be displaced and reestablished by mining operations. These stream impacts will not occur simultaneously, but rather will occur incrementally during the life-of-mine period. In accordance with the COE March 2009 SOP for stream mitigation, ephemeral stream impacts are accounted for through wetland mitigation measures.

A sample ADVERSE IMPACT WORKSHEET is presented as **Figure 2**. It illustrates the Total Mitigation Credits Required under various scenarios that could occur in the Kemper County mine site. Computations are based on impacts to 1,000 linear feet of 1st or 2nd Order Perennial Stream or an Intermittent Stream, where the Existing Condition of the stream is either Somewhat Impaired or Impaired, and the Dominant Impact factor used is

Morphologic Change. The total mitigation credits that could be required to offset stream impacts range from 2,050 for a 1000-foot reach of impaired intermittent stream, to 3,450 for a 1000-foot reach of somewhat impaired perennial stream.

Stream Mitigation Approach

The initial step in the stream mitigation approach will entail collecting additional baseline data for each of the streams using a stable reference reach for each stream. Information to be collected will focus on dimension metrics including width/depth ratio, bank height ratio, entrenchment ratio, as well as pattern and profile metrics including slope, bed features, sinuosity, meander/width ratio, and radius of curvature. Stream SOP data sheets will be provided for each "Reference Reach" stream. Baseline data would also include rapid bioassessment studies conducted on reference reach streams. Those baseline data will be used as a model for the design of both the relocated/diverted streams and the restored/reclaimed streams.

Prior to beginning mining operations within a block, any intermittent or perennial stream that would be immediately impacted will be relocated/diverted around the block and tied back into the natural stream channel at a point downstream. This mitigative action will maintain an uninterrupted flow through the system. The relocated/diverted streams will be constructed according to the Stream Mitigation SOP Guidelines to "reflect the overall dimension, pattern, and profile of natural referenced stable conditions". Although some stream functions may be lost for a period of time (up to 24 months) in the newly constructed streams, it is expected that during their five to ten year life the diverted/relocated streams will develop functional quality surpassing that of the impacted natural streams, considering that the existing condition of all the natural streams in the Kemper County site are either impaired or somewhat impaired. Studies of similar diversion and reference streams at the Red Hills Mine (Choctaw Co.) have shown that mining block diversion streams achieve functional values equal to natural streams within five years. Even though the enhanced functions provided by the diverted/relocated stream will be lost when the mining of the block is stopped and reclamation/restoration actions are completed, some mitigation credit is merited for this action. The diverted/relocated stream will be left in place until the restoration of the natural streambed is completed and the stream can be returned to its natural course.

Additional stream mitigation will be accomplished through the restoration of the natural streambed during the reclamation process. Any impacted stream will be reestablished in its original location and will be constructed to the specifications of the stable reference reach stream. A minimum 50-foot wide riparian corridor of vegetated species will be planted along the restored streams to mimic the species diversity, composition, and structure of the reference reach habitats.

A sample IN-STREAM WORK, STREAM CHANNEL/STREAMBANK RESTORATION AND RELOCATION WORKSHEET is provided in **Figure 3** and reflects the total credits generated for Stream Relocation and Stream Channel Restoration under scenarios that could occur on the Kemper County site. Values shown are based on Relocation and Restoration (Net Benefit) of 1,000 linear feet of 1st or 2nd Order Perennial Stream in either Somewhat Impaired or Impaired pre-impact condition. Diverted/relocated streams could produce moderate numbers of mitigation credits, as shown in **Figure 3**. Replacement of somewhat-impaired streams by diverted/relocated channels could generate 650 net credits per 1000 feet of stream, while replacement of impaired steams by diverted/relocated channels could generate 825 net credits per 1000 feet. Final reclamation/restoration of the pre-mine stream could produce 3,050 to 3,400 credits per 1000 feet. The cumulative effect of stream diverted/relocated channel construction and reestablishment of pre-mine streams is estimated to more than balance the losses of stream values due to mining.

WETLAND MITIGATION

Existing Wetland Conditions

Barry A. Vittor & Associates, Inc. conducted wetland surveys in the mine study area between the months of June and October, 2008. In addition to several months of on-site observation of accessible lands in the 31,260-acre study area, Vittor & Associates biologists documented the quality of wetland habitat at 53 individual locations. The quality of each wetland habitat was evaluated using the Wetland Rapid Assessment Procedure (WRAP). The WRAP is a rating index that was developed by the South Florida Water Management District to assist in the regulatory evaluation of mitigation sites. In 2007, the Mobile, Alabama District Corps of Engineers (COE) began using the WRAP to evaluate the habitat quality of jurisdictional wetlands as defined by the 1987 Corps of Engineers Wetland Delineation Manual. Each of the 53 evaluated wetlands were categorized as one of the following vegetation/land use types: planted pine (PP), hardwood forest (H), pine-hardwood forest (PH), hardwood-pine forest (HP), bottomland forest (BF), shrub land (S), and fields (F). Wetlands that were classified as vegetation types PP, H, PH, HP, and BF are forested wetlands; fields (pastures, hay fields, "deer plots", or any area cleared of forest cover and maintained in an herbaceous state) represent herbaceous wetlands; and scrub-shrub wetlands were designated as Shrub Land under the vegetation/land use types.

Many of the wetlands observed in the project area are associated with large creeks, the confluences of small creeks, man-made ponds, and a very small number of seepage slopes. A vast majority of the small streams and creeks observed have steep, deeply incised-banks, apparently caused by heavy erosion caused by deforestation and ditching to facilitate pastureland or silvicultural use. Wetlands rarely exist alongside the deeply incised stream banks, due to drawdown effects of increased drainage. The wetland types most commonly evaluated were planted pine and bottomland forest. The hardwood bottoms associated with the major creeks such as Chickasawhay Creek, Penders Creek and Okatibbee Creek, are generally forested with medium-to-high quality wetlands with mature hardwood canopies dispersed along the creek channel. The floodplains of these creeks are where the majority of the wetlands are located. Wetlands were also frequently documented in fields in the study area due to the common practice of converting floodplain forests to pastureland, rangeland and hunting plots. These areas have low densities of canopy and shrub species, and are often planted in non-native grasses and forbs. Forested hardwood wetlands have also been converted into row-planted pine plantations. Large stands of loblolly pine (*Pinus taeda*) are commonly managed for commercial timber production by large industry and private landowners throughout the study area. On average PP wetlands received low WRAP scores and they account for a large percentage of low-quality wetlands within the study area. Only two Shrub Land wetlands were evaluated during the WRAP surveys. These wetlands account for a small percentage of all wetlands mapped within the study area, and are generally low-to-medium quality.

Of the 53 WRAPs performed in the study area 14 were performed on lands in which NACC currently proposes to conduct surface mining operations. The purpose of evaluating these wetlands was to determine overall quality of wetlands in the area and to provide NACC with the information needed to perform the reclamation of wetlands impacted by mining operations. Due to the extensive impacts to wetland quality and function associated with current and previously implemented land management practices inside the study area, it is feasible to create a functional lift of the wetlands through the establishment of the following proposed NACC reclamation activities: re-contouring incised stream beds and drainage courses; replanting pine dominated wetlands with native hardwoods; removal of beaver dams; and replacement of improperly placed or non-functional culverts. The baseline information provided by the WRAPs that evaluate conditions prior to mining impacts could be compared to WRAPs that project post-reclamation wetland function, to provide a reasonable estimate of functional lift achieved through NACC's reclamation activities. Vittor & Associates performed WRAPs that project the functional lift achieved at the ten-year and 40-year stages of reclamation at the 14 WRAP locations located within the proposed mine blocks. Estimated WRAP values of 40-year post-reclamation wetlands were compared with the existing condition WRAPs to determine the net change in wetland function. The proposed post-reclamation change in wetland function and COE-mandated Temporal Loss Factors were applied to the impacted wetlands in order to provide an estimate of the acreages of preserved and enhanced wetlands that will be required, in addition to reclamation activities, to achieve mitigation for wetland impacts resulting from the time lag between the initiation of impacts to wetlands and the reestablishment of their pre-mine wetland quality.

Wetland Impacts

There are approximately 5,994 acres of wetlands located within the 31,260-acre study area. Approximately 13,375 acres (excluding linear facilities) will be impacted over a 40-year period by the construction of the power plant and the associated surface mining operation, including 2,374 acres of wetlands (**Figure 1**). The impact to the wetlands associated with the surface mining operation will not occur simultaneously; rather as the years advance and the disturbances advance, the acres of wetland mitigation will also advance. The wetland impacts will occur in incremental steps as the mining advances through the mine block area. This will include 979 acres of high quality wetlands, 950 acres of medium quality wetlands, and 445 acres of low quality wetlands. The quality of wetlands vary throughout each mine block; as a result, disturbance in a mine block impacts a variety of wetlands and does not necessarily target one key quality category. The majority of all wetland impacts will occur in forested wetlands (1,956 acres); whereas, relatively small acreages of scrub-shrub wetlands (247 acres) and herbaceous wetlands (181 acres) will be impacted by the mining operation.

Wetland Mitigation Approach

The reclamation of impacted wetlands will be performed upon the completion of mining. Impacted wetlands will be restored to a hydrologic condition that will adequately support wetland vegetation and overall function. The reclamation lands that are owned by NACC will be replanted with native hardwood species; leased lands will be replanted in accordance with contractual rights of the property owner. Mitigation will be accomplished through the preservation of high and/or medium quality wetlands that will not be disturbed by mining activity, and through the enhancement of low quality wetlands. Preserved wetlands will primarily consist of high-quality hardwood wetlands located within the study area. Wetlands that will be enhanced as part of mitigation will primarily consist of low-quality herbaceous wetlands that occur in the extensive areas of wet fields located inside the study area. Wet pasture will be converted to hardwood wetlands as part of the enhancement measures. In addition to the conversion of wet pasture to hardwoods, some areas of low-quality pine dominated forested wetlands may be converted to hardwood wetland ecosystems to fulfill a portion of the mitigation requirements.

The following conditions will likely be prevalent in the evaluated wetlands after ten years of reclamation activities: native hardwood trees will be approximately 15 to 20 feet in height; the shrub layer will be very thick due to a relatively open canopy; herbaceous vegetative growth will be inhibited by shading and competition with shrub species; exotic species will be controlled and will account for less than ten percent of species composition in the canopy, shrub and herbaceous layers; hydrologic function will improve; and in cases where the wetland is buffered by other impacted wetlands there will be an increased value in both buffer quality and water quality input.

In areas where high WRAP scores were recorded prior to the surface mining operations the determination was made that there would generally be a slight increase in score for Wetland Hydrology after ten years, and projected a decreased score in the Wetland Overstory and Wetland Ground Cover parameters. A large majority of wetlands in the study area were observed to have some extent of decreased hydrologic function due to ditching, erosion of upland soils into wetlands, improperly sized/placed culverts, and reduced drainage areas. The proposed reclamation will address and correct most of those hydrology problems. Wildlife Utilization scores will likely remain stable due to the influence of surrounding uplands and land use on the determination of the parameter’s score. When evaluating the ten-year and 40-year scores for the Upland/Wetland Buffer parameter it was assumed that the surrounding land use types associated with the upland buffers will typically be consistent with those prior to mining. Pastureland, pine plantation, and agricultural fields are the land use practices most commonly observed in the uplands throughout the study area.

In areas where medium WRAP scores were recorded in the study area, there will generally not be a significant change in wetland function after the first 10 years of reclamation; however, a majority of the planted pine forest, herbaceous field, and scrub-shrub wetland types (which generally received low pre-mine WRAP scores) within the mine block will either gain functional lift or be restored to their pre-mine state within the first ten years of reclamation. WRAP scores for these wetland types will typically increase in the Wetland Canopy, Wetland Ground Cover, and Field Hydrology parameters through the establishment of adequate wetland hydrology and re-planting of native hardwoods. Due to the time lag for hardwood maturation, areas defined as high-quality forested wetlands will not gain functional lift from their pre-mine state within the first 10 years of reclamation.

Vittor & Associates believes that the following conditions will likely be prevalent in the evaluated wetlands after 40 years of reclamation activities: the middle-aged hardwood stand will create a relatively closed canopy; the shrub layer will be significantly thinned down from the 10-year densities; herbaceous vegetative growth will benefit from a lack of competition with shrub species; exotic species will be controlled in the canopy, shrub and herbaceous layers; hydrologic function will improve; and the wetlands themselves will act as buffers and wildlife corridors.

A majority of the projected 40-year post-reclamation WRAP scores reflected a functional lift from the pre-mining wetlands. Typically the wetlands will be improved due to a more natural composition of native wetland vegetation and more desirable densities in the vegetative layers. Wildlife will benefit from increased cover, food availability, and roosting/nesting habitat. Mature hardwoods will produce nutrient-rich mast for deer, squirrels, rodents and other wildlife. Wetlands soils will be stabilized by the root mass of the maturing forest and will help buffer streams during rain events. As previously mentioned, the upland buffers were considered to mirror present day conditions and did not account for any increase in functional lift for the evaluated wetlands.

To provide an estimation of the net change in wetland qualities the differences between pre-mine and 40-year post-reclamation WRAP scores were calculated for each of the 14 mine block wetlands that were evaluated (see results in **Table 1**). No scrub-shrub wetlands were evaluated within the currently proposed mine block; however, the 40-year post-reclamation WRAP scores were projected for two scrub-shrub wetlands within the study area that are representative of the overall quality of scrub-shrub wetlands located within the mine block. The estimated functional lift values in **Table 1** were used to determine the number of wetland credits that will be required to mitigate for the temporal loss of wetland function due to mining operations (**See Table 2**).

In accordance with the policies of the Mobile District Corps of Engineers, NACC proposes to offset half of the temporal loss of wetland function associated with its mining activities through preservation of high and/or medium quality wetlands, and half through enhancement of low quality wetlands. During extensive field surveys the widespread conversion of high and medium quality forested wetlands to two predominant forms of land use were observed: pasture (which accounts for nearly all acres classified as low quality herbaceous wetland) and row-planted pine (which accounts for a large portion of the acreage classified as low quality forested wetland). Vittor & Associates acknowledged the likelihood that high and medium quality forested wetlands that are not owned by NACC are susceptible to being converted to pasture or row-planted pine, and accounted for that probability by using the average loss of function associated with the conversion to pasture and planted pine to determine the credit value per acre of preserved high and medium quality forested wetlands. That value was then divided into the total credits needed to achieve 50 percent preservation (233.5) to determine the acreage of both medium and high quality wetlands that will need to be preserved (**Table 3**). Vittor & Associates believes that the preservation of wetlands in the study area, where land use practices often diminish wetland quality, will provide a significant benefit to wetland function over time. Based on the calculations in **Table 3** NACC will need to set aside approximately 577 acres of high quality wetlands, or 1,038 acres of medium quality wetlands, to achieve the preservation requirement.

Low quality herbaceous and forested wetland types are prevalent throughout the study area. These wetland types generally receive low WRAP scores in the Wetland Canopy and Wetland Ground Cover parameters, and can be successfully enhanced by replacing undesirable canopy species with proper densities of native hardwoods, and by reestablishing wetland hydrology in areas that had been partially drained by farming. The average WRAP for high quality forested wetlands was used as the achievable target for enhancement wetlands. The average WRAP score of both herbaceous and forested low quality wetlands in the study area was subtracted from the estimated WRAP score of enhanced wetlands to obtain the average functional lift (per acre) of each wetland type. The functional lift values were then divided into the total credits needed to achieve 50 percent enhancement (233.5 units) to determine the acreage of both low quality forested and low quality herbaceous wetlands that will need to be enhanced (see **Table 4**). Based on these calculations NACC will need to enhance 491 acres of low quality herbaceous wetlands, or 614 acres of low quality forested wetlands to achieve the enhancement mitigation requirement (see **Table 4**).

Wetlands that are preserved or enhanced on Company-owned property will be deed restricted and maintained in perpetuity in accordance with Clean Water Act, Section 404 compensatory mitigation guidelines. An accepted compensatory mitigation plan will be provided to the COE prior to the impact of any streams or wetlands.

MITIGATION MONITORING

Monitoring of the stream and wetland reclamation/mitigation sites will be conducted annually for at least five years after a mine block is reclaimed. Stream monitoring will include measurement of physical parameters including stream pattern, profile, and dimension metrics, water temperature, dissolved oxygen content, pH, stream substrate characteristics, erosion patterns, and biological parameters that may include density and diversity of reptiles, amphibians, fish, freshwater mussels, or other fauna at sites in the stream above, within, and below the restored reach. Monitoring of the restored riparian buffers will include documenting the present vegetative species composition, density, and structure including average species height and diameter (dbh). Photographic documentation will be included in the monitoring effort. Wetland mitigation area monitoring will address growth and percent survival of planted wetland trees, percent cover by ground-cover and shrub species, presence/absence of exotic invasive plant species, and evidence of wildlife utilization of the site. Annual monitoring reports will be provided to the appropriate State and Federal agencies.

CRITERIA FOR SUCCESS

Stream mitigation will be considered successful if the restored stream banks are stable with no substantial degradation, the stream is maintaining the pattern, profile and dimension of the reference reach stream, riparian buffer vegetation is achieving the reference reach target habitats in plant species diversity, density and structure, and stream habitats and aquatic populations indicate a positive trend in composition, density, and diversity. Wetland mitigation success criteria will include a minimum 75 percent survival rate for planted trees; a ground-cover of at least 50 percent after two growing seasons; and an average height of ten feet for wetland trees, within ten years of planting.

REMEDIAL ACTIONS

If the restored stream and riparian buffers fail to achieve target success criteria in terms of stream bank stability, riparian buffer vegetation, stream channel stability, or biological indicators, reasons for failure will be evaluated and adaptive management actions will be planned, approved, and implemented. Similarly, if reclaimed wetlands fail to meet the goals of hydrologic regime or vegetative cover, remedial actions will be considered, such as planting alternative species of trees, introducing additional suitable wetland herbaceous or graminoid plants (seeding or transplanting), and/or modifying post-reclamation contours. Such measures will be addressed through discussions with the cognizant regulatory and resource agencies.

FIGURE 1

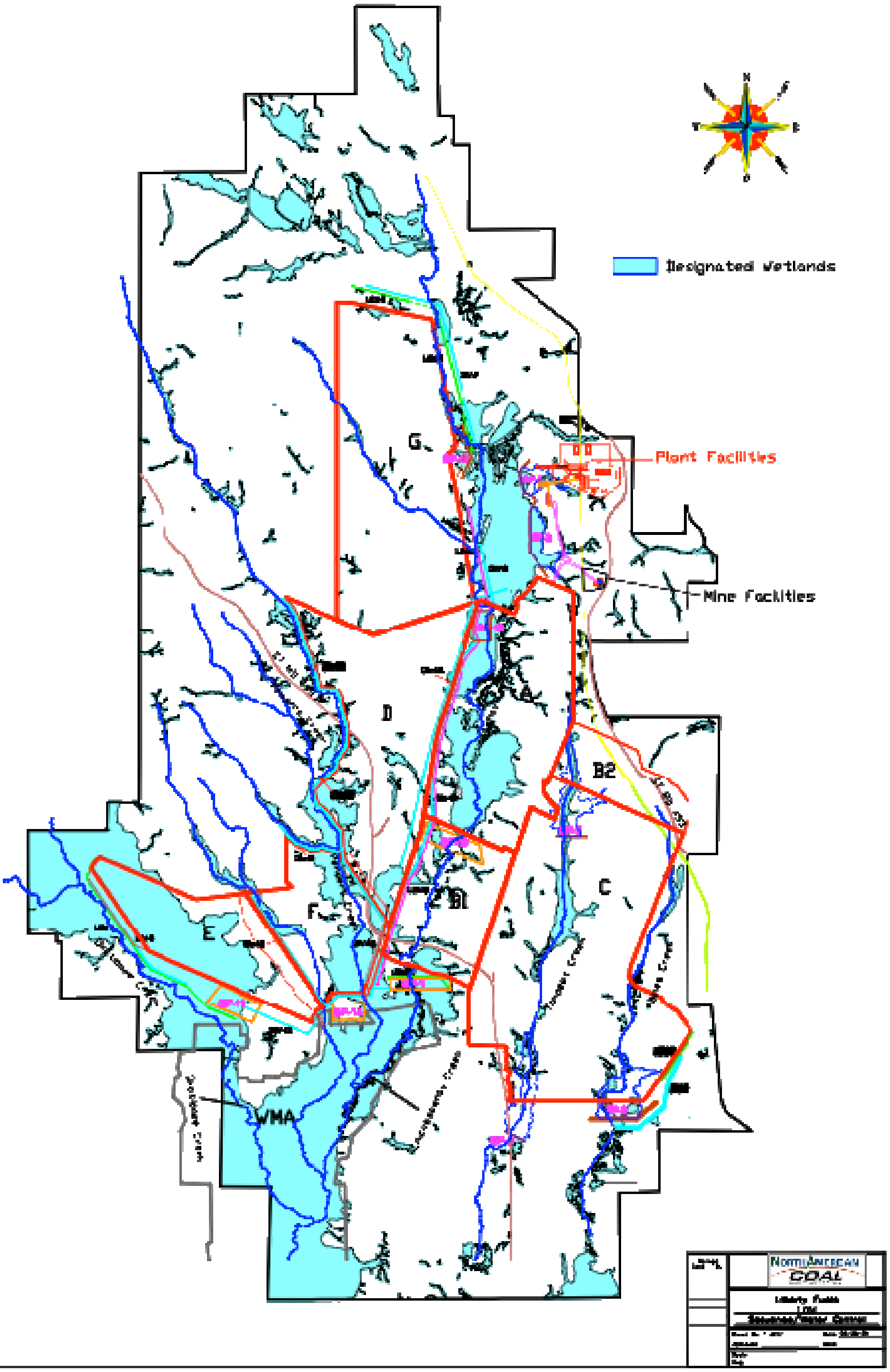
Designated Wetlands
Plant Facilities
Mine Facilities
G
D
A
B2
B1
C
E
F
WMA
NorthAmerican
COAL
Liberty Fuels
LCM

FIGURE 2
ADVERSE IMPACT
FACTORS FOR RIVERINE SYSTEMS WORKSHEET

Stream Type Impacted	Intermittent 0.1			1st or 2nd Order Perennial Stream 0.8			>2nd Order Perennial Stream 0.4		
Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Impaired 0.1			Somewhat Impaired 0.8			Fully Functional 1.6		
Duration	Temporary 0.05			Recurrent 0.1			Permanent 0.3		
Dominant Impact	Shade/ Clear 0.05	Utility Crossing 0.15	Below Grade Culvert 0.3	Armor 0.5	Detention/ Weir 0.75	Morpho-logic Change 1.5	Impound-ment (dam) 2.0	Pipe >100′ 2.2	Fill 2.5
Cumulative Impact Factor	<100′ 0	100′-200′ 0.05	201′-500′ 0.1	501-1000′ 0.2	>1000 linear feet (LF) 0.1 for each 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1)				

Factor	Somewhat Impaired 1st or 2nd Perennial Dominant Impact Type 1	Impaired 1st or 2nd Perennial Dominant Impact Type 2	Somewhat Impaired Intermittent Dominant Impact Type 2	Impaired Intermittent Dominant Impact Type 2	Dominant Impact Type 2
Stream Type Impacted	0.8	0.8	0.1	0.1	
Priority Area	0.1	0.1	0.1	0.1	
Existing Condition	0.8	0.1	0.8	0.1	
Duration	0.05	0.05	0.05	0.05	
Dominant Impact	1.5	1.5	1.5	1.5	
Cumulative Impacts Factor	0.2	0.2	0.2	0.2	
Sum of Factors	M= 3.45	2.75	2.75	2.05	
Linear Feet Of Stream Impacted in Research	LF= 1,000	1,000	1,000	1,000	
M X LF	3,450	2,750	2,750	2,050	

Total Mitigation Credits Required = (MXLF) = ____________________

FIGURE 3
IN-STREAM WORK
STREAM CHANNEL/STREAMBANK RESTORATION AND RELOCATION WORKSHEET

<table>
<tr><td rowspan="2">Stream Type</td><td rowspan="2">Intermittent
0.05</td><td colspan="4" rowspan="2">1st or 2nd Order Perennial Stream
0.4</td><td colspan="9">>2nd order Perennial Stream (Bankfull width)</td></tr>
<tr><td colspan="2">>15′
0.4</td><td colspan="3">15′-30′
0.6</td><td colspan="3">30′-50′
0.8</td><td>>50′
1.0</td></tr>
<tr><td>Priority Area</td><td colspan="3">Tertiary
0.05</td><td colspan="6">Secondary
0.2</td><td colspan="5">Primary
0.4</td></tr>
<tr><td>Existing Condition</td><td colspan="5">Impaired
0.4</td><td colspan="9">Somewhat Impaired
0.05</td></tr>
<tr><td rowspan="2">Net Benefit</td><td colspan="5" rowspan="2">Stream Relocation
0.1</td><td colspan="9">Stream Channel Restoration/Stream Bank Stabilization</td></tr>
<tr><td colspan="3">Moderate
1.0</td><td colspan="4">Good
2.0</td><td colspan="2">Excellent
3.5</td></tr>
<tr><td>Streambank Stability</td><td colspan="6">Stable Banks
0.4</td><td colspan="8">Moderately Stable Banks
0.2</td></tr>
<tr><td>Instream Habitat</td><td colspan="2">>5 Cover types
0.35</td><td colspan="4">5 Cover types
0.25</td><td colspan="5">4 Cover types
0.15</td><td colspan="3">3 Cover types
0.1</td></tr>
<tr><td>Timing of Mitigation</td><td colspan="4">Before
0.15</td><td colspan="6">During
0.05</td><td colspan="4">After
0</td></tr>
</table>

Factors	Somewhat Impaired Net Benefit 1	Impaired Net Benefit 2	Net Benefit 3	Net Benefit 4	Somewhat Impaired Net Benefit 5	Impaired Net Benefit 6
Stream Type	0.4	0.4			0.4	0.4
Priority Area	0.05	0.05			0.05	0.05
Existing Condition	0.05	0.4			0.05	0.4
Net Benefit	0.1	0.1			2.0	2.0
Bank Stability	0.4	0.4			0.4	0.4
Instream Habitat	0.15	0.15			0.15	0.15
Timing of Mitigation	0.15	0.15				
Sum Factors (M)=	1.3	1.65			3.05	3.4
Stream length in Reach (do not count each bank separately) (LF)=	1,000	1,000			1,000	1,000
Credits (C) = M x LF	1,300	1,650			3,050	3,400
Mitigation Factor Use (MF) = 0.5 or 1.0	0.5	0.5			1.0	1.0
Total Credits Generated C x MF=	650	825			3,050	3,400

Total Channel Restoration/Relocation Credits Generated = ____________________

Table 1. Net Change in Mine Block WRAP Values (Pre-Mine Vs. Proposed Post-Reclamation)

WRAP ID	Wetland Type (Pre-Mine)	WRAP Score (Pre-Mine)	10 - Year		40 - Year	
			WRAP Score (Post-Reclamation)	Net Change	WRAP Score (Post-Reclamation)	Net Change
WRAP 3	Forested - Planted Pine	0.49	0.61	0.12	0.74	0.25
WRAP 8	Forested - Planted Pine	0.47	0.69	0.22	0.86	0.39
WRAP 13	Forested - Hardwood	0.72	0.74	0.02	0.82	0.10
WRAP 19	Forested - Bottomland Forest	0.67	0.72	0.05	0.78	0.11
WRAP 22	Forested - Bottomland Forest	0.81	0.72	-0.09	0.86	0.05
WRAP 23	Forested - Bottomland Forest	0.83	0.72	-0.11	0.86	0.03
WRAP 29	Forested - Hardwood	0.61	0.67	0.06	0.88	0.27
WRAP 31	Forested - Bottomland Forest	0.61	0.77	0.16	0.86	0.25
WRAP 32	Herbaceous - Field	0.51	0.77	0.26	0.88	0.37
WRAP 35	Herbaceous - Field	0.44	0.63	0.19	0.73	0.29
WRAP 36	Forested - Mixed Pine/Hardwood	0.61	0.76	0.15	0.83	0.22
WRAP 43	Herbaceous - Field	0.28	0.60	0.32	0.80	0.52
WRAP 47	Forested - Bottomland Forest	0.83	0.71	-0.12	0.83	0.00
WRAP 49	Forested - Mixed Hardwood/Pine	0.45	0.67	0.22	0.83	0.38
WRAP 48*****	Scrub-Shrub	0.42	0.57	0.15	0.71	0.29
WRAP 51*****	Scrub-Shrub	0.61	0.60	-0.01	0.71	0.10

***** WRAP scores for scrub-shrub wetlands were not recorded within the currently proposed mine block; however, the scrub-shrub scores listed in **Table 1.** were obtained in close proximity to the mine block and are representative of the overall qualities of scrub-shrub wetlands within the study area.

Table 2. Wetland Credits Required to Achieve Mitigation for Temporal Loss

Wetland Type	Average WRAP Score Within Proposed Mine Blocks (Existing Conditions)	Average Functional Lift - 40 Years (Post Reclamation)	Time(yrs) Required for Compensatory Mitigation	Temporal Loss Factor (YS = +3)	Wetland Acreage Impacted	Wetland Credits Required for Mitigation	Wetland Credits Accrued by Reclamation	Post-Reclamation: Net Gain (+) or Loss (-) of Wetland Credits
Herbaceous - Low Quality	0.36	0.41	4.0	0.9025	222.50	21.69	91.23	69.53
Herbaceous - Medium Quality	0.58	0.37	5.0	0.8871	14.99	1.69	5.55	3.85
Scrub/Shrub - Low Quality	0.42	0.29	6.0	0.8727	0.27	0.03	0.08	0.04
Scrub/Shrub - Medium Quality	0.61	0.10	9.0	0.8288	180.41	30.89	18.04	-12.85
Forested - Low Quality	0.45	0.34	13.0	0.7757	221.82	49.76	75.42	25.67
Forested - Medium Quality	0.63	0.19	18.0	0.7141	754.43	215.69	143.34	-72.35
Forested - High Quality	0.81	0.03	43.0	0.4789	979.44	510.38	29.38	-481.00

Total Wetland Credits Required : **467.10**

Table 3. Acreages Required for Alternative Wetland Types to Achieve 50% Mitigation (233.5 Credits) Through Preservation

Wetland Type Offered as Preservation	Average WRAP Score of Wetland Type Within the Study Area	Average WRAP Score of Low Quality Herbaceous Wetlands in Study Area	Average WRAP Score of Low Quality Forested Wetlands in Study Area	Average Wetland Function Preserved (Per Acre) Through the Avoidance of Conversion of Wetland Type to Low Quality Herbaceous or Low Quality Forested Wetland*	Acreage Required to Achieve 50% Preservation (233.5 credits)
Forested - High Quality	0.81	0.36	0.45	0.41	**576.54**
Forested - Medium Quality	0.63	0.36	0.45	0.23	**1037.78**

* During extensive field surveys BVA observed extensive conversion of High and Medium Quality Forested wetlands to two predominant forms of land use; Pasture (which accounts for nearly all acres classified as Low Quality Herbaceous wetland) and Row Planted Pine (which accounts for a large portion of the acreage classified as Low Quality Forested wetland). BVA acknowledged the likelihood that High and Medium Quality Forested wetlands are susceptible to being converted to Pasture or Row Planted Pine, and accounted for that probability by using the average loss of function associated with Pasture and Planted Pine to determine the credit value per acre of preserved High and Medium Quality Forested wetlands.

Table 4. Acreages Required for Alternative Wetland Types to Achieve 50% Mitigation (233.5 Credits) Through Enhancement

Wetland Type Being Restored	**Average WRAP Score of Wetland Type Within the Study Area**	**Wetland Quality Achieved by Enhancement***	**Functional Lift Achieved (Per Acre) by the Enhancement of Low Quality Herbaceous or Low Quality Forested Wetland Types***	**Acreage Required to Achieve 50% Enhancement (233.5 credits)**
Herbaceous - Low Quality	0.36	0.81	0.45	**491.27**
Forested - Low Quality	0.45	0.81	0.36	**614.08**

* Low Quality Herbaceous and Forested Wetland Types are prevalent throughout the study area. These wetland types generally receive low WRAP scores in the Wetland Canopy and Wetland Ground Cover parameters, and can be successfully enhanced by replacing undesirable canopy species with proper densities of native hardwoods. BVA used the average WRAP for High Quality Forested wetlands as the achievable wetland quality of enhanced wetlands.

APPENDIX Q

KEMPER COUNTY IGCC PROJECT
NOISE IMPACT STUDY

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NOISE STUDY FOR THE MISSISSIPPI POWER COMPANY IGCC POWER PLANT AND COAL MINING PROJECT

KEMPER COUNTY, MISSISSIPPI

January 2009

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NOISE STUDY FOR THE MISSISSIPPI POWER COMPANY IGCC POWER PLANT AND COAL MINING PROJECT KEMPER COUNTY, MISSISSIPPI

Prepared for:

Environmental Consulting & Technology, Inc.
3701 NW 98th Street
Gainesville, FL 32606

Prepared by:

Tech Environmental, Inc.
1601 Trapelo Road
Waltham, MA 02451
(781) 890-2220

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1.0 INTRODUCTION AND SUMMARY

Mississippi Power Company is proposing to build and operate a 550 MW Integrated Gasification Combined-Cycle (IGCC) power plant and coal mine in Kemper County, Mississippi. The site is located to the west of State Route 493 near the town of Liberty. The closest noise-sensitive receivers are Liberty Church and residences along Route 493. The major sound sources at the IGCC project site would be Process Air Compressors (PAC), PAC intercoolers, a GE 7FB combustion turbine, steam turbine, HRSG, generators, transformers and auxiliary equipment. The major sound sources for the coal mining operations would include the electric-powered dragline, hydraulic-powered shovel, large dozers, backhoes, dump trucks and graders. Both the IGCC power plant and coal mining operations would normally operate 24 hours per day, seven days per week. This report discusses project sound sources and the potential effects on the surrounding area.

The IGCC power plant and coal mining maximum sound levels at nearby sensitive receivers were calculated using the Cadna-A acoustic model that implements ISO Standard 9613-2. Sound mitigation for the IGCC power plant includes standard silencers and acoustical enclosures on the combined-cycle turbine equipment plus noise barrier walls around the PAC and PAC intercoolers. Predicted maximum facility sound levels would be 43 to 51 A-weighted decibels (dBA) at the nearest noise-sensitive receivers. Day-night sound levels (L_{dn}) are 6 dBA higher due to a nighttime penalty in the definition of L_{dn}. Predicted day-night sound levels (L_{dn}) from the facility are below the EPA residential noise guideline (55 dBA) at Liberty Church and all nearby residences except one. At that one residence, the predicted L_{dn} sound level would be 57 dBA and, though higher than the EPA guideline, it is below the HUD residential noise guideline of 65 dBA L_{dn} for acceptable residential noise exposure.

Because the coal mining operations' closest proximity to the nearest noise-sensitive receivers to the IGCC power plant is more than 2.3 miles away, the sound level contribution from coal mining operations would cause no impact. Furthermore, the cumulative impact form the IGCC power plant and coal mine operating simultaneously would not generate sound levels any higher than those generated from the IGCC power plant by itself.

This report is organized as follows. Section 2.0 discusses the concepts used in community noise analysis and provides examples so the reader can understand the decibel scale. Section 3.0 presents the State, County, and EPA guidelines that apply to the Project. Section 4.0 presents background measurements that were made in the study area. Section 5.0 presents the IGCC plant operational noise impact analysis along with a summary of proposed noise mitigation measures. Section 6.0 presents the coal mining operations and cumulative impacts. Finally, Section 7.0 discusses IGCC plant construction noise and mitigation measures.

2.0 NOISE CONCEPTS

Noise is defined as "unwanted sound", which implies sound pressure levels that are annoying or disrupt activities people are engaged in. The human sense of hearing is subjective and highly variable between individuals. Noise regulations and guidelines set quantitative limits to the sound pressure level (measured with sound analyzers and predicted with computer models) in order to protect people from sound exposures that most would judge to be annoying or disruptive.

The loudness of a sound is dependent on the radiated energy of the sound source and the propagation and attenuation characteristics of the air. The standard unit of sound pressure level (L_p) is the decibel (dB), a logarithmic scale formed by taking 20 times the $\log_{10}$ of a ratio of two pressures: the measured sound pressure divided by a reference sound pressure. The decibel level scale conveniently compresses the range of audible sound pressures, which span 12 orders of magnitude, into an easy to use scale spanning 0 to 120 dB. Airborne sound is referenced to 20 micro-Pascals[1] (20 µPa), which corresponds to 0 dB and the threshold of hearing. A property of the decibel scale is that the sound pressure levels of two separate sounds are not directly additive. For example, if a sound of 70 dB is added to another sound of 70 dB, the total is only a 3-decibel increase (or 73 dB), not a doubling to 140 dB. For broadband sounds, a 3 dB change is the minimum change perceptible to the human ear.

The acoustic energy level of a source is its sound power level (L_w), and L_w is also measured on a decibel scale, where the reference power is 10^{-12} Watts. The sound power level (e.g., L_w of 110 dBA re 10^{-12} W) is the same at any distance since it represents the energy intensity of a source. Thus, L_w values do not have reference distances. By contrast, a sound pressure level (e.g., L_p of 81 dBA re 20 µPa at 50 feet) must have a reference distance. Sound power levels are typically greater than 100 dBA in value and the large L_w numbers should not be confused with the sound pressure levels we hear.

Sound metrics are used to quantify sound pressure levels and to describe a sound's loudness, duration, and tonal character. A commonly used descriptor is the A-weighted decibel (dBA). The A-weighting scale attempts to approximate the human ear's sensitivity to certain frequencies by emphasizing the middle frequencies and de-emphasizing the lower and higher frequency sounds. The decibel is a

---

[1] A micro-Pascal is 10^{-6} Newton/meter^2.

logarithmic unit of measure of sound, meaning that a 10-decibel change in the sound level roughly corresponds to a doubling or halving of perceived loudness. A 3-dBA change in the noise level is generally defined as being just perceptible to the human ear. Table 1 provides the subjective effect of different changes in sound levels.

TABLE 1

SUBJECTIVE EFFECT OF CHANGES IN SOUND PRESSURE LEVELS

Change in Sound Level	Apparent Change in Loudness
3 dB	Just perceptible
5 dB	Noticeable
10 dB	Twice (or half) as loud

Reference: American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), 1989 ASHRAE Handbook—Fundamentals, Atlanta, Georgia, 1989.

The following measures of sound pressure level are based on the A-weighted decibel and are typically used when evaluating sound measurement data.

L_{eq}, or Equivalent Level, is the steady-state sound level during a given amount of time that has the same acoustic energy as the fluctuating noise levels during that same period.

L_{max}, or Maximum Level, represents the maximum sound level during a given time period.

L_n, or "n" Percentile Level, is the statistical representation of time-varying sound levels. This metric indicates that over a given time period, the fluctuating noise level was equal to or greater than the stated level for "n" percent of the time. Commonly used percentiles include the L_{10} and the L_{90}.

The **L_{90}**, or background level, is the sound level exceeded 90 percent of the time and represents sound levels heard during the quietest 10 percent of the time. The **L_{10}** defines the peaks of the intermittent noise sources and is commonly referred to as the intrusive sound level.

The day-night sound level **L_{dn}** is equal to the 24-hour L_{eq} level with a 10-dBA penalty added for the nighttime hours of 10 p.m. to 7 a.m.

Sound pressure level measurements typically include the analysis and breakdown of the sound spectrum into its various frequency components to determine tonal characteristics. The unit of measure of frequency is the Hertz (Hz), a measure of the cycles per second of sound waves. A total of eleven octave bands are used to define the frequency spectrum from 16 Hz to 16,000 Hz that approximates the range of audible sound.

The noise environment in an industrial area such as the site in Kemper County results from traffic on Route 493, and jet over flights. Natural sounds (wind noise, insects) predominate in areas located away from the existing highway. Typical sound levels associated with various activities and environments are presented in Table 2.

TABLE 2

COMMON SOUND LEVELS

Activity	dBA
Threshold of pain	130
Chipping on metal	120
Loud rock band	110
Jack hammer	100
Jet airliner ½ mile away	95
Threshold of hearing damage	90
Freeway traffic - downtown streets	80
Urban residential area	70
Normal conversation	60
Normal Suburban Area	50
Quiet suburban area	40
Rural area	30
Wilderness area	25
Threshold of audibility	0

3.0 NOISE REGULATIONS AND GUIDELINES

3.1 State and Local Noise Regulations

There are no State or local noise regulations that apply to this project. Kemper County has no ordinances pertaining to noise beyond the prohibition of creating a nuisance.

3.2 U.S. EPA Residential Noise Guidelines

The U.S. Environmental Protection Agency (EPA) has published residential guidelines[2] on environmental sound levels to protect public health and welfare. Because noise is usually associated with annoyance, criteria levels are based on community surveys of people's tolerance to noise. Different types of land uses also exhibit different sensitivities to noise. The EPA sound level guidelines do not provide an absolute measure of noise impact, but rather a consensus on potential community interference. It should also be noted that in any noise environment, some people may always be annoyed regardless of the sound level. The EPA residential guidelines are designed to protect against:

- Hearing Loss – 70 dBA 24-hour L_{eq}
- Outdoor Activity Interference and Annoyance – 55 dBA L_{dn}

The EPA suggests 55 dBA L_{dn} as an overall design goal for residential development. As a goal, the 55 L_{dn} is not enforceable, and does not consider economic considerations or engineering feasibility. EPA observes that maintenance of an outdoor L_{dn} not exceeding 55 dBA will permit normal speech communication and protect against sleep interference.[3] 55 dBA L_{dn} is equivalent to a 24-hour average L_{eq} level of 48.6 dBA. The EPA guidelines are proposed for use as one benchmark in evaluating sounds from the IGCC plant, and are summarized in Table 3.

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[2] U.S. EPA, Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety, Publication EPA-550/9-74-004, March, 1974.

[3] Ibid., page 21.

TABLE 3

U.S. EPA NOISE GUIDELINES TO PROTECT PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY FROM UNDUE EFFECTS

For Protection Against	Outdoor Guideline (dBA)
Activity interference, annoyance and sleep disturbance on residential property	55 L_{dn} (Equivalent to 48.6 L_{eq})
Hearing damage	70 L_{eq} (24-hours)

3.3 HUD Guidelines

The Department of Housing and Urban Development (HUD) has also established guidelines[4.] for evaluating noise impacts on residential land uses. The guidelines summarized in Table 4 suggest what are acceptable noise levels at residential locations. According to the HUD regulations, sites where the L_{dn} does not exceed 65 dBA are acceptable for housing. Sites where the L_{dn} is between 65 and 75 dBA are classified by HUD as "normally unacceptable" but may be approved if additional sound attenuation is designed into new housing, and sites where the L_{dn} exceeds 75 dBA are classified by HUD as "unacceptable". The L_{dn} 65 dBA HUD guideline is proposed for use as one benchmark in evaluating the IGCC plant. L_{dn} 65 dBA is equivalent to a 24-hour L_{eq} level of 58.6 dBA.

In the absence of State and local noise regulations, the EPA and HUD residential noise guidelines, L_{dn} 55 dBA and L_{dn} 65 dBA, respectively, will be used to evaluate sound impacts from the IGCC plant.

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[4] U.S. HUD, Environmental Criteria and Standards, 44 Federal Register 40860, July 12, 1979.

TABLE 4

U.S. HUD GUIDELINES FOR EVALUATING SOUND EFFECTS ON RESIDENTIAL PROPERTIES

Acceptability for Residential Use	**Outdoor Guideline Levels (dBA)**
Acceptable	65 L_{dn} (Equivalent to 58.6 L_{eq})
Acceptable With Design Attenuation	65-75 L_{dn}
Unacceptable	Greater than 75 L_{dn}

4.0 EXISTING CONDITIONS

Sound measurements were made by ECT, Inc. in the project area on September 17 and 18, 2008 between the hours of 11:00 a.m. and 9:00 p.m. for periods of slightly greater than 20 minutes at each location. These measurements were made in front of various residences located along Route 493. Average sound levels varied according to the distance from the highway and levels of existing traffic; average sound levels (L_{eq}) varied from 35 to 53 dBA. Maximum sound levels from roadway traffic ranged from 72 to 81 dBA. For one measurement without roadway traffic, an L_{eq} of 35 dBA was recorded. This is a typical sound level for a rural area. The existing residences and Liberty Church on Route 493 often experience higher average sound levels than 35 dBA due to motor vehicle traffic.

5.0 IGCC PLANT OPERATIONAL NOISE IMPACT AND MITIGATION

Maximum sound levels at nearby sensitive receivers (residences and Liberty Church) were calculated using the Cadna-A acoustic model assuming simultaneous operation of all IGCC plant equipment at maximum operating conditions. Figure 1 shows the location of noise sensitive receivers in relation to the project site and its property boundaries. Cadna-A is a sophisticated 3-D model for sound propagation and attenuation based on International Standard ISO 9613-2.[5] Atmospheric absorption is the process by which sound energy is absorbed by the air and was calculated using ANSI S1.26-1995.[6] Air absorption of sound assumed standard day conditions and is significant at large distances and at high frequencies. ISO 9613-2 was used to calculate propagation and attenuation of sound energy by hemispherical divergence with distance, surface and building reflection, and shielding effects by barriers, buildings, and ground topography. The predicted maximum sound levels are conservative because: (1) the acoustic model assumes a ground-based temperature inversion, such as may occur on a calm, clear night when sound propagation is most favorable; (2) the model was instructed to ignore foliage sound absorption; and (3) no ground absorption (i.e., 100% sound wave reflection) was assumed for the plant equipment area.

The potential future sources of sound at the site are the coal gasification process equipment, including process air compressors (PAC) and PAC intercoolers, a GE 7FB combustion turbine (CT) and generator, a steam turbine (ST) and generator, CT air inlet, heat recovery steam generator (HRSG), HRSG exhaust stack, cooling towers, transformers and auxiliary equipment. The design assumes standard silencers on the HRSG air inlet and exhaust and standard acoustical enclosures for the CT and ST. An added noise mitigation element in the design is noise barrier walls around the PAC and PAC intercoolers on the north, east, and south sides assumed to be 18 meters high. These sound sources have the highest sound power at the facility and the barrier walls are necessary to prevent offsite noise impacts.

---

[5] International Standard, ISO 9613-2, Acoustics – Attenuation of Sound During Propagation Outdoors, -- Part 2 General Method of Calculation.

[6] American National Standards Institute, ANSI S1.26-1995, American National Standard Method for the Calculation of the Absorption of Sound by the Atmosphere, 1995.

Future sound levels (L_{eq}) at the sensitive receiver locations are summarized in Table 3. These are maximum sound levels that assume all facility equipment is in operation and atmospheric conditions produce minimum sound attenuation. Predicted maximum facility sound levels are 43 to 51 dBA at the nearest receivers. Figure 2 presents a color contour plot of the facility sound levels and predicted levels at the sensitive receivers.

Table 3 also provides the day-night sound levels (L_{dn}) computed for noise from the project. Whereas the facility would operate 24 hours per day, the L_{dn} level is equal to the predicted L_{eq} level plus 6.4 dBA. These results show that the day-night (L_{dn}) operational sound levels at Liberty Church and at all but one of the nearest residences will comply with the EPA residential noise guideline of 55 dBA L_{dn}. The predicted level at Residence 6 will be slightly above the EPA guideline but below the HUD residential guideline of 65 dBA L_{dn}.

TABLE 5

MAXIMUM SOUND LEVELS FROM THE KEMPER COUNTY IGCC PLANT (dBA)

Receiver Location	Sound Facility (L_{eq})	Sound Facility (L_{dn})
Residence 1	46.2	52.6
Residence 2	47.4	53.8
Liberty Church	43.4	49.8
Residence 3	44.7	51.1
Residence 4	47.9	54.3
Residence 5	45.6	52.0
Residence 6	50.9	57.3

It is expected that the sound from the Kemper County IGCC plant will be more audible at night when there is less roadway traffic or human activity. Much of the time, depending upon weather conditions, actual sound levels would be less than predicted here, because this analysis does not include additional attenuation from wind gradients and atmospheric turbulence, effects that, at times, can reduce sound levels 10 to 20 dBA.

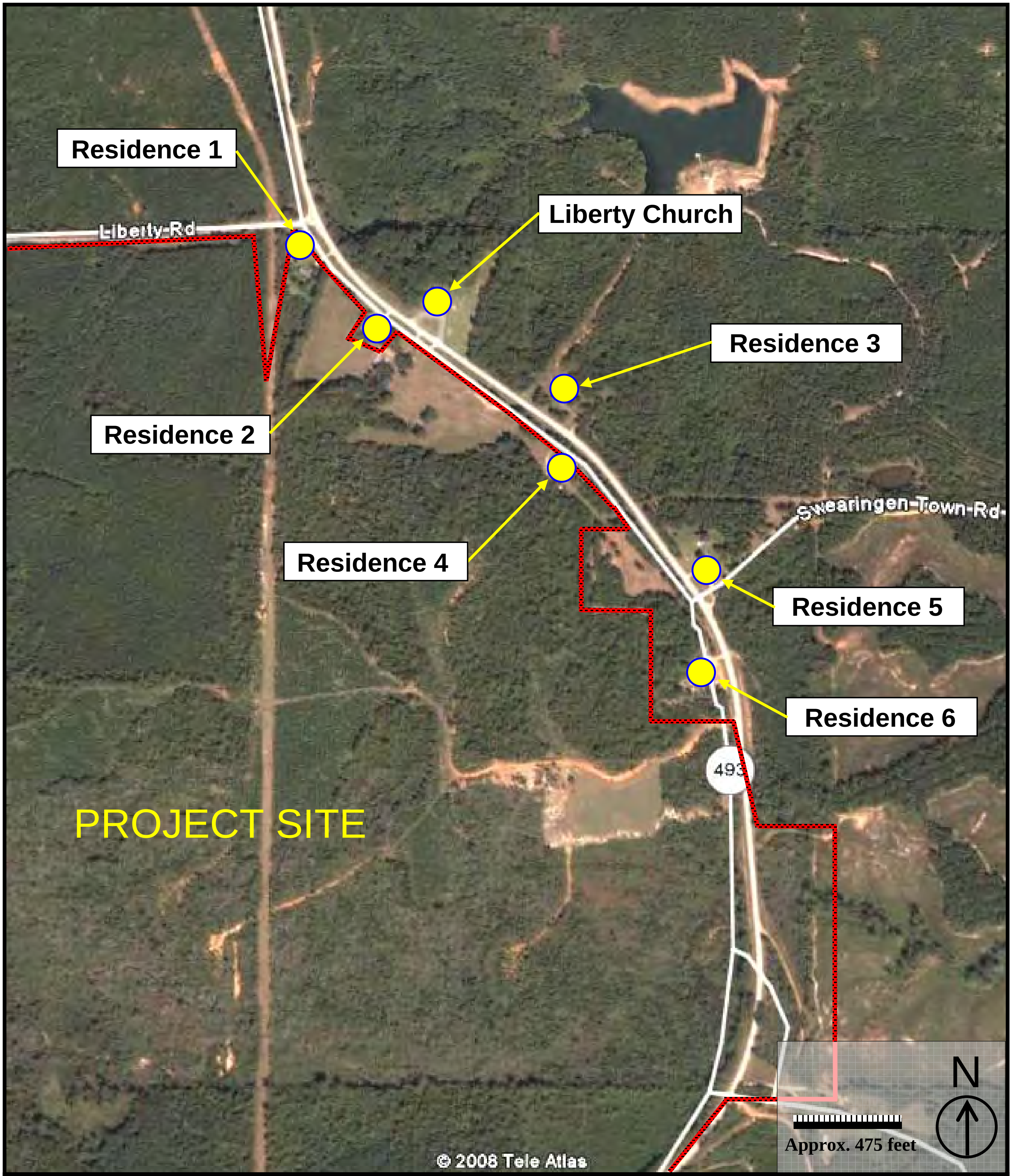

Figure 1

Sensitive Receiver Locations
Near Kemper County IGCC Plant

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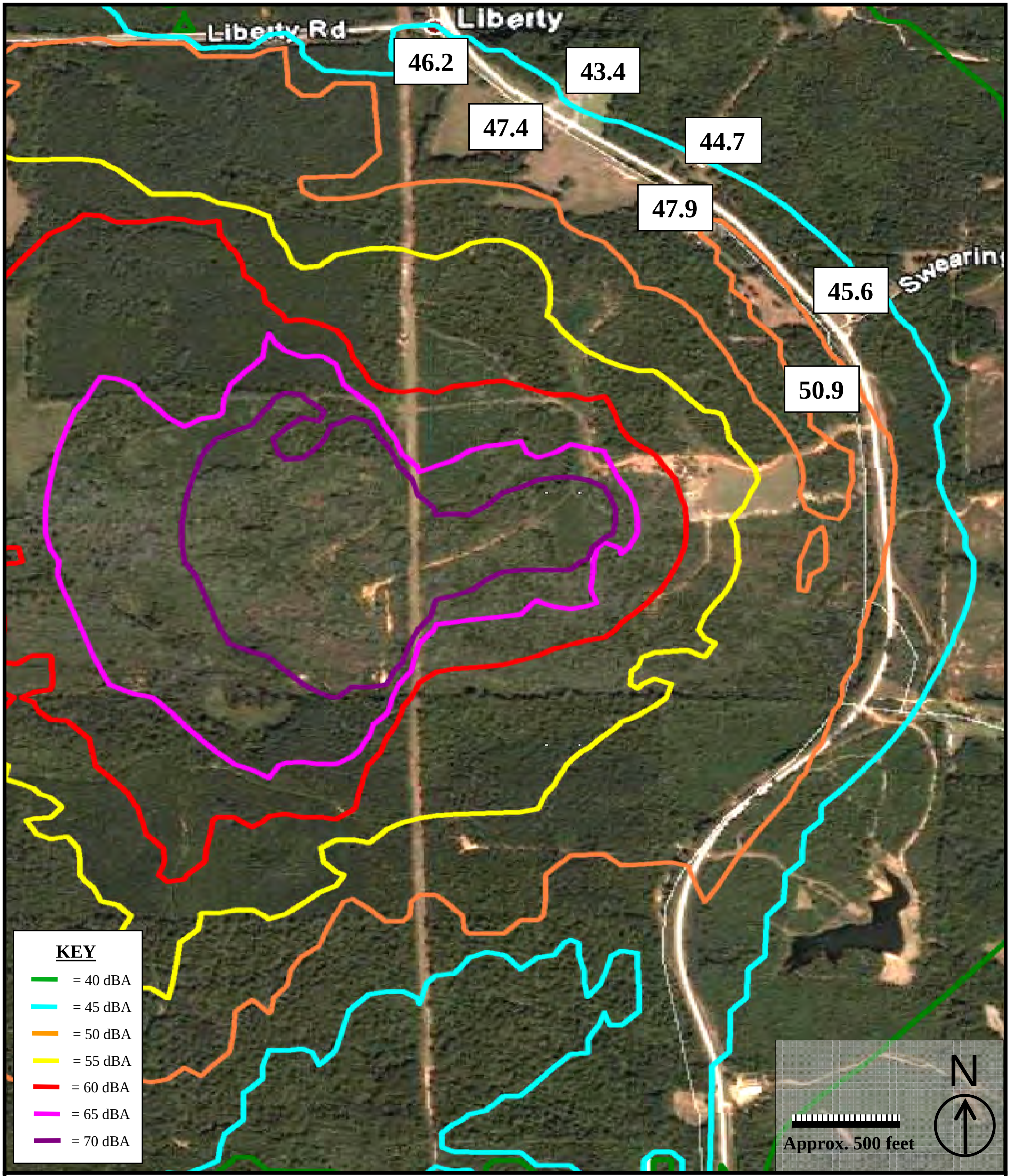

Figure 2

Maximum Sound Levels (dBA)
Kemper County IGCC Plant

TECH environmental

6.0 COAL MINING OPERATIONS AND CUMULATIVE IMPACTS

This section of the report presents the potential sound impacts from coal mining operations and the potential cumulative sound impact of coal mining and the IGCC power plant operations occurring simultaneously. Both operations would normally occur 24 hours per day and 7 days per week. The coal mining operation would consist of three major activities: 1) removal of overburden; 2) surface mining of coal, and 3) reclamation of the open pit. Each of these activities is described below.

Surface mining would first consist of removing the overburden and then the exposed coal seam with excavating equipment. This sequence would be repeated for each of coal seam to be mined. The removal of the overburden for the first 5 to 20-foot depths would be conducted using a hydraulic-powered shovel to excavate the overburden and load into large dump trucks, which would then remove the overburden from the area. At depths below 20 feet, the electric-powered dragline would be used to remove overburden material. The dragline would operate from a bench within the pit mine. Once the overburden is removed from the pit, surface mining operations would occur.

Equipment used during surface mining activities would consist of electric-powered dragline, cable tractor, loaders, large dump trucks, dozers, graders and backhoes. Surface mining would commence in the northeast corner of the “life of mine area” closest to the IGCC power plant. Each mining pit would be approximately 140 feet and 7,000 feet long and would be constructed from north to south with mining operations occurring from east to west within each pit.

As required by federal and state surface mining regulations, reclamation of mined areas would occur concurrently with other mining operations. Following removal of the final coal seam from a mine pit, the pit would be filled with the remaining overburden material from the adjacent active mine pit. The same equipment used to remove the overburden would be used during reclamation activities. If necessary, top soil would be brought on to the site and large dozers would be used to spread the final cover. The final cover would be mulched, seeded and planted to reduced run-off and dust impacts.

North American Coal Corporation (NAC) provided a list of equipment anticipated to be operation during coal mining. Noise emissions from mining operations were based on sound level measurements taken by NAC of some of the louder pieces of equipment and from Federal Highway Administration (FHWA) documentation[7]. Table 6 presents the equipment and sound power levels used to represent surface coal mining operations. Usage factors were applied to the sound power levels for each piece of equipment. A usage factor is the percentage of time during a one-hour period that the equipment is actually being used at its maximum power and not shutdown or at idles. For example, during mining operations, the dragline would have a high usage factor of 90 percent, whereas a large dozer would have usage factor of 40 percent[7].

The Cadna-A model was used to model the surface coal mining operations. The overburden removal phase would generate the highest sound levels during coal mining operations because much of the equipment would be working at the shallowest depth of the coal mining activities compared to those inside the pit, which would provide shielding for the dragline other mining equipment. These highest sound levels were used to assess potential noise impacts at the seven noise-sensitive receivers. Sound modeling was conducted for two worst-case scenarios: 1) coal mining operations at its closest point to the noise sensitive receivers and 2) coal mining and IGCC power plant operating simultaneously. Because the coal mining operations' closest proximity to the nearest noise-sensitive receivers to the IGCC power plant is more than 2.3 miles away, the sound level contribution from coal mining operations would cause no impact at the noise-sensitive receivers; therefore, background sound levels would not increase. Similarly, the cumulative modeling results showed that the IGCC power plant and coal mine operating simultaneously would not generate sound levels higher than those presented in Table 5 for IGCC power plant operating by itself. Figures 3 and 4 show the maximum sound level contours for coal mining operations only and coal mining and IGCC power plant operating simultaneously. Appendix A presents the Cadna-A model outputs.

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[7] U.S. Department of Transportation, FHWA Roadway Construction Noise Model User's Guide, January 2006.

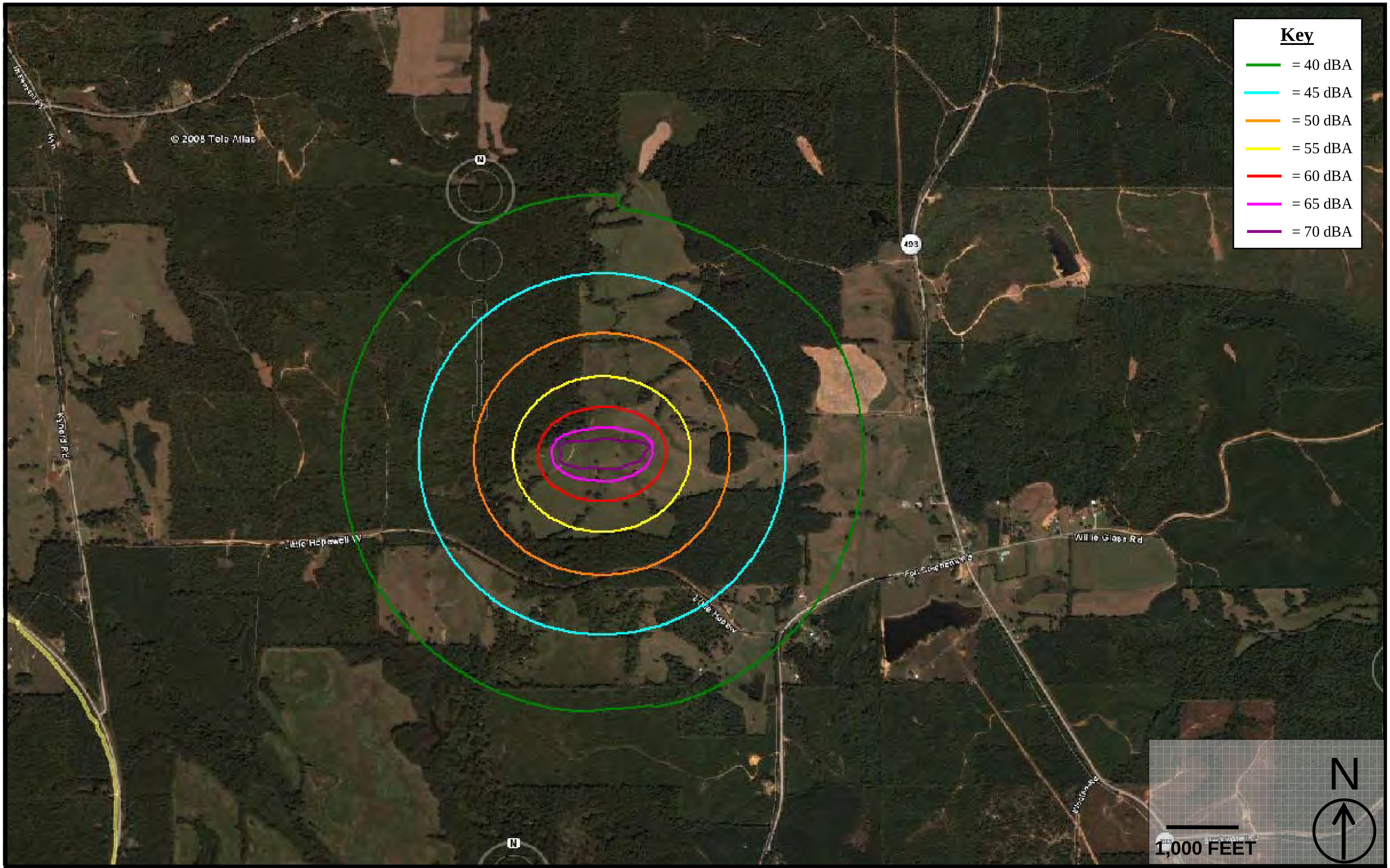

FIGURE 3.

Maximum Sound Levels
From Surface Mining Operations
With No IGCC Power Plant Noise (dBA)

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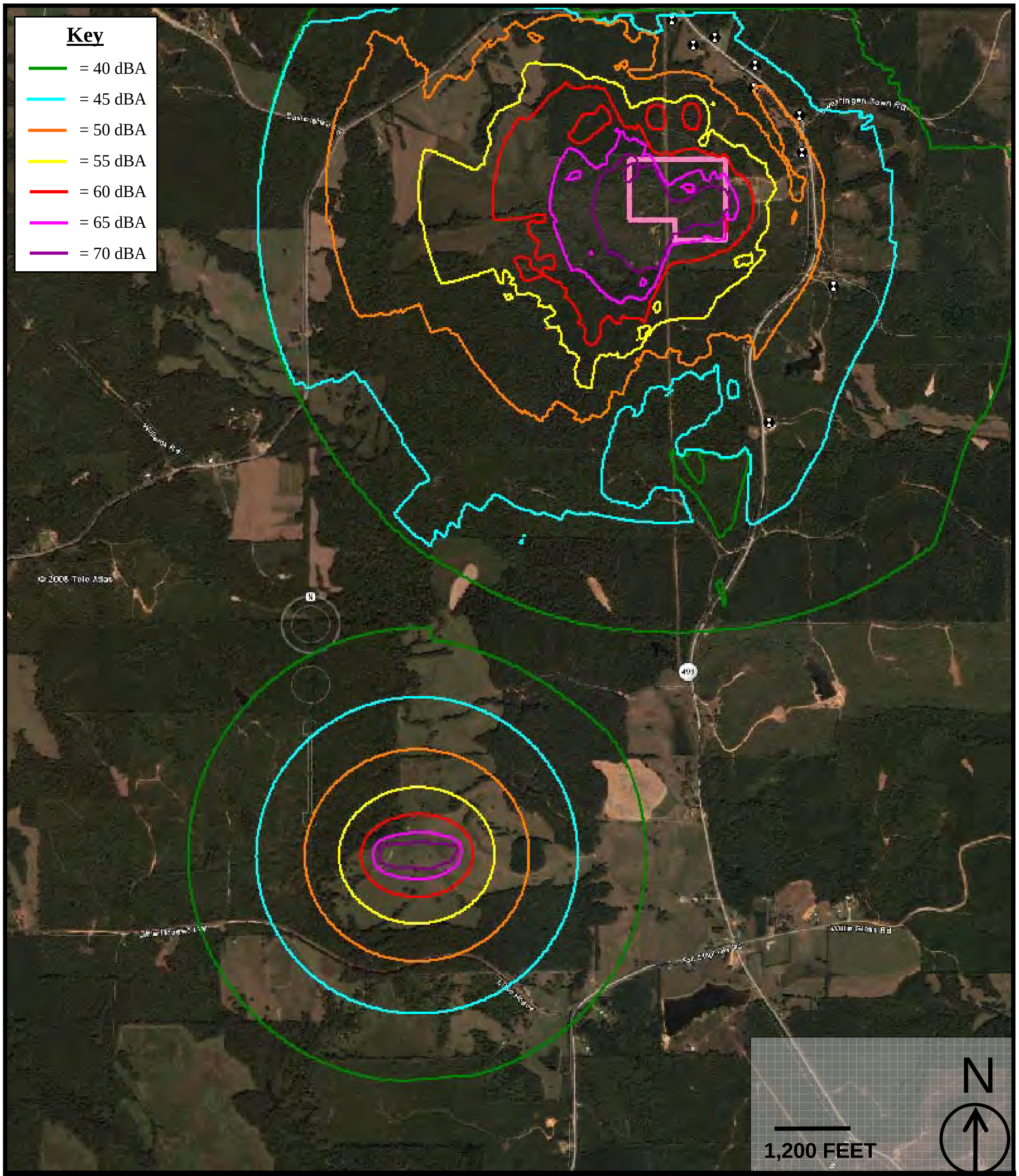

Figure 4.

Maximum Sound Levels
From Surface Mining Operations and
IGCC Power Plant Noise (dBA)

Tech environmental

TABLE 6

COAL MINING EQUIPMENT SOUND POWER LEVELS

Equipment	Sound Power Level (L_w) (dBA)
P&H 757 Dragline*	119
Cable Tractor	113
Cat 966 F.E.L.	108
Cat 345 Backhoe	108
Cat 365 Backhoe	108
Cat 789C End Dump Truck*	112
Cat 785C End Dump Truck	111
Cat 844 Wheel Dozer	110
Cat 994F Wheel Loader	112
Cat D11R Track Dozer	109
Cat D10R Track Dozer	110
Cat D10R D.L. Dozer	116
Cat D6LGP/D8LPG Track Dozer	110
Cat 24H *and 16 H Graders	115
Cat D400 Dump Truck	110
O&K Hydraulic Shovel	116
O&K RH120C Backhoe	108
Cat 436 Backhoe/Loader	114
Cat 825C Compactor	109
Cat Water Truck	107

*NAC provided sound data for these pieces of equipment.

7.0 IGCC PLANT CONSTRUCTION NOISE IMPACT AND MITIGATION

The construction of the Kemper County IGCC Project will require the use of equipment that may be audible from off-site locations. Facility construction will consist of site clearance, excavation, foundation work, steel erection and installation of facility equipment, and finishing work. These activities will overlap. Pile driving, generally considered the noisiest construction activity, may be required.

The noise levels resulting from construction activities vary greatly depending on factors such as the type of equipment, the specific equipment model, the operations being performed, and the overall condition of the equipment. Variations in the energy expended by the equipment and changes in construction phases and equipment mix make the prediction of potential noise impacts even more challenging.

EPA[8] has published data on the average sound levels for typical construction phases of industrial facilities. These average levels were projected from the edge of the facility footprint to the closest residential receiver, located at a distance of approximately 900 feet. This calculation conservatively assumes all equipment operating concurrently onsite for the specified construction phase. The results of these calculations are presented in Table 7 and show estimated construction sound levels at the nearest residence will be between 53 and 64 dBA for all activities except pile driving, which if necessary would produce a sound level of about 68 dBA at the nearest residence. If pile driving were required for the project's foundations, that activity would be limited to daytime hours. The construction sound at more distant locations will be less since sound level decreases with distance from the sound source. Construction noise impacts will be temporarily and the highest levels experienced by residents will be no louder than maximum levels from passby traffic on Route 493.

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[8] EPA PB 206 717, Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances, February, 1971.

TABLE 7

ESTIMATED SOUND LEVELS AT THE CLOSEST RESIDENTIAL RECEPTOR BY CONSTRUCTION PHASE

Construction Phase	50 Feet from Source (L_{eq})	At Closest Residential Receptor, (L_{eq})
Site Clearance	90	64
Excavation	89	63
Pile Driving	95	68
Foundations	78	53
Erection	85	60
Finishing	89	63

Reasonable effort will be made to minimize the impact of noise resulting from construction activities. The mitigation measures outlined below will be incorporated into the construction management guidelines:

- Construction activities that produce significant noise will generally be limited to daytime hours.
- Properly designed engine enclosures and intake silencers will be required.
- Regular equipment maintenance and lubrication will be required.
- All exhaust systems will be in good working order.

As the design of the Project progresses and construction scheduling has been finalized, the mitigation plan will be reviewed to minimize the effects of construction noise.

APPENDIX A

CADNA MODEL OUTPUT

Dragline P&H 757

1/1 Octave Band Sound Power

	16Hz	114.16
50% usage	**31.5Hz**	114.16
3dB	**63Hz**	113.16
	125Hz	113.16
	250Hz	113.16
	500Hz	112.16
	1KHz	113.16
	2KHz	111.16
	4KHz	111.16
	8KHz	110.16
	16KHz	108.16
L-Weighted		
	Broadband	**122.9**
A-Weighted		
	Broadband	**118.7**

Cable Tractor

1/1 Octave Band Sound Power

	16Hz	103.60
50% usage	**31.5Hz**	101.60
3dB	**63Hz**	109.60
	125Hz	109.60
	250Hz	106.60
	500Hz	106.60
	1KHz	104.60
	2KHz	105.60
	4KHz	105.60
	8KHz	104.60
	16KHz	103.60
L-Weighted		
	Broadband	**116.70**
A-Weighted		
	Broadband	**112.60**

Cat 966 F.E.L

1/1 Octave Band Sound Power

	16Hz	98.60
40% usage	**31.5Hz**	96.60
4dB	**63Hz**	104.60
	125Hz	104.60
	250Hz	101.60
	500Hz	101.60
	1KHz	99.60
	2KHz	100.60
	4KHz	100.60
	8KHz	99.60
	16KHz	98.60
L-Weighted		
	Broadband	**111.70**
A-Weighted		
	Broadband	**107.50**

Cat 345 Backhoe

1/1 Octave Band Sound Power

	16Hz	98.60
40% usage	**31.5Hz**	96.60
4dB	**63Hz**	104.60
	125Hz	104.60
	250Hz	101.60
	500Hz	101.60
	1KHz	99.60
	2KHz	100.60
	4KHz	100.60
	8KHz	99.60
	16KHz	98.60
L-Weighted		
	Broadband	**111.70**
A-Weighted		
	Broadband	**107.50**

Cat 789C End Dump

1/1 Octave Band Sound Power		
	16Hz	114.16
40% usage	**31.5Hz**	114.16
4dB	**63Hz**	106.16
	125Hz	108.16
	250Hz	111.16
	500Hz	106.16
	1KHz	104.16
	2KHz	93.16
	4KHz	95.16
	8KHz	109.16
	16KHz	88.16
L-Weighted		
	Broadband	**119.62**
A-Weighted		
	Broadband	**111.38**

Cat 785C End Dump

1/1 Octave Band Sound Power		
	16Hz	114.16
40% usage	**31.5Hz**	114.16
4dB	**63Hz**	106.16
	125Hz	108.16
	250Hz	111.16
	500Hz	106.16
	1KHz	104.16
	2KHz	93.16
	4KHz	95.16
	8KHz	109.16
	16KHz	88.16
L-Weighted		
	Broadband	**119.62**
A-Weighted		
	Broadband	**111.38**

O&K RH120C Backhoe

1/1 Octave Band Sound Power		
	16Hz	98.60
40% usage	**31.5Hz**	96.60
4dB	**63Hz**	104.60
	125Hz	104.60
	250Hz	101.60
	500Hz	101.60
	1KHz	99.60
	2KHz	100.60
	4KHz	100.60
	8KHz	99.60
	16KHz	98.60
L-Weighted		
	Broadband	**111.70**
A-Weighted		
	Broadband	**107.50**

Cat 994F Wheel Loader

1/1 Octave Band Sound Power		
	16Hz	109.60
40% usage	**31.5Hz**	109.60
4dB	**63Hz**	108.60
	125Hz	106.60
	250Hz	110.60
	500Hz	111.60
	1KHz	107.60
	2KHz	98.60
	4KHz	98.60
	8KHz	97.60
	16KHz	92.60
L-Weighted		
	Broadband	**118.10**
A-Weighted		
	Broadband	**112.30**

Cat D11R Track Dozer

1/1 Octave Band Sound Power

	16Hz	110.26
40% usage	**31.5Hz**	109.26
4dB	**63Hz**	106.26
	125Hz	106.26
	250Hz	102.26
	500Hz	105.26
	1KHz	105.26
	2KHz	101.26
	4KHz	99.26
	8KHz	96.26
	16KHz	90.26
L-Weighted		
	Broadband	**115.87**
A-Weighted		
	Broadband	**109.28**

Cat D10R D.L Dozer

1/1 Octave Band Sound Power

	16Hz	116.60
40% usage	**31.5Hz**	115.60
4dB	**63Hz**	112.60
	125Hz	112.60
	250Hz	108.60
	500Hz	111.60
	1KHz	111.60
	2KHz	107.60
	4KHz	105.60
	8KHz	102.60
	16KHz	96.60
L-Weighted		
	Broadband	**122.20**
A-Weighted		
	Broadband	**115.60**

Cat D10R Track Dozer

1/1 Octave Band Sound Power

	16Hz	111.00
40% usage	**31.5Hz**	110.00
4dB	**63Hz**	107.00
	125Hz	107.00
	250Hz	103.00
	500Hz	106.00
	1KHz	106.00
	2KHz	102.00
	4KHz	100.00
	8KHz	97.00
	16KHz	91.00
L-Weighted		
	Broadband	**117.00**
A-Weighted		
	Broadband	**110.00**

Cat D8LPG Track Dozer

1/1 Octave Band Sound Power

	16Hz	111.00
40% usage	**31.5Hz**	110.00
4dB	**63Hz**	107.00
	125Hz	107.00
	250Hz	103.00
	500Hz	106.00
	1KHz	106.00
	2KHz	102.00
	4KHz	100.00
	8KHz	97.00
	16KHz	91.00
L-Weighted		
	Broadband	**117.00**
A-Weighted		
	Broadband	**110.00**

Cat D6LGP Track Dozer

1/1 Octave Band Sound Power		
	16Hz	111.00
40% usage	**31.5Hz**	110.00
4dB	**63Hz**	107.00
	125Hz	107.00
	250Hz	103.00
	500Hz	106.00
	1KHz	106.00
	2KHz	102.00
	4KHz	100.00
	8KHz	97.00
	16KHz	91.00
L-Weighted		
	Broadband	**117.00**
A-Weighted		
	Broadband	**110.00**

Cat 24H Motor Grader

1/1 Octave Band Sound Power		
	16Hz	114.60
40% usage	**31.5Hz**	114.60
4dB	**63Hz**	113.60
	125Hz	107.60
	250Hz	112.60
	500Hz	108.60
	1KHz	107.60
	2KHz	109.60
	4KHz	106.60
	8KHz	102.60
	16KHz	96.60
L-Weighted		
	Broadband	**121.30**
A-Weighted		
	Broadband	**114.90**

Cat 16H Motor Grader

1/1 Octave Band Sound Power		
	16Hz	114.60
40% usage	**31.5Hz**	114.60
4dB	**63Hz**	113.60
	125Hz	107.60
	250Hz	112.60
	500Hz	108.60
	1KHz	107.60
	2KHz	109.60
	4KHz	106.60
	8KHz	102.60
	16KHz	96.60
L-Weighted		
	Broadband	**121.30**
A-Weighted		
	Broadband	**114.90**

Cat 12,000 gal. Water Truck

1/1 Octave Band Sound Power		
	16Hz	109.00
40% usage	**31.5Hz**	109.00
4dB	**63Hz**	107.00
	125Hz	100.00
	250Hz	100.00
	500Hz	103.00
	1KHz	102.00
	2KHz	99.00
	4KHz	97.00
	8KHz	95.00
	16KHz	92.00
L-Weighted		
	Broadband	**115.00**
A-Weighted		
	Broadband	**107.00**

Cat 365 Backhoe

1/1 Octave Band Sound Power		
	16Hz	98.60
40% usage	**31.5Hz**	96.60
4dB	**63Hz**	104.60
	125Hz	104.60
	250Hz	101.60
	500Hz	101.60
	1KHz	99.60
	2KHz	100.60
	4KHz	100.60
	8KHz	99.60
	16KHz	98.60
L-Weighted		
	Broadband	**111.70**
A-Weighted		
	Broadband	**107.50**

Cat 844 Wheel Dozer

1/1 Octave Band Sound Power		
	16Hz	111.00
40% usage	**31.5Hz**	110.00
4dB	**63Hz**	107.00
	125Hz	107.00
	250Hz	103.00
	500Hz	106.00
	1KHz	106.00
	2KHz	102.00
	4KHz	100.00
	8KHz	97.00
	16KHz	91.00
L-Weighted		
	Broadband	**117.00**
A-Weighted		
	Broadband	**110.00**

Cat D400 Artic. Dump Truck

1/1 Octave Band Sound Power		
	16Hz	112.60
40% usage	**31.5Hz**	112.60
4dB	**63Hz**	110.60
	125Hz	103.60
	250Hz	103.60
	500Hz	106.60
	1KHz	105.60
	2KHz	102.60
	4KHz	100.60
	8KHz	98.60
	16KHz	95.60
L-Weighted		
	Broadband	**118.15**
A-Weighted		
	Broadband	**110.30**

O&K RH200 Hydraulic Shovel

1/1 Octave Band Sound Power		
	16Hz	111.66
40% usage	**31.5Hz**	111.66
4dB	**63Hz**	110.66
	125Hz	110.66
	250Hz	109.66
	500Hz	109.66
	1KHz	110.66
	2KHz	108.66
	4KHz	108.66
	8KHz	107.66
	16KHz	105.66
L-Weighted		
	Broadband	**120.30**
A-Weighted		
	Broadband	**116.20**

Cat 436 Backhoe/Loader ITC

1/1 Octave Band Sound Power		
	16Hz	115.00
40% usage	**31.5Hz**	114.00
4dB	**63Hz**	111.00
	125Hz	111.00
	250Hz	107.00
	500Hz	110.00
	1KHz	110.00
	2KHz	106.00
	4KHz	104.00
	8KHz	101.00
	16KHz	95.00
L-Weighted		
	Broadband	**121.00**
A-Weighted		
	Broadband	**114.00**

Cat 825C Compactor

1/1 Octave Band Sound Power		
	16Hz	110.60
40% usage	**31.5Hz**	110.60
4dB	**63Hz**	109.60
	125Hz	105.60
	250Hz	103.60
	500Hz	101.60
	1KHz	105.60
	2KHz	98.60
	4KHz	97.60
	8KHz	95.60
	16KHz	92.60
L-Weighted		
	Broadband	**116.50**
A-Weighted		
	Broadband	**108.80**

Cadna A Output

Sound Levels from IGCC Operations only

Name	Level Lr	Limit. Value			Height		Coordinates		
	Day	Day	Night	Noise Type			X	Y	Z
	(dBA)	(dBA)	(dBA)		(m)		(m)	(m)	(m)
Residence 1	46.2			Total	1.5	r	307040.8	350329.9	135.5
Residence 2	47.4			Total	1.5	r	307144.9	350368.5	135.07
Liberty Church	43.4			Total	1.5	r	307334.8	350237.5	143.2
Residence 3	44.7			Total	1.5	r	307328.8	350126.1	146.47
Residence 4	47.9			Total	1.5	r	307559.5	349822.7	153.9
Residence 5	45.6			Total	1.5	r	307709.4	349188.8	146.07
Residence 6	50.9			Total	1.5	r	307402	348540.3	147.39

Cumulative Sound Levels from IGCC Operations and Coal Mining

Name	Level Lr	Limit. Value					Height	Coordinates	
	Day	Day	Night	Noise Type			X	Y	Z
	(dBA)	(dBA)	(dBA)		(m)		(m)	(m)	(m)
Residence 1	46.2			Total	1.5	r	307040.8	350329.9	135.5
Residence 2	47.4			Total	1.5	r	307144.9	350368.5	135.07
Liberty Church	43.4			Total	1.5	r	307334.8	350237.5	143.2
Residence 3	44.7			Total	1.5	r	307328.8	350126.1	146.47
Residence 4	47.9			Total	1.5	r	307559.5	349822.7	153.9
Residence 5	45.6			Total	1.5	r	307709.4	349188.8	146.07
Residence 6	50.9			Total	1.5	r	307402	348540.3	147.39

Cadna A Output

	ID	**Result. PWL**							
		Day	**Type**	**Value**					
Name		**(dBA)**			**Height**			**Coordinates**	
Gas Compressor	Compressor_1	129.3	Lw	GC2			**X**	**Y**	**Z**
Gas Compressor	Compressor_2	129.3	Lw	GC2	(m)		**(m)**	**(m)**	**(m)**
Gas Compressor	Compressor_3	129.3	Lw	GC2	9	r	306973.6	349539.3	151.01
Gas Compressor	Compressor_4	129.3	Lw	GC2	9	r	306972.2	349522	150.03
Gas Cooler	Cooler_4	122.2	Lw	GC1	9	r	306972.2	349501.7	149.2
Gas Cooler	Cooler_3	122.2	Lw	GC1	9	r	306972.9	349483.3	149.2
Gas Cooler	Cooler_2	122.2	Lw	GC1	5	r	306977.6	349486.7	145.2
Gas Cooler	Cooler_1	122.2	Lw	GC1	5	r	306978.2	349504.7	145.44
HRSG Inlet Duct	HRSG_Inlet_1	107	Lw	H2	5	r	306976.9	349524	146.38
HRSG Inlet Duct	HRSG_Inlet_2	107	Lw	H2	5	r	306976.2	349542.7	147.32
HRSG Outlet	HRSG_Outlet_2	110	Lw	H3	4	r	307118.9	349585.4	151.74
HRSG Outlet	HRSG_Outlet_3	110	Lw	H3	5	r	307166.6	349584.4	153.21
HRSG Outlet	HRSG_Outlet_1	102.8	Lw	H1	99.01	r	307115.3	349626.2	247.01
HRSG Body	HRSG_Body	102.8	Lw	H1	99.01	r	307163.8	349625.9	249.01
Dragline	Dragline	118.7	Lw	Dragline	18	r	307115.2	349607.9	166.07
Cable Tractor	Cable_Tractor	112.4	Lw	Cable_Tractor	18	r	307164.3	349607.5	167.66
Hydraulic Shovel	Hyd_Shovel	116.2	Lw	O_K_Shovel	3.5	r	305948.2	346468.6	122.4
3454 Backhoe	Backhoe_1	107.4	Lw	Cat_345	3.5	r	305924.7	346465.9	113.3
RH120 Backhoe	Backhoe_2	107.4	Lw	O_K_Backhoe	3.5	r	305912.4	346465.2	113.3
844 Dozer	Dozer_1	110	Lw	Cat_844	3	r	305889.7	346449.8	112.8
Dump Truck	Dump_Truck	110.3	Lw	Cat_D400	3	r	305924.9	346507	121.9
Compactor	Compactor	108.3	Lw	Cat_825C	3	r	305561.7	346523.5	124.95
Backhoe #1	1_Backhoe_1	114	Lw	Cat_436	3	r	305564.2	346423.1	121.9
Backhoe #2	1_Backhoe_2	107.4	Lw	Cat_365	3	r	305599.2	346478.7	131
Dump Truck #1	1_Dump_Truck_1	107.4	Lw	Cat_365	3	r	305743.3	346479.4	131
Dump Truck #2	1_Dump_Truck_2	110.3	Lw	Cat_D400	3	r	305786	346450	131

Cadna A Output

	ID	Result. PWL		
Name		Day (dBA)	Type	Value
Gas Turbine	Turbine_2	113.5	Lw	GT1
Gas Turbine	Turbine_1	113.5	Lw	GT1
Steam Turbine	Steam_1	108.3	Lw	ST2
Truck Path #1	Truck_Path_1	111.4	Lw	Cat_789C
Truck Path #2	Truck_Path_2	106.7	Lw	Water_Truck
Grader #1	Grader_1	114.9	Lw	Cat_24H
Grader #2	Grader_2	114.9	Lw	Cat_24H

	ID	Result. PWL		
Name		Day (dBA)	Type	Value
Cooling #1	Cooling_Tower_1	104.5	Lw	CT1
Cooling #2	Cooling_Tower_2	105	Lw	CT1

APPENDIX R

KEMPER COUNTY IGCC PROJECT HAZARDOUS AIR POLLUTANT RISK SCREENING ANALYSES

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Prepared for:
Southern Company Services, Inc.

Risk Screening Analysis of Hazardous Air Pollutant Emissions from the Proposed Kemper County IGCC Facility, 50% CO_2 Capture Case Kemper County, Mississippi

AECOM, Inc.
May 2009
Document No.: 06204-041-0001a

AECOM

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Risk Screening Analysis of Hazardous Air Pollutant Emissions from the Proposed Kemper County IGCC Facility, 50% CO_2 Capture Case Kemper County, Mississippi

David W. Heinold

Prepared By: Dave Heinold

Brian Stormwind

Reviewed By: Brian Stormwind

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AECOM

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1.0 Introduction

AECOM Environment has conducted a screening level evaluation of the potential effects of hazardous air pollutant (HAP) emissions from the proposed Kemper County Integrated Gasification Combined Cycle (IGCC) stacks.

2.0 HAP Selection

The evaluation considers the HAP emissions associated with continuous firing of syngas in the combustion turbines and natural gas in the associated duct burners. Although the combustion turbines are also capable of combusting natural gas, the fraction of time that natural gas alone would be fired is expected to be small. Two combustion turbine vendors are under consideration, Siemens and GE. HAP emissions were quantified for both turbines and the emission rates were found to comparable, with the Siemens turbines resulting in slightly higher potential emissions. Therefore, the Siemens turbines were addressed in this assessment. The HAPs emissions for a Siemens turbine are provided in Table 1 for all HAPs with the exception of mercury. Mercury emissions are provided in Table 2.

This assessment addressed two classes of health risk: carcinogenic risk and non-carcinogenic risk for long- and short-term (acute and chronic) inhalation of airborne concentrations. For inhalation pathway risk, this screening-level assessment identifies two HAPs, which were selected based on relative emissions and long-term inhalation toxicity. To identify the HAPs to include in the assessment, the HAP emissions were ranked according to relative cancer and chronic non-cancer risk associated with their emissions. The U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) has tabulated dose-response assessments that OAQPS uses for risk assessments of hazardous air pollutants and has made these available on the Technology Transfer Network at http://www.epa.gov/ttn/atw/toxsource/summary.html. For this ranking the Dose-Response Values compiled by U.S. EPA OAQPS (Ref: Prioritized Chronic Dose-Response Values, provided at http://www.epa.gov/ttn/atw/toxsource/table1.pdf) were applied. To estimate the relative contribution of HAP to inhalation cancer risk, each HAP emission rate listed in Table 1 was multiplied the by U.S. EPA's Unit Risk Estimates (URE). In a similar way, the relative percent contribution among HAPs was estimated by dividing the HAP emission rates by their respective chronic inhalation concentration levels (referred to here as Reference Air Concentrations or RACs). The result of this ranking, shown in Table 1, indicates that the two HAPs that contribute most to both cancer and non-cancer inhalation risks are arsenic and cadmium. Together these two HAPs contribute nearly 75% of the inhalation cancer risk associated with the IGCCs and nearly 50% of the chronic non-cancer inhalation risk. The implication is that if the modeled risk for these two HAPs is well below significance levels, it is assured that the combined risk associated with all of the HAPs will also be insignificant.

In addition to risks due to direct inhalation of HAPs, it is well-recognized that the routine ingestion of fish that contain elevated concentrations of mercury can pose non-carcinogenic chronic health risk. Some of the mercury in fish may result from deposition of airborne concentrations onto watersheds and subsequent bioaccumulation through the aquatic food chain. Although the presence of mercury in the ambient environment is a global issue, because mercury is among the HAPs that are known to be emitted from coal combustion, the local dispersion and deposition of this HAP from the IGCCs were also evaluated.

3.0 Evaluation Methods

To assess inhalation risk, AERMOD was applied to estimate the facility's contribution to ambient concentrations at the point of maximum off-site impact, as well as the average concentrations throughout Kemper County. Modeled long-term concentrations of arsenic, cadmium and mercury were then added to

U.S. EPA's model estimates of the pre-existing concentrations in Kemper County associated with other local and regional emission sources for these three HAPs as computed by the 1999 National-Scale Air Toxics Assessment (NATA, http://www.epa.gov/ttn/atw/nata1999/tables.html). In modeling long-term concentrations, as described in more detail below, an average concentration over a 5-year period was computed assuming that the IGCCs ran on syngas continuously at peak load. The level of incremental inhalation cancer and non-cancer risk, and combined risk (facility plus NATA), for each HAP were then evaluated. To evaluate the maximum individual lifetime cancer risk the estimated long-term average air concentration was multiplied by the URE (see Table 1). The result of this calculation is the increase in probability of a person contracting cancer after 70 years of exposure. A cancer risk value of less than $1x10^{-6}$ is generally recognized to be insignificant (U.S. EPA, 1991). For chronic non-cancer effects, the long-term average concentration was divided by the respective RAC to form what is referred to as a Hazard Quotient (HQ). A HQ value of less than 1.0 indicates that adverse non-cancer health effects are highly unlikely to occur (U.S. EPA, 2008). To assess potential acute health effects, the maximum modeled 1-hour average concentrations for the IGCCs were divided by minimum acute RAC found in EPA guidance (Acute Dose-Response Values for Screening Risk Assessments (6/12/2007) in http://www.epa.gov/ttn/atw/toxsource/table2.pdf.

In addition to the evaluation of inhalation health risks, the long-term deposition of mercury was also evaluated. Mercury is emitted in three forms, elemental mercury vapor, reactive gaseous mercury (RGM), and particulate-bound mercury (PBM). As indicated in Table 2, it is estimated that 90% of the total mercury emitted from the IGCCs is in the form of elemental mercury, 10% RGM and un-quantified trace amounts of PBM. In terms of the contribution to wet or dry deposition, elemental mercury is essentially inert because it has an extremely low solubility and is non-reactive. Therefore, most of the elemental mercury remains airborne and is transported over long distances (U.S. EPA, 1997). PBM is deposited with the particles with which it is incorporated, but in this case the rate of emission is so low that the rate of PBM deposition cannot be quantified. In contrast, RGM is soluble and reactive such that it is subject to both dry and wet deposition. Dry deposition occurs when airborne RGM comes into contact with elements on the earth's surface such as vegetation and water bodies. Wet deposition occurs when precipitation falling through the plume captures soluble RGM vapor. As discussed further below, these deposition processes are simulated by U. S. EPA's AERMOD air quality model. The ambient concentration and deposition of mercury from the IGCC units at the point of maximum impact, and the average over Kemper County, are evaluated by comparing modeled results to measurements taken at two locations along the Gulf coast, and a third located in Oak Grove, MS, where there are long-term mercury monitoring networks (see Figure 1).

4.0 Modeling Approach

U.S. EPA's AERMOD model was applied to estimate air concentrations of arsenic, cadmium and mercury, and deposition of mercury emitted from the IGCC units. Five years of representative meteorological data (1991-1995) were applied, including National Weather Service (NWS) surface and precipitation data from Meridian Key Field in Meridian, MS and upper air data from Jackson International Airport in Jackson, MS. The relative location of the meteorological measurement sites with respect to the project site are provided in Figure 1. Processed, AERMOD-ready meteorological data was provided by the Mississippi Department of Environmental Quality (MDEQ) on their website (http://www.mississippi.gov/frameset.jsp?URL=http%3A%2F%2F%2Fwww.deq.state.ms.us%2FMDEQ.nsf%2Fpage%2FMain_Home%3FOpenDocument). The 5-year wind rose shown in Figure 2 indicates prevailing winds are primarily southerly, but northerly winds are also frequent. In accordance with U. S. EPA guidance, a sensitivity analysis was conducted using both the surface site characteristics (roughness, albedo and Bowen ratio) from the project site and the NWS station site, and the site characteristics that resulted in the greater modeled concentrations were applied. On this basis, the surface characteristics of the NWS site at Meridian were used. Two sets of receptors were used in the analysis. The first set, which was developed for the air quality modeling in support of the project permitting effort, was applied to model the concentration and deposition at the maximum point of impact. This receptor grid consisted of "tight" receptors spaced 50 meters apart along the fence line and extending out 500 meters from the fence-line. Beyond 500 meters, a spacing of 100 meters was used up to one-kilometer from the facility. Between one- and five-kilometers, a spacing of 500 meters was used. Between five- and ten-kilometers, a spacing of 1,000 meters was used. Between ten- and twenty-kilometers, a spacing of 2,000 meters was used. For this grid, the near field receptors are shown in Figure 3 and the far field receptors are shown in Figure 4. A second set of receptors comprised of a uniform, 1 km spaced receptor grid across Kemper County, was used to model the Kemper County-wide average for comparison to NATA county-level results. Receptor elevations were developed using Digital Elevation Model (DEM) data from USGS. The Kemper County grid is shown in Figure 5.

Table 3 provides the source parameters used to apply AERMOD. For the IGCC dispersion modeling and RGM deposition analysis, the general modeling procedures and options specified in the current versions of in the AERMOD User's Guide (U.S. EPA 2004), AERMOD Implementation Guide (U.S. EPA 2009), and the Guideline on Air Quality Models (GAQM; U.S. EPA 2005) were followed. To model ambient concentrations of arsenic, cadmium and elemental mercury, it was conservatively assumed that no deposition occurred. Deposition was accounted for in modeling the concentration of RGM. Modeling was conducted in a manner consistent with U.S. EPA guidance and standard practices, including the use of regulatory default options, as appropriate. The building downwash analysis was performed using the most recent version of EPA's Building Profile Input Program (BPIP) (Version 04274) with the plume rise model enhancements (PRIME) building downwash algorithms, consistent with the air quality modeling.

Aerial imagery (2004) was examined to determine the land-use characteristics around the project site for use as input into the model for mercury deposition calculations. The area in the vicinity of the project was found to be heavily forested. As a result, category 4 (forest) was used for the gas dry deposition land-use category for all 36 10o radials in the mercury deposition modeling as described in the Addendum to the AERMOD User's Guide (U.S EPA, 2006).

The transport and mobility of a pollutant are determined by the physical properties of the specific

pollutant. For deposition modeling, AERMOD requires several pollutant-specific parameters:

(1) diffusivity in air; (2) diffusivity in water; (3) leaf cuticular resistance to lipid uptake; and (4) the Henry's Law constant. The following values of these parameters recommended by U.S. EPA were applied:

- diffusivity in air: 6.0E-2 cm^2/sec (1)
- diffusivity in water: 5.25E-6 cm^2/sec (2)
- Cuticular resistance: 1.0E7 sec/m (1)
- Henry's Law constant: 6.0E-6 pa-m^3/mol (1)
- Reactivity factor: 1.0 (1)

(1) Source is Wesley, M.L., Doskey, P.V., and Shannon, J.D. Deposition Parameterizations for the Industrial Source Complex (ISC3) Model, Argonne National Laboratory, June, 2002, Table 7 (p.27).

(2) Source is U.S. EPA's *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities –* [Publication No. EPA 530-R-05-006], September 2005. *Information from companion HHRAP Database – Value for mercuric chloride.* http://www.epa.gov/osw/hazard/tsd/td/combust/riskvol.htm#volume2 - scroll down to "**Download HHRAP Companion Database (ACCESS)**"

5.0 Findings

Figure 6 provides the location of the maximum modeled air concentrations for the modeled HAPs and the location of the highest RGM deposition relative to the facility. The maximum air concentration impacts, along with the maximum dry deposition, were found to be along the southeast fence-line of the power block portion of the facility. The maximum wet and total RGM deposition was found to occur along, and just past, the northeast fence-line of the power block, directly to the north of the IGCC stacks.

Table 4 provides inhalation risk estimates associated with arsenic, cadmium and mercury emitted from the facility and the combined county-wide risk of these HAPs, incorporating the 1999 NATA Kemper County modeling results. The maximum cancer risk, which is associated with arsenic, is less than 2×10^{-7} at the point of maximum, and the county-wide-average risk, including the proposed IGCC units is only about 1×10^{-8}. These levels are below the EPA's recommended significance levels of $1x10^{-6}$. The hazard quotients for each of the three HAPs are also insignificant with the highest incremental HQ, which occurs for cadmium, of less than 3×10^{-3} compared to a significance level of 1.0. The corresponding Kemper County HQ for cadmium is about 2×10^{-4}. The results of acute inhalation assessment, provided in Table 5, indicate that arsenic is the HAP with the largest acute hazard quotient with a value of about 5×10^{-3}. This analysis demonstrates that the proposed IGCC units will not cause or contribute significantly to acute or chronic health effects and cancer risk.

The analyses for mercury are provided in Tables 6 and 7. Table 6 compares maximum modeled long-term air concentrations of elemental mercury and RGM with available measurements from two measurement sites located to the south near the Gulf Coast. The long-term concentration of elemental mercury is two orders of magnitude less than the measured ambient concentrations, and the maximum modeled RGM concentration is about a third of the ambient concentrations. Thus, the combined maximum long-term modeled concentration of elemental mercury and RGM is only one hundredth of the measured ambient concentrations. This finding is consistent with NATA which specifies a U.S. background mercury concentration associated with global transport of 1.5 x 10-3 $\mu g/m^3$. Table 7 provides a comparison of the maximum modeled RGM deposition from the facility with values developed from measurements from the OLF study and the NADP Mercury Deposition Network. The maximum long-term wet deposition is one to two orders of magnitude less than measurements. The modeled dry deposition at the location of maximum deposition is comparable to the dry deposition estimates from the OLF study. The result is that the total modeled mercury deposition is only about one eighth of total ambient deposition. The deposition analysis therefore demonstrates that the project will not contribute substantially to the ambient concentration or deposition of mercury in the vicinity.

6.0 Summary

An assessment of the HAP emissions from the proposed IGCC units was conducted using the conservative assumption that the IGCC units will operate continuously at 100% load on syngas for five years. Modeling of concentrations and RGM deposition was conducted with AERMOD, a U.S. EPA designed model that provides conservative estimates of air quality impacts. The results of the assessment indicate that no HAP emitted from the project will result in, or contribute to, human health risk due to inhalation. In addition, the ambient concentrations of mercury resulting from the IGCC units were modeled to be orders of magnitude less than ambient concentrations, and the modeled deposition of mercury was less than has been measured at nearby study areas.

7.0 References

U.S. Environmental Protection Agency (EPA), 1997. Mercury Stud report to Congress, Volume III: Fate and Transport of Mercury in the Environment, EPA-452/R-97-005, December.

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Wesley, M.L., Doskey, P.V., and Shannon, J.D. Deposition Parameterizations for the Industrial Source Complex (ISC3) Model, Argonne National Laboratory, June, 2002.

Table 1: Estimates of HAP Emissions for Each of Two IGCC Stacks for Siemens Turbines and Ranking in Terms of Inhalation Risk

	Maximum Short-Term Emissions (1,3) (lb/hour)	Cancer Unit Risk Estimate(4) (1/μg/m^3)	Percent of Cancer Risk	Reference Air Concentration(4) (μg/m3)	Percent of Chronic Hazard Index
Volatile Organic Compounds					
Acetaldehyde	2.29E-02	2.20E-06	0.1%	9.00	0.1%
Acrolein	2.22E-03	NA	--	0.02	5.4%
Benzene	2.16E-02	7.80E-06	0.2%	30.00	0.0%
Ethylbenzene	9.03E-03	NA	--	1000.00	0.0%
Formaldehyde	1.01E-01	5.50E-09	0.0%	9.80	0.5%
Toluene	2.69E-02	NA	--	5000.00	0.0%
Xylene	2.58E-02	NA	--	100.00	0.0%
Polycyclic Organic Matter (POM)					
Polycyclic Aromatic Hydrocarbons (PAH)	1.90E-04	1.10E-03	0.2%	200.00	0.0%
2-Methylnapthalene	1.20E-03	NA	--	NA	--
Acenapthylene	8.50E-05	NA	--	NA	--
Benzo(a)anthracene	7.50E-06	1.10E-04	0.0%	NA	--
Benzo(e)pyrene	1.80E-05	NA	--	NA	--
Benzo(g,h,i)perylene	3.10E-05	NA	--	NA	--
Napthalene	1.60E-03	3.40E-05	0.1%	3.00	0.0%
Metals					
Antimony	1.27E-02	NA	--	NA	--
Arsenic	**9.79E-03**	**4.30E-03**	**45.7%**	**0.03**	**15.8%**
Beryllium	3.00E-03	2.40E-03	7.8%	0.02	7.3%
Cadmium	**1.37E-02**	**1.80E-03**	**26.8%**	**0.02**	**33.1%**
Chromium VI (2)	1.49E-03	1.20E-02	19.4%	0.10	0.7%
Cobalt	2.64E-03	NA	--	0.10	1.3%
Lead	1.30E-02	NA	--	0.15	4.2%
Manganese	1.40E-02	NA	--	0.05	13.6%
Mercury (total)	**3.61E-03**	NA	--	**0.30**	**0.6%**
Elemental Mercury	3.25E-03	NA	--	NA	--
Reactive Gaseous Mercury	3.61E-04	NA	--	NA	--
Particulate-bound Mercury	Trace	NA	--	NA	--
Nickel	1.83E-02	NA	--	0.09	9.8%
Phosphorous	1.11E-02	NA	--	0.07	7.7%
Selenium	1.40E-02	NA	--	NA	--
Inorganic Compounds					
Carbon Disulfide	1.47E-01	NA	--	700.00	0.0%

(1) Emission rates based on emission factors from "A Study of Toxic Emissions from a Coal-Fired Gasification Plant", Radian Corporation, December 1995.

(2) 12% of total chromium emissions characterized as hexavalent for coal combustion per U.S. EPA 2005 National Emissions Inventory Data & Documentation (http://www.epa.gov/ttn/chief/net/2005inventory.html).

(3) Estimates are based on full load operating scenarios with Duct Burner firing.

(4) Source: Prioritized Chronic Dose-Response Values: http://www.epa.gov/ttn/atw/toxsource/table1.pdf.

Table 2: Estimate of Mercury Emissions for Each of Two IGCC Stacks for Siemens Turbines

	Average Short-Term Syngas (lb/hour)	**Average Annual (lb/year)**
Total Mercury	0.0036	31.64
Elemental (90% of Total)	*0.0033*	*28.47*
RGM (10% of Total)	*0.00036*	*3.16*
Particle-Bound (Only trace amounts)	*Trace*	*Trace*

Table 3: IGCC Source Parameters

Parameter	**Value**	
	CC1A	CC2A
UTM Coordinate East (m) (1)	335223.3	335177.6
UTM Coordinate North (m) (1)	3614049.2	3614050.0
Stack Base Elevation (ft)	474	474
Stack Height (ft)	325	325
Stack Diameter (ft)	24	24
Exit Temperature (^{o}F)	270.6	270.6
Exit Velocity (ft/s)	51.4	51.4

(1) Coordinates for UTM Zone 16 referenced to Datum NAD27.

Table 4: Modeled Project-Related Chronic Inhalation Risk Estimates for Arsenic, Cadmium, and Mercury

	Maximum Project Related Risk Estimates			Kemper County-Wide Average Risk Estimates				
Hazardous Air Pollutant	Maximum Modeled Long-Term Concentration (µg/m^3)	Chronic Hazard Quotient	Individual Inhalation Cancer Risk	Long-Term Modeled Concentration from Project $^{(1)}$ (µg/m^3)	NATA Modeled Kemper County Long-Term Concentration (µg/m^3) $^{(2)}$	Total Modeled Long-Term Kemper County Concentration (µg/m^3)	Chronic Hazard Quotient	Individual Inhalation Cancer Risk
Arsenic	3.7E-05	1.2E-03	1.6E-07	2.3E-06	7.8E-07	3.1E-06	1.0E-04	1.3E-08
Cadmium	5.1E-05	2.6E-03	9.3E-08	3.2E-06	7.2E-07	3.9E-06	1.9E-04	7.0E-09
Mercury - Total	1.4E-05	4.5E-05	not applicable	8.3E-07	8.9E-07	1.7E-06	5.7E-06	not applicable

(1) Values are the average of all receptors (total 2085) in an evenly spaced grid covering all of Kemper County in 1000m increments.

(2) 1999 National Air Toxics Assessment (http://www.epa.gov/ttn/atw/nata1999/tables.html) NATA's National Ambient Background for mercury is 1.50E-03 µg/m^3.

Table 5: Modeled Project-Related Acute Inhalation Risk Estimates for Arsenic, Cadmium, and Mercury

Pollutant	Maximum Modeled Concentration (µg/m^3)	Acute Dose Response Value[1] (µg/m^3)	Acute Hazard Quotient
Arsenic	0.00093	0.19	4.90E-03
Cadmium	0.00130	900	1.45E-06
Mercury - Total	0.00034	1.8	1.90E-04

(1) Minimum value provided in Table 2: Acute Dose-Response Values for Screening Risk Assessments (http://www.epa.gov/ttn/atw/toxsource/summary.html).

Table 6: Maximum Modeled Long-Term Mercury Air Concentrations (µg/m^3)

Hazardous Air Pollutant	Maximum Modeled Long-Term Concentration	Grand Bay Lab Ambient Conc. (1)	OLF Mercury Study Average Concentration (2005-2008) (2)
Mercury - Elemental	1.22E-05	1.40E-03	1.35E-03
Mercury – RGM	1.35E-06	4.02E-06	3.68E-06
Elemental + RGM	1.36E-05	1.41E-03	1.35E-03

(1) http://www.arl.noaa.gov/documents/reports/Luke_NADP_v2.pdf.
(2) Data provided by Southern Company.

Table 7: Comparison of Modeled Mercury Deposition from the Facility with Measured Deposition (g/m^2/year)

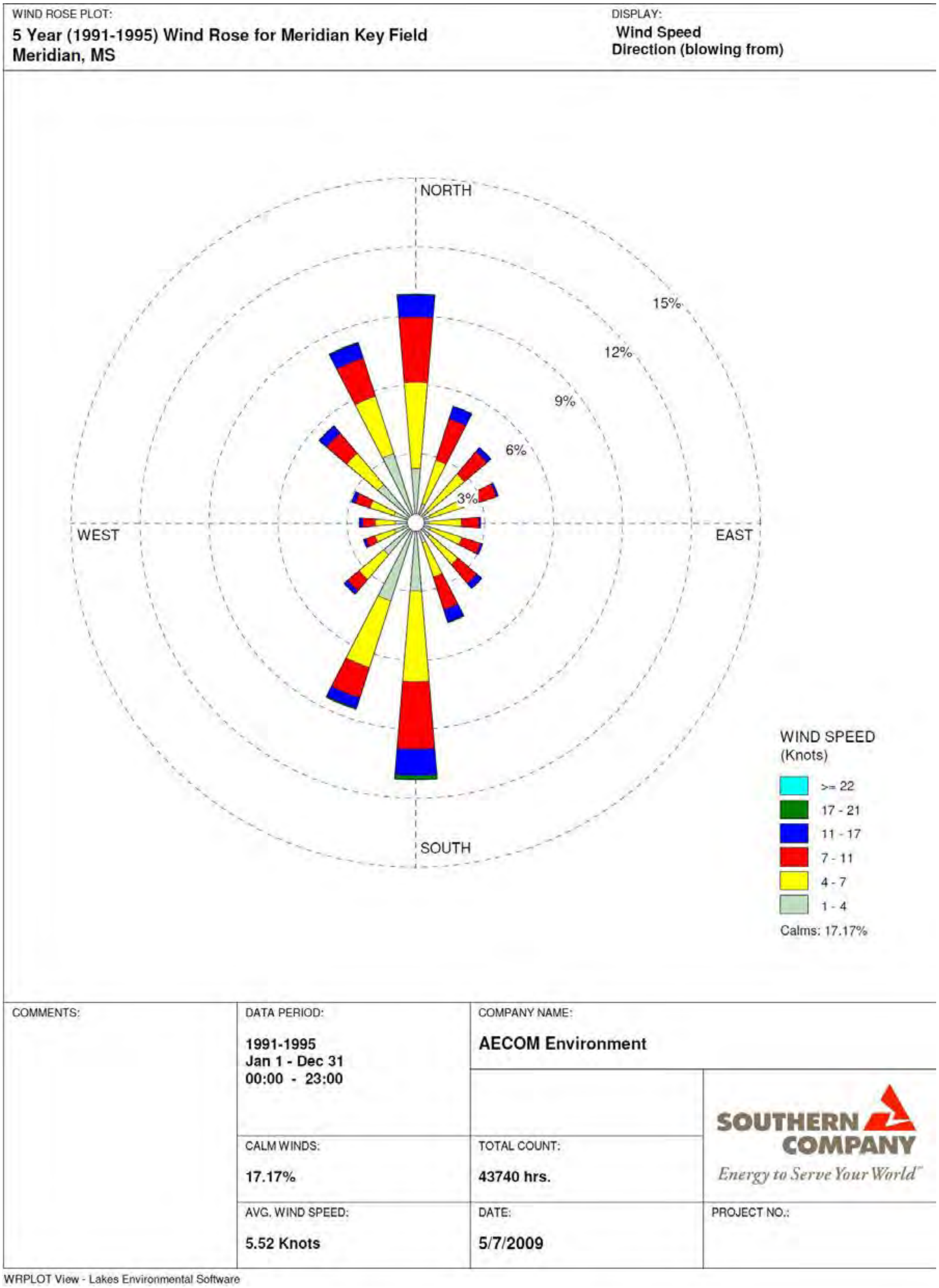
Pollutant	Max. Annual Modeled Impact	NADP Mercury Deposition Network(1)	OLF 2005-08 Average Low/High Estimates (2)
Mercury - Wet Deposition	3.21E-07	1.68E-05	1.47E-05
Mercury - Dry Deposition	1.71E-06	not available	1.22E-06/2.45E-06
Mercury - Total Deposition	1.90E-06	not available	15.9E-06/17.2E-06

(1) Average concentration at MS22 monitor (Oak Grove, MS) from 2001-2007.

(2) Data for OLF provided by Southern Company. Wet deposition is directly measured and dry deposition has been estimated based on measured concentrations and estimated range of deposition velocity applicable to the surface type in the OLF study area.

Figure 1: Relative Location of Kemper IGCC Project Site, Meteorological Data Sources, and Ambient Mercury Monitors

Figure 2: Meridian Key Field 5-year (1991-1995) Wind Rose



WIND ROSE PLOT:
5 Year (1991-1995) Wind Rose for Meridian Key Field
Meridian, MS

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:

DATA PERIOD:
1991-1995
Jan 1 - Dec 31
00:00 - 23:00

COMPANY NAME:
AECOM Environment

CALM WINDS:
17.17%

TOTAL COUNT:
43740 hrs.

AVG. WIND SPEED:
5.52 Knots

DATE:
5/7/2009

PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Figure 3: Project Receptors Used to Determine Maximum Annual and Short-Term Impacts – Near-Field Receptors

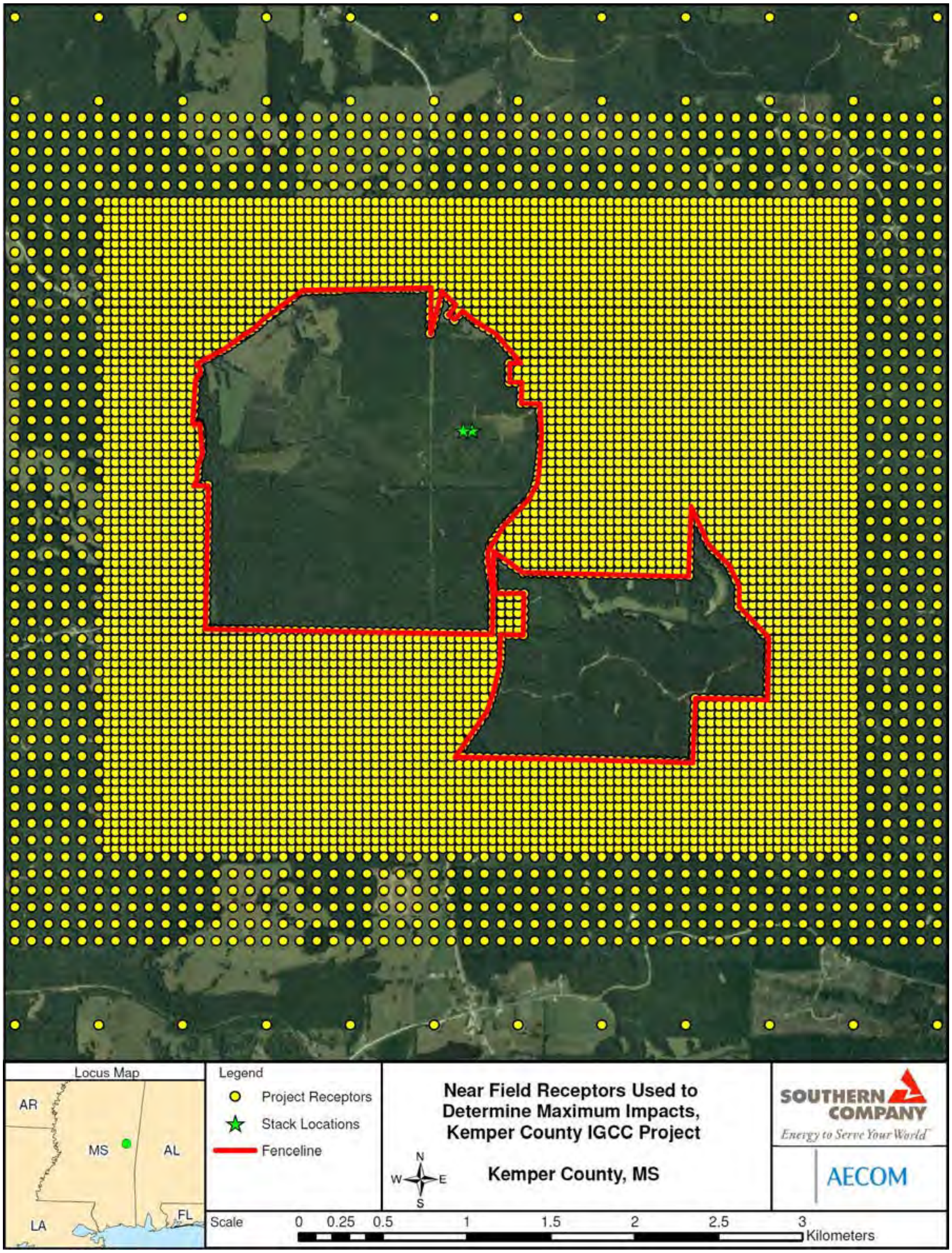


Figure 4: Project Receptors Used to Determine Maximum Annual and Short-Term Impacts – Far-Field Receptors

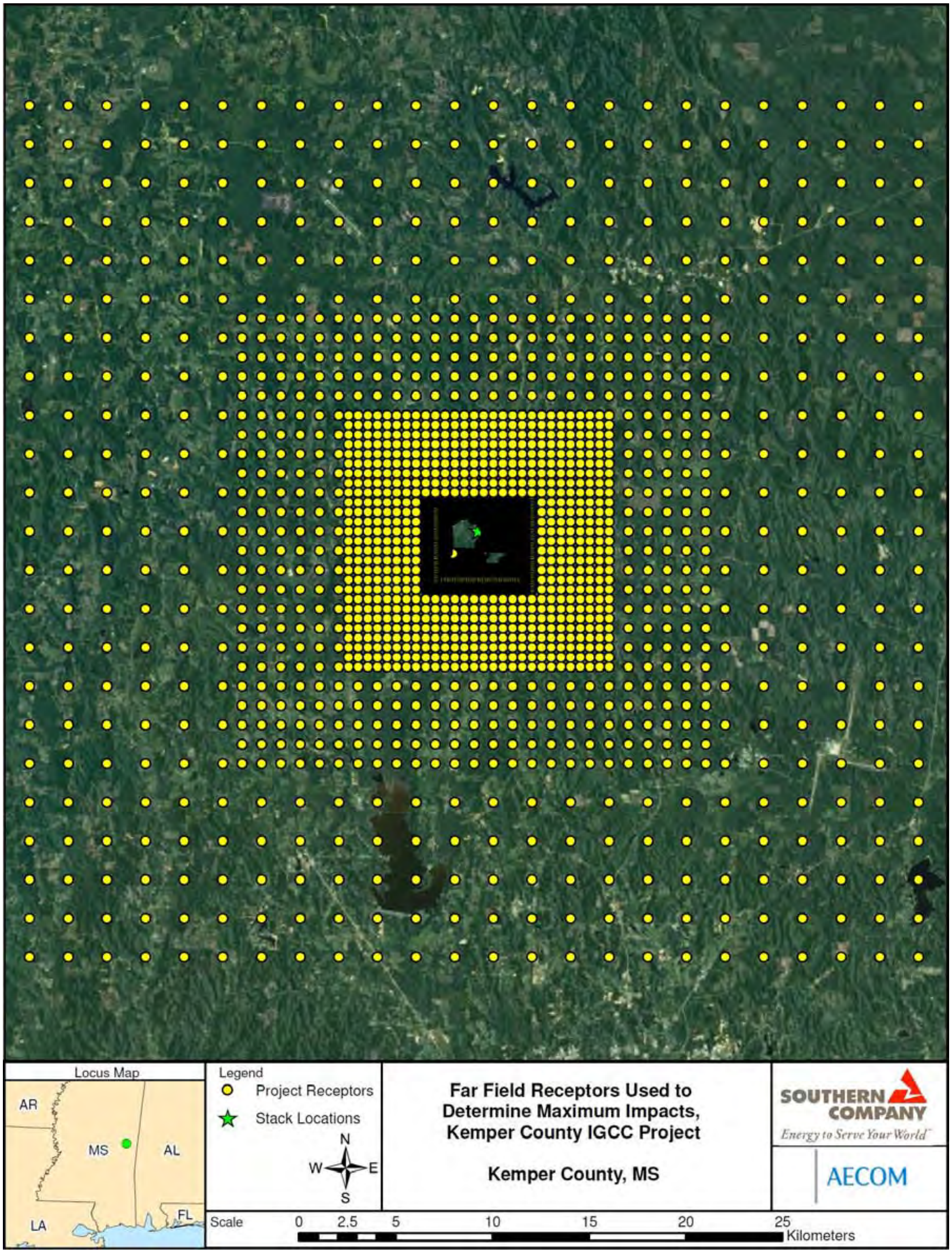


Figure 5: Kemper County Receptor Grid

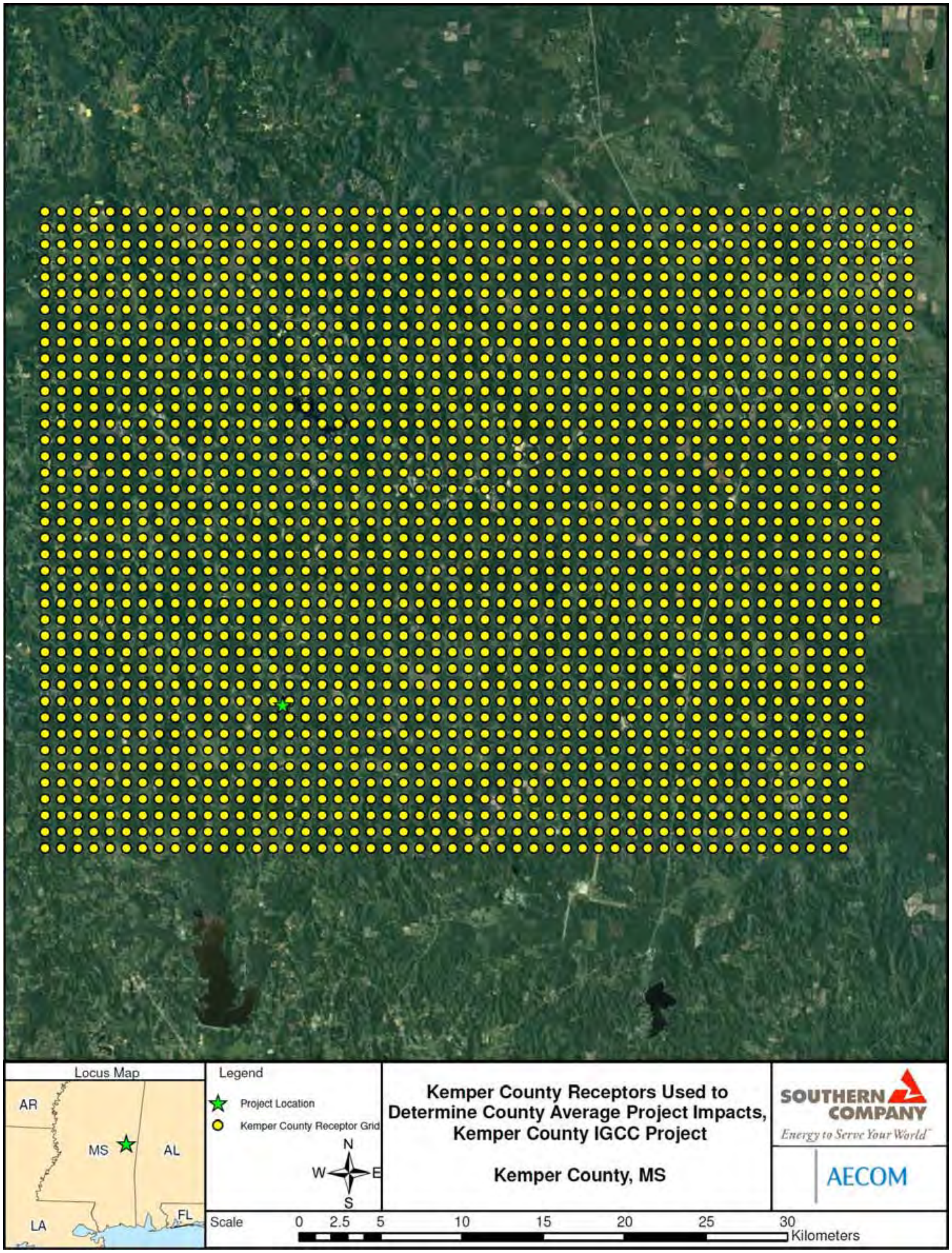
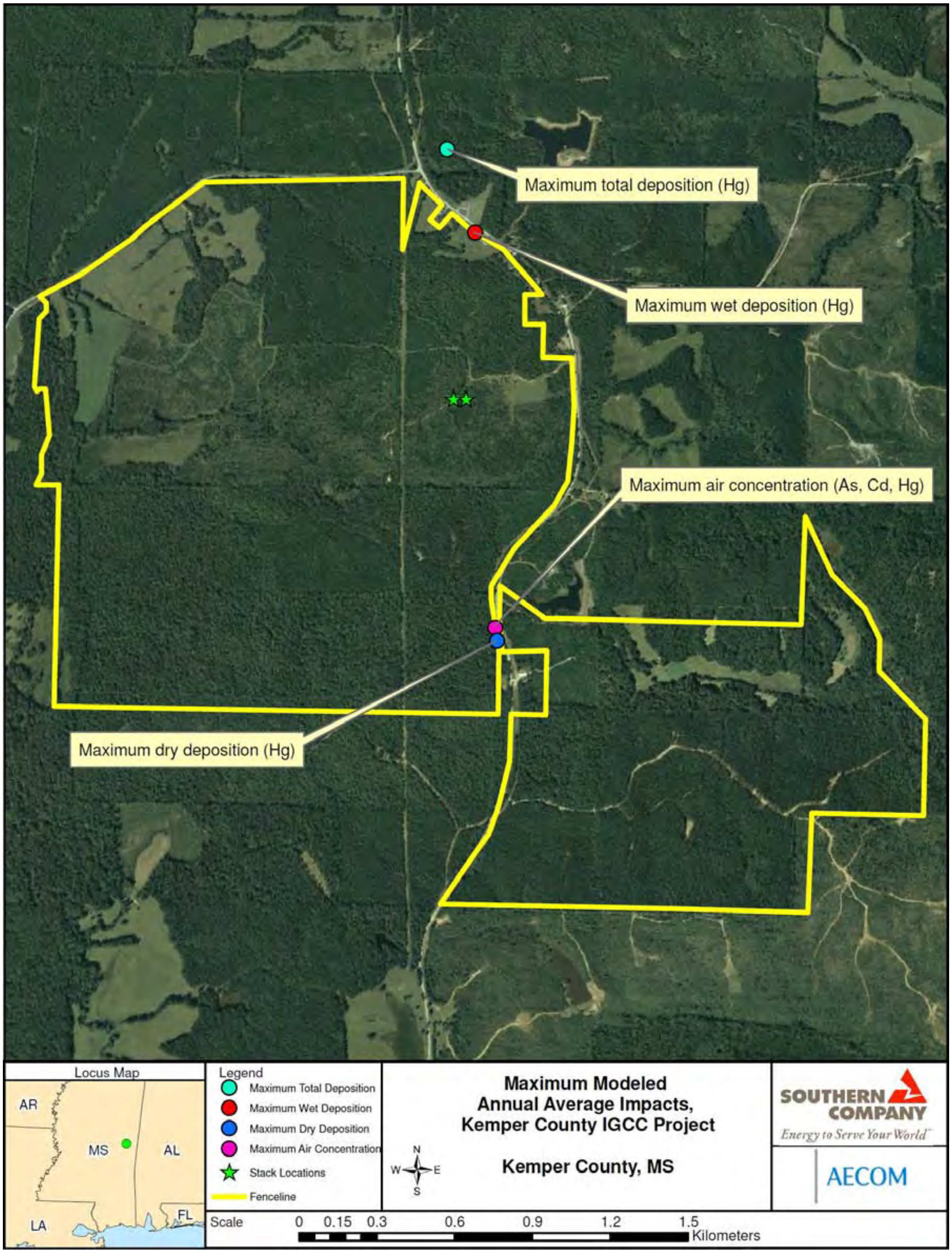


Figure 6: Location of Maximum Air Concentration Impacts and Mercury Deposition



Prepared for:
Southern Company Services, Inc.

Risk Screening Analysis of Hazardous Air Pollutant Emissions from the Proposed Kemper County IGCC Facility,
67% CO_2 Capture Case
Kemper County, Mississippi

AECOM, Inc.
August 2009
Document No.: 06204-041-0001b

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Risk Screening Analysis of Hazardous Air Pollutant Emissions from the Proposed Kemper County IGCC Facility, 67% CO_2 Capture Case Kemper County, Mississippi

Dave W. Heinold

Prepared By: Dave Heinold

Brian Stormwind

Reviewed By: Brian Stormwind

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1.0 Introduction

AECOM Environment has conducted a screening level evaluation of the potential effects of hazardous air pollutant (HAP) emissions from the proposed Kemper County Integrated Gasification Combined Cycle (IGCC) stacks.

2.0 HAP Selection

The evaluation considers the HAP emissions associated with continuous firing of syngas in the combustion turbines and natural gas in the associated duct burners. Although the combustion turbines are also capable of combusting natural gas, the fraction of time that natural gas alone would be fired is expected to be small. Siemens turbines were addressed in this assessment. The HAPs emissions for a Siemens turbine are provided in Table 1 for all HAPs with the exception of mercury. Mercury emissions are provided in Table 2.

This assessment addressed two classes of health risk: carcinogenic risk and non-carcinogenic risk for long- and short-term (acute and chronic) inhalation of airborne concentrations. For inhalation pathway risk, this screening-level assessment identifies two HAPs, which were selected based on relative emissions and long-term inhalation toxicity. To identify the HAPs to include in the assessment, the HAP emissions were ranked according to relative cancer and chronic non-cancer risk associated with their emissions. The U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) has tabulated dose-response assessments that OAQPS uses for risk assessments of hazardous air pollutants and has made these available on the Technology Transfer Network at http://www.epa.gov/ttn/atw/toxsource/summary.html. For this ranking the Dose-Response Values compiled by U.S. EPA OAQPS (Ref: Prioritized Chronic Dose-Response Values, provided at http://www.epa.gov/ttn/atw/toxsource/table1.pdf) were applied. To estimate the relative contribution of HAP to inhalation cancer risk, each HAP emission rate listed in Table 1 was multiplied the by U.S. EPA's Unit Risk Estimates (URE). In a similar way, the relative percent contribution among HAPs was estimated by dividing the HAP emission rates by their respective chronic inhalation concentration levels (referred to here as Reference Air Concentrations or RACs). The result of this ranking, shown in Table 1, indicates that the two HAPs that contribute most to both cancer and non-cancer inhalation risks are arsenic and cadmium. Together these two HAPs contribute nearly 75% of the inhalation cancer risk associated with the IGCCs and nearly 50% of the chronic non-cancer inhalation risk. The implication is that if the modeled risk for these two HAPs is well below significance levels, it is assured that the combined risk associated with all of the HAPs will also be insignificant.

In addition to risks due to direct inhalation of HAPs, it is well-recognized that the routine ingestion of fish that contain elevated concentrations of mercury can pose non-carcinogenic chronic health risk. Some of the mercury in fish may result from deposition of airborne concentrations onto watersheds and subsequent bioaccumulation through the aquatic food chain. Although the presence of mercury in the ambient environment is a global issue, because mercury is among the HAPs that are known to be emitted from coal combustion, the local dispersion and deposition of this HAP from the IGCCs were also evaluated.

3.0 Evaluation Methods

To assess inhalation risk, AERMOD was applied to estimate the facility's contribution to ambient concentrations at the point of maximum off-site impact, as well as the average concentrations throughout Kemper County. Modeled long-term concentrations of arsenic, cadmium and mercury were then added to U.S. EPA's model estimates of the pre-existing concentrations in Kemper County associated with other local and regional emission sources for these three HAPs as computed by the 1999 National-Scale Air Toxics Assessment (NATA, http://www.epa.gov/ttn/atw/nata1999/tables.html). In modeling long-term concentrations, as described in more detail below, an average concentration over a 5-year period was computed assuming that the IGCCs ran on syngas continuously at peak load. The level of incremental inhalation cancer and non-cancer risk, and combined risk (facility plus NATA), for each HAP were then evaluated. To evaluate the maximum individual lifetime cancer risk the estimated long-term average air concentration was multiplied by the URE (see Table 1). The result of this calculation is the increase in probability of a person contracting cancer after 70 years of exposure. A cancer risk value of less than $1x10^{-6}$ is generally recognized to be insignificant (U.S. EPA, 1991). For chronic non-cancer effects, the long-term average concentration was divided by the respective RAC to form what is referred to as a Hazard Quotient (HQ). A HQ value of less than 1.0 indicates that adverse non-cancer health effects are highly unlikely to occur (U.S. EPA, 2008). To assess potential acute health effects, the maximum modeled 1-hour average concentrations for the IGCCs were divided by minimum acute RAC found in EPA guidance (Acute Dose-Response Values for Screening Risk Assessments (6/12/2007) in http://www.epa.gov/ttn/atw/toxsource/table2.pdf.

In addition to the evaluation of inhalation health risks, the long-term deposition of mercury was also evaluated. Mercury is emitted in three forms, elemental mercury vapor, reactive gaseous mercury (RGM), and particulate-bound mercury (PBM). As indicated in Table 2, it is estimated that 90% of the total mercury emitted from the IGCCs is in the form of elemental mercury, 10% RGM and un-quantified trace amounts of PBM. In terms of the contribution to wet or dry deposition, elemental mercury is essentially inert because it has an extremely low solubility and is non-reactive. Therefore, most of the elemental mercury remains airborne and is transported over long distances (U.S. EPA, 1997). PBM is deposited with the particles with which it is incorporated, but in this case the rate of emission is so low that the rate of PBM deposition cannot be quantified. In contrast, RGM is soluble and reactive such that it is subject to both dry and wet deposition. Dry deposition occurs when airborne RGM comes into contact with elements on the earth's surface such as vegetation and water bodies. Wet deposition occurs when precipitation falling through the plume captures soluble RGM vapor. As discussed further below, these deposition processes are simulated by U. S. EPA's AERMOD air quality model. The ambient concentration and deposition of mercury from the IGCC units at the point of maximum impact, and the average over Kemper County, are evaluated by comparing modeled results to measurements taken at two locations along the Gulf coast, and a third located in Oak Grove, MS, where there are long-term mercury monitoring networks (see Figure 1).

4.0 Modeling Approach

U.S. EPA's AERMOD model was applied to estimate air concentrations of arsenic, cadmium and mercury, and deposition of mercury emitted from the IGCC units. Five years of representative meteorological data (1991-1995) were applied, including National Weather Service (NWS) surface and precipitation data from Meridian Key Field in Meridian, MS and upper air data from Jackson International Airport in Jackson, MS. The relative location of the meteorological measurement sites with respect to the project site are provided in Figure 1. Processed, AERMOD-ready meteorological data was provided by the Mississippi Department of Environmental Quality (MDEQ) on their website (http://www.mississippi.gov/frameset.jsp?URL=http%3A%2F%2F%2Fwww.deq.state.ms.us%2FMDEQ.nsf%2Fpage%2FMain_Home%3FOpenDocument). The 5-year wind rose shown in Figure 2 indicates prevailing winds are primarily southerly, but northerly winds are also frequent. In accordance with U. S. EPA guidance, a sensitivity analysis was conducted using both the surface site characteristics (roughness, albedo and Bowen ratio) from the project site and the NWS station site, and the site characteristics that resulted in the greater modeled concentrations were applied. On this basis, the surface characteristics of the NWS site at Meridian were used. Two sets of receptors were used in the analysis. The first set, which was developed for the air quality modeling in support of the project permitting effort, was applied to model the concentration and deposition at the maximum point of impact. This receptor grid consisted of "tight" receptors spaced 50 meters apart along the fence line and extending out 500 meters from the fence-line. Beyond 500 meters, a spacing of 100 meters was used up to one-kilometer from the facility. Between one- and five-kilometers, a spacing of 500 meters was used. Between five- and ten-kilometers, a spacing of 1,000 meters was used. Between ten- and twenty-kilometers, a spacing of 2,000 meters was used. For this grid, the near field receptors are shown in Figure 3 and the far field receptors are shown in Figure 4. A second set of receptors comprised of a uniform, 1 km spaced receptor grid across Kemper County, was used to model the Kemper County-wide average for comparison to NATA county-level results. Receptor elevations were developed using Digital Elevation Model (DEM) data from USGS. The Kemper County grid is shown in Figure 5.

Table 3 provides the source parameters used to apply AERMOD. For the IGCC dispersion modeling and RGM deposition analysis, the general modeling procedures and options specified in the current versions of in the AERMOD User's Guide (U.S. EPA 2004), AERMOD Implementation Guide (U.S. EPA 2009), and the Guideline on Air Quality Models (GAQM; U.S. EPA 2005) were followed. To model ambient concentrations of arsenic, cadmium and elemental mercury, it was conservatively assumed that no deposition occurred. Deposition was accounted for in modeling the concentration of RGM. Modeling was conducted in a manner consistent with U.S. EPA guidance and standard practices, including the use of regulatory default options, as appropriate. The building downwash analysis was performed using the most recent version of EPA's Building Profile Input Program (BPIP) (Version 04274) with the plume rise model enhancements (PRIME) building downwash algorithms, consistent with the air quality modeling.

Aerial imagery (2004) was examined to determine the land-use characteristics around the project site for use as input into the model for mercury deposition calculations. The area in the vicinity of the project was found to be heavily forested. As a result, category 4 (forest) was used for the gas dry deposition land-use category for all 36 10^o radials in the mercury deposition modeling as described in the Addendum to the AERMOD User's Guide (U.S EPA, 2006).

The transport and mobility of a pollutant are determined by the physical properties of the specific pollutant. For deposition modeling, AERMOD requires several pollutant-specific parameters: (1) diffusivity in air; (2) diffusivity in water; (3) leaf cuticular resistance to lipid uptake; and (4) the Henry's Law constant. The following values of these parameters recommended by U.S. EPA were applied:

- diffusivity in air: 6.0E-2 cm^2/sec (1)
- diffusivity in water: 5.25E-6 cm^2/sec (2)
- Cuticular resistance: 1.0E7 sec/m (1)
- Henry's Law constant: 6.0E-6 pa-m^3/mol (1)
- Reactivity factor: 1.0 (1)

---

[1] Source is Wesley, M.L., Doskey, P.V., and Shannon, J.D. Deposition Parameterizations for the Industrial Source Complex (ISC3) Model, Argonne National Laboratory, June, 2002, Table 7 (p.27).

[2] Source is U.S. EPA's *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* – [Publication No. EPA 530-R-05-006], September 2005. *Information from companion HHRAP Database – Value for mercuric chloride.* http://www.epa.gov/osw/hazard/tsd/td/combust/riskvol.htm#volume2 - scroll down to "**Download HHRAP Companion Database (ACCESS)**"

5.0 Findings

Figure 6 provides the location of the maximum modeled air concentrations for the modeled HAPs and the location of the highest RGM deposition relative to the facility. The maximum air concentration impacts, along with the maximum dry deposition, were found to be along the southeast fence-line of the power block portion of the facility. The maximum wet and total RGM deposition was found to occur along, and just past, the northeast fence-line of the power block, directly to the north of the IGCC stacks.

Table 4 provides inhalation risk estimates associated with arsenic, cadmium and mercury emitted from the facility and the combined county-wide risk of these HAPs, incorporating the 1999 NATA Kemper County modeling results. The maximum cancer risk, which is associated with arsenic, is 2.0×10^{-7} at the point of maximum, and the county-wide-average risk, including the proposed IGCC units is only about 1.7×10^{-8}. These levels are below the EPA's recommended significance level of 1×10^{-6}. The hazard quotients for each of the three HAPs are also insignificant with the highest incremental HQ, which occurs for cadmium, of 3.2×10^{-3} compared to a significance level of 1.0. The corresponding Kemper County HQ for cadmium is about 2.6×10^{-4}. The results of acute inhalation assessment, provided in Table 5, indicate that arsenic is the HAP with the largest acute hazard quotient with a value of about 5.6×10^{-3}. This analysis demonstrates that the proposed IGCC units will not cause or contribute significantly to acute or chronic health effects and cancer risk.

The analyses for mercury are provided in Tables 6 and 7. Table 6 compares maximum modeled long-term air concentrations of elemental mercury and RGM with available measurements from two measurement sites located to the south near the Gulf Coast. The long-term concentration of elemental mercury is two orders of magnitude less than the measured ambient concentrations, and the maximum modeled RGM concentration is less than half of the ambient concentrations. Thus, the combined maximum long-term modeled concentration of elemental mercury and RGM is only about one hundredth of the measured ambient concentrations. This finding is consistent with NATA which specifies a U.S. background mercury concentration associated with global transport of 1.5×10^{-3} μg/m^3. Table 7 provides a comparison of the maximum modeled RGM deposition from the facility with values developed from measurements from the OLF study and the NADP Mercury Deposition Network. The maximum long-term wet deposition is one to two orders of magnitude less than measurements. The modeled dry deposition at the location of maximum deposition is comparable to the dry deposition estimates from the OLF study. The result is that the total modeled mercury deposition is only about one seventh of total ambient deposition. The deposition analysis therefore demonstrates that the project will not contribute substantially to the ambient concentration or deposition of mercury in the vicinity.

6.0 Summary

An assessment of the HAP emissions from the proposed IGCC units was conducted using the conservative assumption that the IGCC units will operate continuously at 100% load on syngas for five years. Modeling of concentrations and RGM deposition was conducted with AERMOD, a U.S. EPA designed model that provides conservative estimates of air quality impacts. The results of the assessment indicate that no HAP emitted from the project will result in, or contribute to, human health risk due to inhalation. In addition, the ambient concentrations of mercury resulting from the IGCC units were modeled to be orders of magnitude less than ambient concentrations, and the modeled deposition of mercury was less than has been measured at nearby study areas.

7.0 References

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Table 1: Estimates of HAP Emissions for Each of Two IGCC Stacks for Siemens Turbines and Ranking in Terms of Inhalation Risk

	Maximum Short-Term Emissions (1,3) (lb/hour)	Cancer Unit Risk Estimate(4) (1/µg/m^3)	Percent of Cancer Risk	Reference Air Concentration(4) (µg/m3)	Percent of Chronic Hazard Index
Volatile Organic Compounds					
Acetaldehyde	1.79E-02	2.20E-06	0.0%	9.00	0.1%
Acrolein	1.58E-03	NA	--	0.02	4.0%
Benzene	1.91E-02	7.80E-06	0.2%	30.00	0.0%
Ethylbenzene	6.43E-03	NA	--	1000.00	0.0%
Formaldehyde	8.61E-02	5.50E-09	0.0%	9.80	0.4%
Toluene	1.92E-02	NA	--	5000.00	0.0%
Xylene	1.83E-02	NA	--	100.00	0.0%
Polycyclic Organic Matter (POM)					
Polycyclic Aromatic Hydrocarbons (PAH)	1.33E-04	1.10E-03	0.2%	200.00	0.0%
2-Methylnapthalene	1.14E-03	NA	--	NA	--
Acenapthylene	8.25E-05	NA	--	NA	--
Benzo(a)anthracene	7.30E-06	1.10E-04	0.0%	NA	--
Benzo(e)pyrene	1.75E-05	NA	--	NA	--
Benzo(g,h,i)perylene	3.02E-05	NA	--	NA	--
Napthalene	1.45E-03	3.40E-05	0.1%	3.00	0.0%
Metals					
Antimony	1.24E-02	NA	--	NA	--
Arsenic	9.52E-03	**4.30E-03**	**45.7%**	**0.03**	**16.0%**
Beryllium	2.92E-03	2.40E-03	7.8%	0.02	7.4%
Cadmium	1.33E-02	**1.80E-03**	**26.8%**	**0.02**	**33.6%**
Chromium VI (2)	1.45E-03	1.20E-02	19.4%	0.10	0.7%
Cobalt	2.57E-03	NA	--	0.10	1.3%
Lead	1.27E-02	NA	--	0.15	4.3%
Manganese	1.36E-02	NA	--	0.05	13.8%
Mercury (total)	**3.67E-03**	NA	--	**0.30**	**0.6%**
Elemental Mercury	3.31E-03	NA	--	NA	--
Reactive Gaseous Mercury	3.67E-04	NA	--	NA	--
Particulate-bound Mercury	Trace	NA	--	NA	--
Nickel	1.78E-02	NA	--	0.09	10.0%
Phosphorous	1.08E-02	NA	--	0.07	7.8%
Selenium	1.36E-02	NA	--	NA	--
Inorganic Compounds					
Carbon Disulfide	1.43E-01	NA	--	700.00	0.0%

(1) Emission rates based on emission factors from "A Study of Toxic Emissions from a Coal-Fired Gasification Plant", Radian Corporation, December 1995.

(2) 12% of total chromium emissions characterized as hexavalent for coal combustion per U.S. EPA 2005 National Emissions Inventory Data & Documentation (http://www.epa.gov/ttn/chief/net/2005inventory.html).

(3) Estimates are based on full load operating scenarios with Duct Burner firing.

(4) Source: Prioritized Chronic Dose-Response Values: http://www.epa.gov/ttn/atw/toxsource/table1.pdf.

Table 2: Estimate of Mercury Emissions for Each of Two IGCC Stacks for Siemens Turbines

	Average Short-Term Syngas (lb/hour)	Average Annual (lb/year)
Total Mercury	3.67E-03	32.18
Elemental (90% of Total)	3.31E-03	28.96
RGM (10% of Total)	3.67E-04	3.22
Particle-Bound (Only trace amounts)	Trace	Trace

Table 3: IGCC Source Parameters

Parameter	Value	
	CC1A	CC2A
UTM Coordinate East (m) (1)	335175.01	335223.77
UTM Coordinate North (m) (1)	3614077.76	3614076.92
Stack Base Elevation (ft)	474	474
Stack Height (ft)	325	325
Stack Diameter (ft)	24	24
Exit Temperature (°F)	213.0	213.0
Exit Velocity (ft/s)	46	46

(1) Coordinates for UTM Zone 16 referenced to Datum NAD27.

Table 4: Modeled Project-Related Chronic Inhalation Risk Estimates for Arsenic, Cadmium, and Mercury

	Maximum Project Related Risk Estimates			Kemper County-Wide Average Risk Estimates				
Hazardous Air Pollutant	Maximum Modeled Long-Term Concentration (µg/m^3)	Chronic Hazard Quotient	Individual Inhalation Cancer Risk	Average (1) Long-Term Modeled Concentration from Project (µg/m^3)	NATA (2) Modeled Kemper County Long-Term Concentration (µg/m^3)	Total Modeled Long-Term Kemper County Concentration (µg/m^3)	Chronic Hazard Quotient	Individual Inhalation Cancer Risk
Arsenic	4.62E-05	1.54E-03	1.99E-07	3.24E-06	7.83E-07	4.02E-06	1.34E-04	1.73E-08
Cadmium	6.46E-05	3.23E-03	1.16E-07	4.53E-06	7.22E-07	5.25E-06	2.63E-04	9.45E-09
Mercury - Total	1.78E-05	5.93E-05	not applicable	1.24E-06	8.91E-07	2.13E-06	7.10E-06	not applicable

(1) Values are the average of all receptors (total 2085) in an evenly spaced grid covering all of Kemper County in 1000m increments.

(2) 1999 National Air Toxics Assessment (http://www.epa.gov/ttn/atw/nata1999/tables.html) NATA's National Ambient Background for mercury is 1.50E-03 µg/m^3.

Table 5: Modeled Project-Related Acute Inhalation Risk Estimates for Arsenic, Cadmium, and Mercury

Pollutant	Maximum Modeled Concentration (µg/m^3)	Acute Dose Response Value[(1)] (µg/m^3)	Acute Hazard Quotient
Arsenic	0.00106	0.19	5.58E-03
Cadmium	0.00148	900.0	1.65E-06
Mercury - Elemental	0.00041	1.8	2.27E-04

(1) Minimum value provided in Table 2: Acute Dose-Response Values for Screening Risk Assessments (http://www.epa.gov/ttn/atw/toxsource/summary.html).

Table 6: Maximum Modeled Long-Term Mercury Air Concentrations (µg/m^3)

Hazardous Air Pollutant	Maximum Modeled Long-Term Concentration	Grand Bay Lab Ambient Conc. (1)	OLF Mercury Study Average Concentration (2005-2008) (2)
Mercury - Elemental	1.60E-05	1.40E-03	1.35E-03
Mercury – RGM	1.78E-06	4.02E-06	3.68E-06
Elemental + RGM	1.78E-05	1.41E-03	1.35E-03

(1) http://www.arl.noaa.gov/documents/reports/Luke_NADP_v2.pdf.
(2) Data provided by Southern Company.

Table 7: Comparison of Modeled Mercury Deposition from the Facility with Measured Deposition (g/m^2/year)

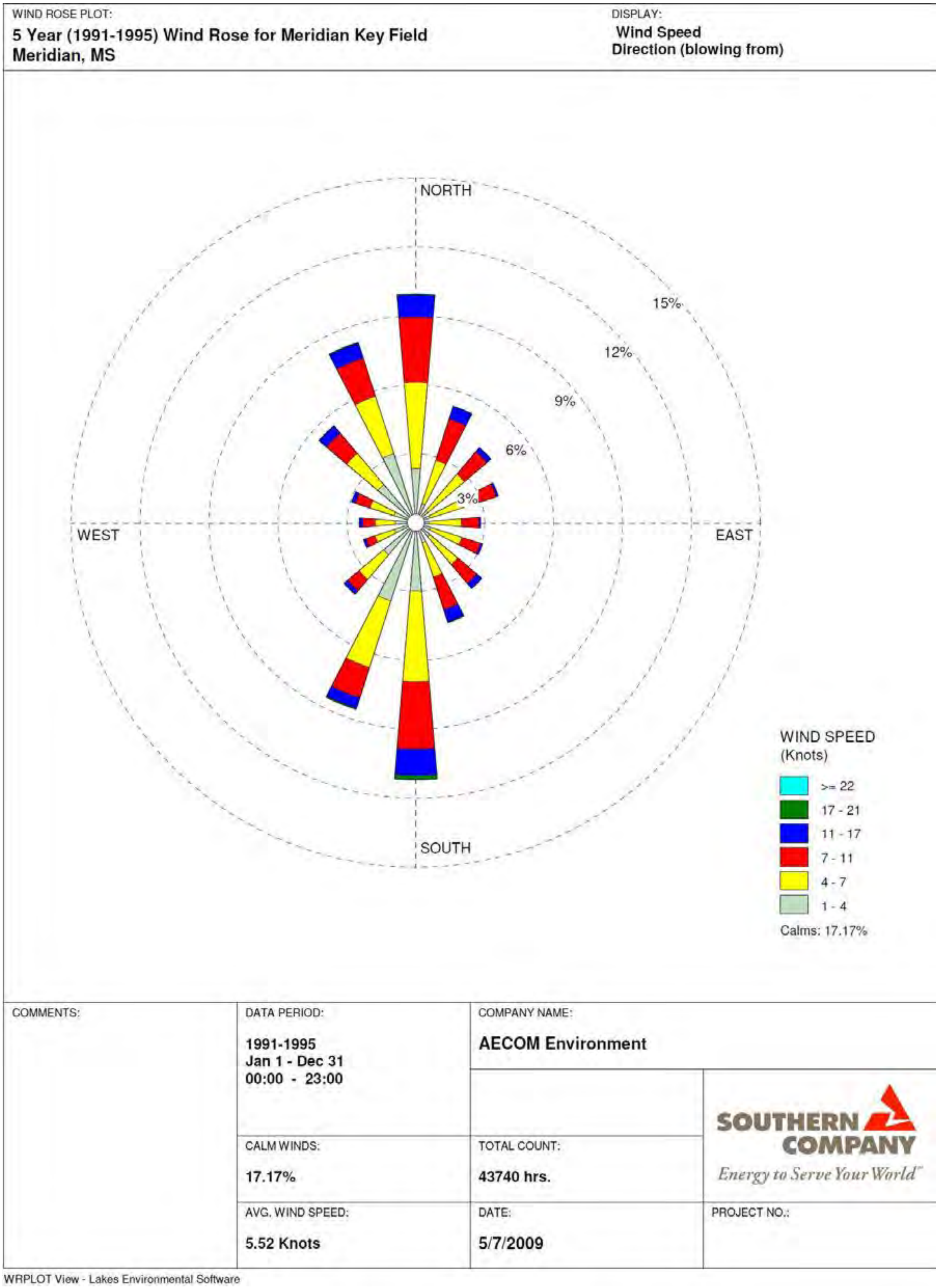
Pollutant	Max. Annual Modeled Impact	NADP Mercury Deposition Network[(1)]	OLF 2005-08 Average Low/High Estimates (2)
Mercury - Wet Deposition	3.44E-07	1.68E-05	1.47E-05
Mercury - Dry Deposition	2.24E-06	not available	1.22E-06/2.45E-06
Mercury - Total Deposition	2.46E-06	not available	15.9E-06/17.2E-06

(1) Average concentration at MS22 monitor (Oak Grove, MS) from 2001-2007.

(2) Data for OLF provided by Southern Company. Wet deposition is directly measured and dry deposition has been estimated based on measured concentrations and estimated range of deposition velocity applicable to the surface type in the OLF study area.

Figure 1: Relative Location of Kemper IGCC Project Site, Meteorological Data Sources, and Ambient Mercury Monitors

Figure 2: Meridian Key Field 5-year (1991-1995) Wind Rose



WIND ROSE PLOT:

5 Year (1991-1995) Wind Rose for Meridian Key Field
Meridian, MS

DISPLAY:

Wind Speed
Direction (blowing from)

COMMENTS:

DATA PERIOD:

1991-1995
Jan 1 - Dec 31
00:00 - 23:00

COMPANY NAME:

AECOM Environment

SOUTHERN COMPANY
Energy to Serve Your World™

CALM WINDS:

17.17%

TOTAL COUNT:

43740 hrs.

AVG. WIND SPEED:

5.52 Knots

DATE:

5/7/2009

PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Figure 3: Project Receptors Used to Determine Maximum Annual and Short-Term Impacts – Near-Field Receptors

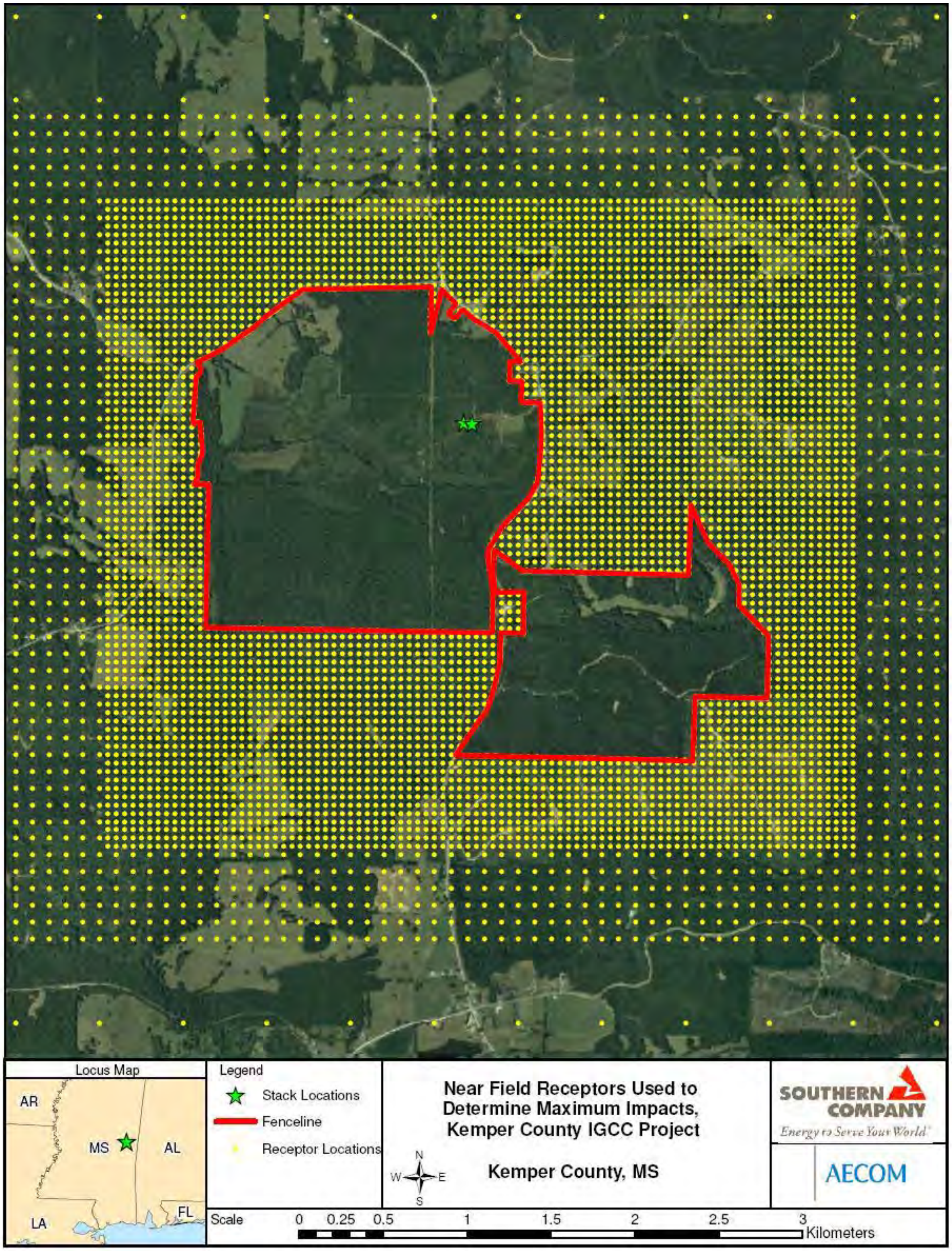


Figure 4: Project Receptors Used to Determine Maximum Annual and Short-Term Impacts – Far-Field Receptors

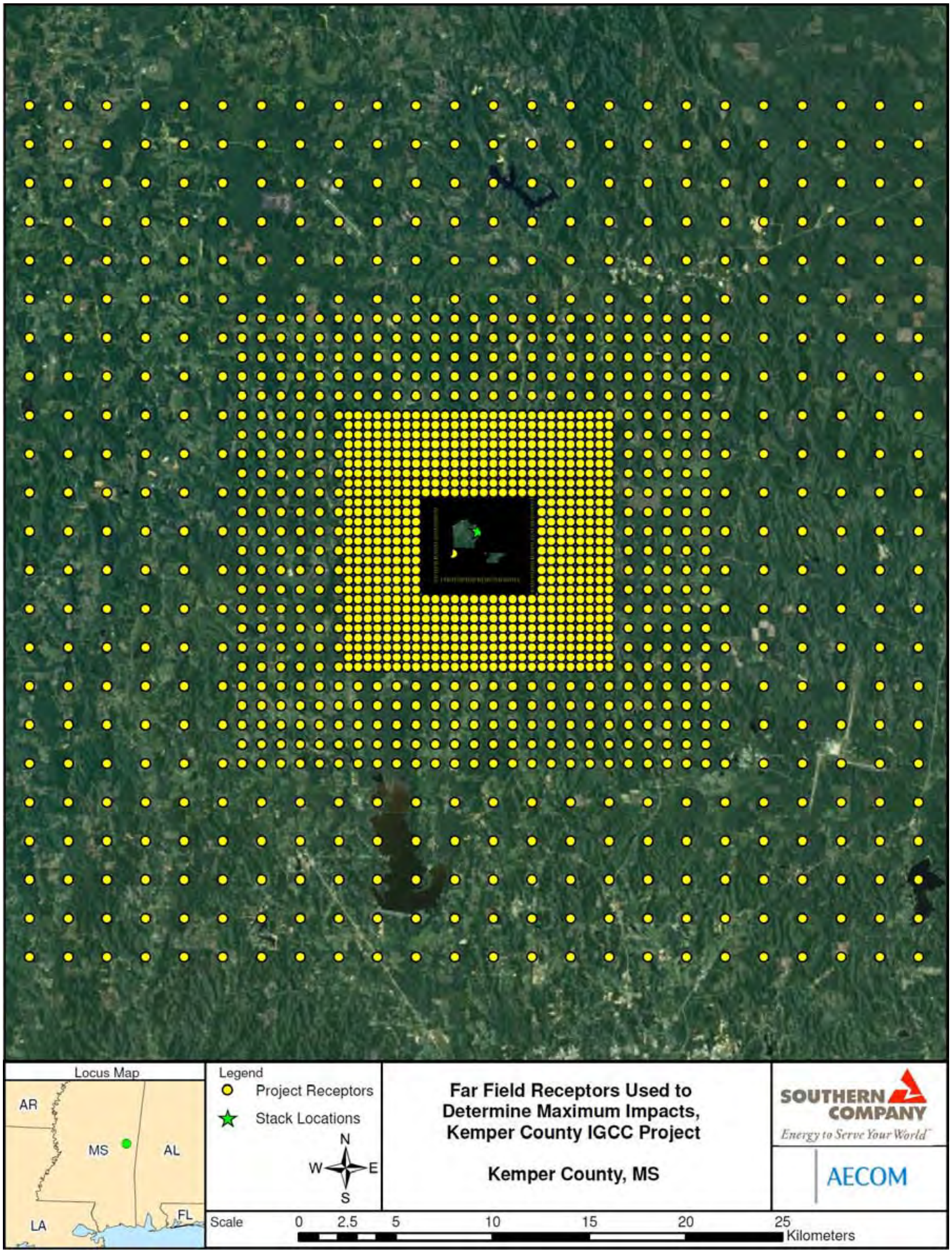


Figure 5: Kemper County Receptor Grid

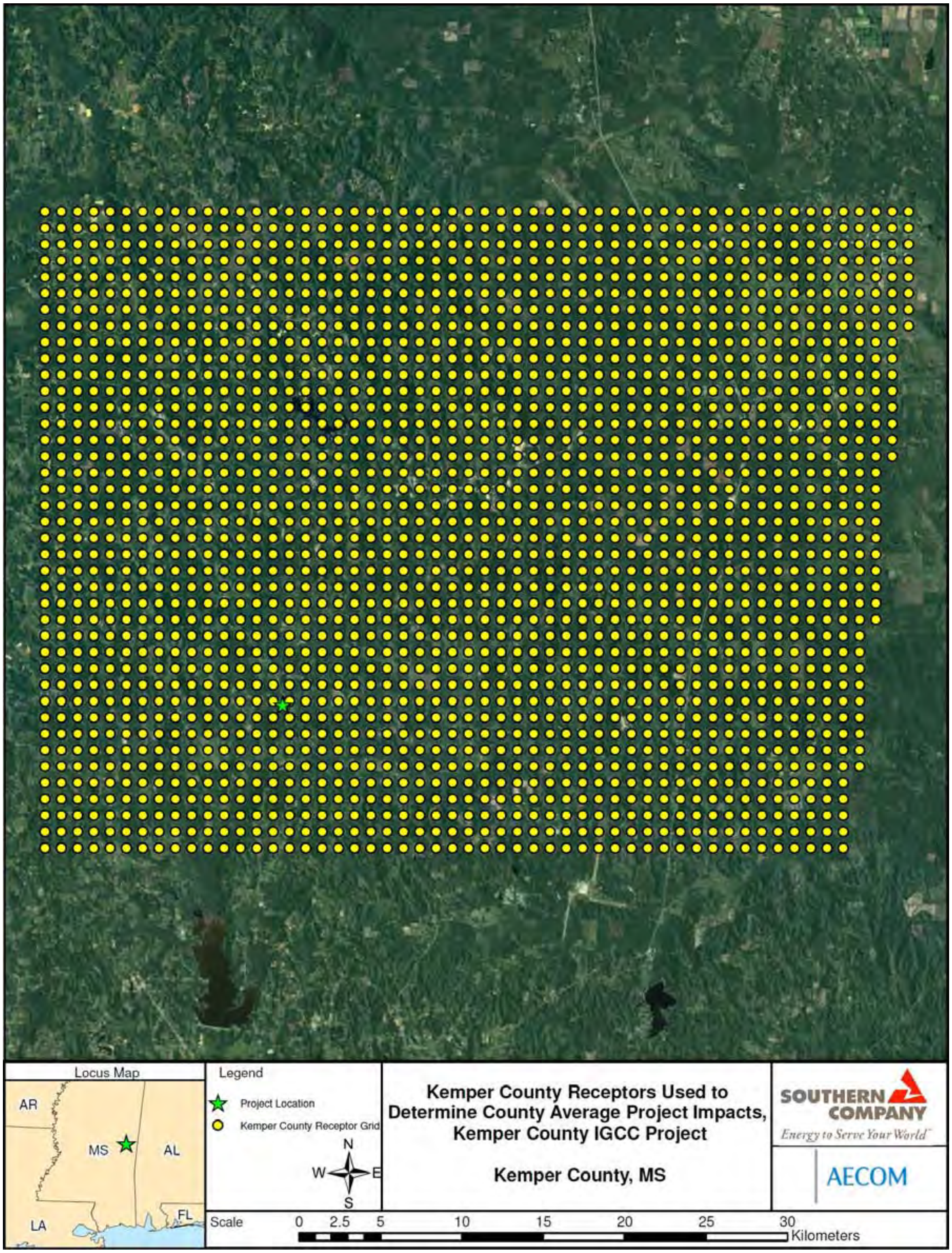
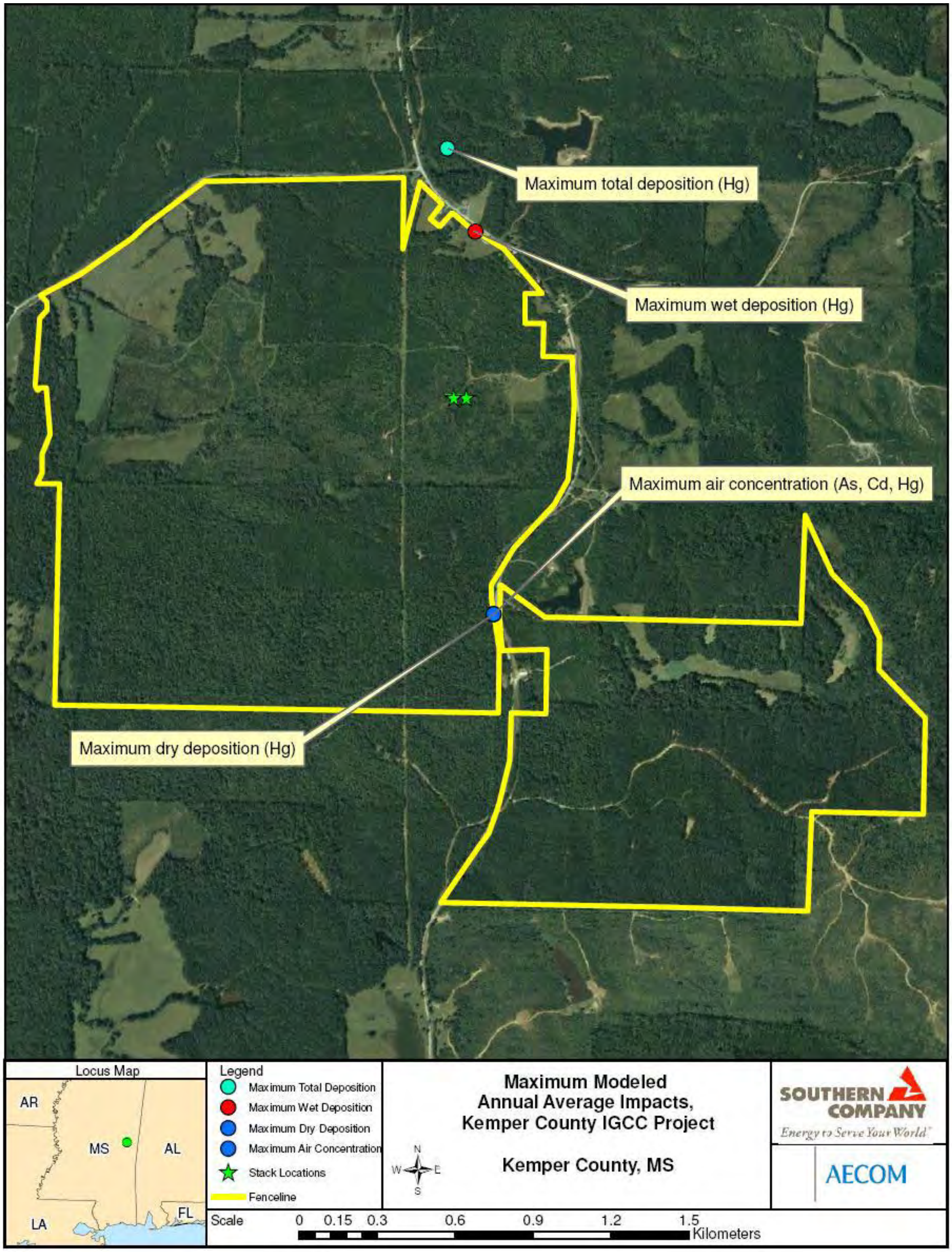


Figure 6: Location of Maximum Air Concentration Impacts and Mercury Deposition



APPENDIX S

LETTER OF UNDERSTANDING AND DISCLOSURE STATEMENT

U.S. Department of Energy

National Energy Technology Laboratory

August 22, 2008

Ms. Kimberly D. Flowers
Vice President and Senior Production Officer
Mississippi Power Company
2992 West Beach Blvd
Gulfport, Mississippi 39501-1907

Mr. Jack D. Doolittle
Chief Executive Officer
Environmental Consulting & Technology, Inc.
3701 NW 98th Street
Gainesville, FL 32606

Re: Letter of Understanding

Dear Ms. Flowers and Mr. Doolittle:

The purpose of this letter is to memorialize the understandings among Mississippi Power Company ("MPC"), Environmental Consulting & Technology, Inc. ("ECT"), and the United States Department of Energy ("DOE"), with respect to the responsibilities and relationships of each party in preparing, pursuant to the National Environmental Policy Act of 1969 ("NEPA"), an Environmental Impact Statement ("EIS"). The EIS is necessary to evaluate the potential environmental impacts associated with a project proposed by MPC known as the Kemper County IGCC Project.

The EIS prepared pursuant to this agreement will be used by DOE to decide whether to provide cost-shared funding for, and certain loan guarantees for, project activities beyond preliminary design, including detailed design, construction, and operation of the proposed facility.

Pursuant to 10 C.F.R. § 1021.215(d) and 40 C.F.R. § 1506.5(c), MPC has recommended and DOE has approved ECT to prepare the Draft and Final EIS at MPC's expense. In accordance with 40 C.F.R. § 1506.2(a) and (c), and to reduce duplication to the fullest extent possible, other federal, state and local agencies having jurisdiction by law or special expertise will be informed and invited to provide input or cooperate with the parties to this Letter of Understanding during the preparation of the Draft and Final EIS.

The parties agree that neither ECT's business relationships, as disclosed by ECT to DOE, with Southern Power Company (an affiliate of MPC) on other power development projects, nor ECT's involvement of the preparation of the EIV for the Orlando Gasification Project for Southern Company, raises a conflict of interest for work on this project.

DOE's Responsibilities

DOE is responsible for preparing and issuing the EIS under NEPA, and has full and final authority to direct preparation by ECT of all draft and final documents related to its preparation, as well as full and final authority to approve or modify any statement, analysis or conclusion made in the EIS. In accordance with 40 C.F.R. § 1506.5(c), DOE will "independently evaluate the statement prior to its approval and take responsibility for its scope and contents." DOE has given approval for ECT to assist DOE in preparing the EIS, and ECT has agreed to abide by all of DOE's instructions in the preparation of the NEPA documents. ECT has stated that it has no conflict of interest in the outcome of MPC's project.

ECT's Responsibilities

ECT is responsible for assisting DOE in performing all of the tasks necessary to prepare an EIS in a prompt and efficient manner. Additionally, in accordance with 10 C.F.R. § 1021.310 , ECT is responsible for executing a disclosure statement, prepared by DOE stating that it has no financial or other interest in the outcome of this project.

MPC's Responsibilities

MPC is responsible for providing ECT with the information ECT requires to prepare the EIS in a timely manner and will ensure that the information concerning MPC that ECT and DOE rely upon is, to the best of its knowledge, true and correct. MPC has agreed by separate contract to compensate ECT directly for all of the work ECT performs in preparing the EIS and agrees that it, and not DOE, is responsible for resolving all claims, demands, or other causes of action that might arise between ECT and MPC connected to those two parties' work on the EIS.

Carl O. Bauer — 9-02-08

Carl O. Bauer, Director — Date
National Energy Technology Laboratory
U.S. Department of Energy

Kimberly Flowers — 9/8/08

Kimberly D. Flowers, Vice President and Senior Production Officer, Mississippi Power Company — Date

Jack D Doolittle — 9/4/08

Jack D. Doolittle, Chief Executive Officer, Environmental Consulting & Technology, Inc. — Date

DISCLOSURE STATEMENT
ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.
ENVIRONMENTAL IMPACT STATEMENT
KEMPER COUNTY IGCC PROJECT

Regulatory Requirement

Council on Environmental Quality (CEQ) Regulations at 40 CFR 1506.5(c), which have been adopted by the Department of Energy (DOE) at 10 CFR 1021, require contractors who will prepare an Environmental Impact Statement (EIS) to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for the purposes of this disclosure is discussed in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at question 17a and b.

"Financial interest or other interest in the outcome of the project" includes "any financial benefits such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g. if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18031.

Disclosure Statement

In accordance with the requirements set forth above, Environmental Consulting & Technology, Inc, (ECT) hereby makes this disclosure statement and certifies that ECT has no past, present, or currently planned financial, or other interest in the outcome of the Kemper County, IGCC Project (the Project). ECT agrees that should it become aware of any facts giving rise to a potential future conflict of interest, it will promptly notify the DOE NEPA Document Manager and take any steps necessary to mitigate the conflict.

For the purposes of complete disclosure, ECT makes the following representations:

1. ECT has no interest in the Project other than NEPA related work. The Project proponent, Southern Company Services, (SCS) has advised that SCS may conduct a competition for a subcontractor to develop NEPA related environmental monitoring plans and perform post-ROD monitoring. ECT may have an interest in submitting a proposal against the subcontract competition.

2. ECT is currently performing environmental work for Southern Power Company, a subsidiary of Southern Company. SCS and Mississippi Power Company (the host site for the Project) are also both subsidiaries of Southern Company under a different

branch of the organization from Southern Power Company. Historically, ECT's work for Southern Power Company has comprised a small portion of ECT's total business base. The Project is ECT's first involvement with Mississippi Power Company.

3. In February 2008, SCS contracted with ECT in anticipation of supporting the NEPA process including the preparation of an Environmental Information Volume (EIV) which would be used to assist DOE in preparation of the Draft EIS. ECT has recently begun environmental field studies and baseline data collections to be included in the NEPA documentation. SCS also contracted with ECT for preparation of an EIV used to support DOE's EIS for the Project when it was planned for Orlando, Florida.

4. ECT anticipates that future work for subsidiaries of Southern Company will be similar in nature to that done in the recent past, such as due diligence studies, site feasibility assessments, and permitting work.

Certified by:

Jack D Doolittle 8/26/08
SIGNATURE DATE

Jack D. Doolittle, Chief Executive Officer
NAME & TITLE (PRINTED)

Environmental Consulting & Technology, Inc.
COMPANY