

Appendix G
Evaluation of Federally Listed Species in Mississippi

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Appendix G Evaluation of Federally Listed Species in Mississippi

G.1 INTRODUCTION

This evaluation of federally listed species was prepared in conjunction with the environmental impact statement (EIS) for expansion of the Strategic Petroleum Reserve (SPR). The EIS evaluates the expansion of the SPR by developing additional storage capacity at two or three existing sites (West Hackberry and Bayou Choctaw in Louisiana and Big Hill in Texas) or developing one of four new sites (Chacahoula in Louisiana; Richton and Bruinsburg in Mississippi; and Stratton Ridge in Texas).

This appendix analyzes potential effects on federally endangered, threatened and candidate species, and marine mammals protected under the Endangered Species Act (ESA) and Marine Mammal Protection Act (special status species), respectively, from the proposed development of sites in Mississippi. Potential effects on endangered, threatened and candidate species and marine mammals from development of sites in Louisiana and Texas are analyzed in appendices F and H, respectively.

The Department of Energy (DOE) prepared this evaluation of federally listed species to review and document its findings of no effect and may affect in accordance with the definitions found in the Final ESA Section 7 Consultation Handbook dated March 1998 (Consultation Handbook) (USFWS and NMFS 1998), a letter from U.S. Fish and Wildlife Service (USFWS) dated September 29, 2005 (Werner 2005), and consultations with the USFWS field offices. The evaluation was based on the definitions of the effects to endangered or threatened species in the Handbook and letter, as provided below.

- **No effect.** The proposed action would not affect federally listed species or habitat (i.e., suitable habitat for the species occurring in the project county is not present in or adjacent to the action area).
- **Is not likely to adversely affect.** The project may affect listed species and/or critical habitat; however, the effects would be discountable, insignificant, or completely beneficial. Certain avoidance and minimization measures may need to be implemented in order to reach this level of effects.
- **Is likely to adversely affect.** Adverse effects to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect would not be discountable, insignificant, or beneficial. If the overall effect of the proposed action would be beneficial to the listed species but also would be likely to cause some adverse effects to individuals of that species, then the proposed action "is likely to adversely affect" the listed species.

DOE is evaluating the impacts associated with four proposed new sites and three proposed expansion sites, some of which may have more than 100 miles (161 kilometers) of new pipelines, new tank farms, and brine disposal systems (offshore diffuser or injection wells) associated with it. When DOE issues a record of decision, it will select either an alternative with one new site and two or three expansion sites for future development, or the no-action alternative. For these reasons, DOE has not conducted comprehensive field surveys and can reach only "no effect" or "may affect" conclusions for this evaluation of special status species instead of using all of the classifications described earlier. For the finding of "may affect," DOE has not completed onsite surveys to support a finding of "is not likely to adversely affect" or "is likely to adversely affect;" therefore, a finding of "no effect" or "may affect" is the conclusion that DOE can reach at this time.

After issuing the record of decision that specifies the new site or sites and the expansion sites that would be developed, DOE would perform site- and species-specific surveys for all the federally listed species that received a finding of “may affect.” DOE would perform the evaluation of the federally listed species in consultation with USFWS and in accordance with section 7 of the ESA and the Final ESA section 7 Consultation Handbook dated March 1998.

G.1.1 Purpose

This evaluation analyzes the potential effects on federally listed threatened and endangered species of construction, operation, and maintenance of additional SPR storage capacity. Proposed activities vary by site (e.g., based on existing infrastructure) and may include construction of underground storage caverns and surface facilities at the storage sites; construction of pipelines for crude oil distribution, raw water supply, and brine disposal; surface or groundwater withdrawals to support solution mining of new caverns; discharge of brine in the Gulf of Mexico; and construction of miscellaneous facilities at oil distribution sites.

G.1.2 Threatened and Endangered Species Terminology

USFWS lists a species on the Federal Endangered Species List as “threatened” when it is likely to become endangered throughout all or a significant portion of its range in the foreseeable future, and lists a species as “endangered” when it is in danger of extinction throughout all or a significant portion of its range. In addition, the USFWS maintains a list of what are called “candidate species” that are being considered for listing under the Endangered Species Act. A candidate species is a species that the USFWS has on file sufficient information to support a proposal to list as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher-priority listing actions. Federal agencies are encouraged to consider these species in preparing environmental impact analysis done under NEPA in order to alleviate threats to them and thereby possibly eliminate the need to list the species as endangered or threatened.

To define all the species that are required to be addressed in the biological assessment, DOE contacted and obtained information from the USFWS, National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the Mississippi Department of Wildlife, Fisheries, and Parks. Appendix K contains lists of the consultation meetings held.

G.1.3 Organization

This appendix includes the following: a brief literature review for each of the species addressed (section G.2); observations made during site visits (section G.3); an assessment of the potential effects of the proposed action on the threatened, endangered, and candidate species (section G.4); and recommendations for minimizing potential adverse effects on the subject species and on other biological resources (section G.5). References cited in this appendix are identified in section G.6.

G.2 LITERATURE REVIEW

The literature review describes the natural histories of all species federally listed as threatened, endangered, or candidate *and* identified as present or potentially present (e.g., based on historical records) in at least one county or parish where proposed new and expanded SPR facilities and associated infrastructure would be located. Table G.2-1 lists the species evaluated in this appendix. Although table

G.2-1 pertains only to the Bruinsburg and Richton candidate sites in Mississippi, it includes species present in Louisiana parishes because the Bruinsburg oil distribution pipeline would cross into Louisiana from Mississippi.

Table G.2-1: Federally Listed Threatened or Endangered Species in Louisiana Parishes and Mississippi Counties Associated with Proposed SPR Sites in Mississippi

Common Name	Scientific Name	Federal Status	Mississippi and Louisiana Status ^a	Counties/Parishes Where Species May Exist ^b
Birds				
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Threatened	Mississippi: Critically imperiled (breeding); imperiled (nonbreeding) Louisiana: Endangered	Mississippi: Adams, Jackson, Wilkinson Louisiana: East Baton Rouge, West Feliciana
Brown Pelican	<i>Pelecanus occidentalis</i>	Endangered	Mississippi: Critically imperiled (nonbreeding)	Mississippi: Jackson
Interior Least Tern	<i>Sterna antillarum athalassos</i>	Endangered	Mississippi: Rare or uncommon	Mississippi: Claiborne, Warren
Mississippi Sandhill Crane	<i>Grus canadensis pulla</i>	Endangered	Mississippi: Critically imperiled	Mississippi: Jackson
Piping Plover	<i>Charadrius melodus</i>	Threatened	Mississippi: Not Listed	Mississippi: Jackson
Red-Cockaded Woodpecker	<i>Picoides borealis</i>	Endangered	Mississippi: Critically imperiled	Mississippi: Amite, Forrest, George, Greene, Jackson, Perry, Wilkinson
Fish				
Bayou Darter	<i>Etheostoma rubrum</i>	Threatened	Mississippi: Critically imperiled	Mississippi: Claiborne, Copiah
Gulf Sturgeon	<i>Acipenser oxyrinchus desotoi</i>	Threatened	Mississippi: Critically imperiled Louisiana: Threatened	Mississippi: Forrest, Copiah, George, Greene, Jackson, Marion, Pike, Perry, Walthall Louisiana: East Baton Rouge, East Feliciana
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered	Mississippi: Critically imperiled Louisiana: Endangered	Mississippi: Adams (P), Claiborne (P), Jefferson (P), Wilkinson (P) Louisiana: East Baton Rouge, East Feliciana, West Baton Rouge, West Feliciana
Pearl Darter	<i>Percina aurora</i>	Candidate	Mississippi: Not listed	Mississippi: Forrest, George, Jackson, Perry
Invertebrates				
Alabama Heelsplitter Mussel	<i>Potamilus inflatus</i>	Threatened	Louisiana: Threatened	Louisiana: East Baton Rouge
Camp Shelby Burrowing Crayfish	<i>Fallicambarus gordonii</i>	Candidate	Mississippi: Critically imperiled	Mississippi: Perry

Table G.2-1: Federally Listed Threatened or Endangered Species in Louisiana Parishes and Mississippi Counties Associated with Proposed SPR Sites in Mississippi

Common Name	Scientific Name	Federal Status	Mississippi and Louisiana Status ^a	Counties/Parishes Where Species May Exist ^b
Fat Pocketbook Mussel	<i>Potamilus capax</i>	Endangered	Mississippi: Critically imperiled	Mississippi: Jefferson
Mammals				
Gray Myotis (Gray Bat)	<i>Myotis grisescens</i>	Endangered	Mississippi: Not listed	Mississippi: Perry (P)
Louisiana Black Bear	<i>Ursus americanus luteolus</i>	Threatened	Mississippi: Critically imperiled Louisiana: Threatened	Mississippi: Adams, Amite, Claiborne, Copiah, Forrest, George, Greene, Jackson, Jefferson, Lamar (P), Marion, Perry, Pike (P), Walthall (P), Wilkinson Louisiana: West Feliciana
Marine Mammals				
Gervais Beaked Whale	<i>Mesoplodon europaeus</i>	Protected	Threatened	Mississippi: Jackson
Goose-Beaked Whale	<i>Ziphius cavirostris</i>	Protected	Threatened	Mississippi: Jackson
Pygmy Sperm Whale	<i>Kogia breviceps</i>	Protected	Threatened	Mississippi: Jackson
Dwarf Sperm Whale	<i>Kogia simus</i>	Protected	Threatened	Mississippi: Jackson
Sperm Whale	<i>Physeter macrophalus</i>	Endangered	Endangered	Mississippi: Jackson
Atlantic Spotted Dolphin	<i>Stenella frontalis</i>	Protected	Threatened	Mississippi: Jackson
Rough-Toothed Dolphin	<i>Steno bredanesis</i>	Protected	Threatened	Mississippi: Jackson
Killer Whale	<i>Orcinus orca</i>	Protected	Threatened	Mississippi: Jackson
False Killer Whale	<i>Pseudorca crassidens</i>	Protected	Threatened	Mississippi: Jackson
Short-Finned Pilot Whale	<i>Globicephala macrorhynchus</i>	Protected	Threatened	Mississippi: Jackson
Pygmy Killer Whale	<i>Feresa attenuate</i>	Protected	Threatened	Mississippi: Jackson
West Indian Manatee	<i>Trichechus manatus</i>	Endangered	Endangered	Mississippi: Jackson Louisiana: East Baton Rouge
Bottlenose Dolphin	(<i>Tursiops truncatus</i>)	Protected	Not listed	Mississippi: Jackson
Plants				
Louisiana Quillwort	<i>Isoetes louisianensis</i>	Endangered	Mississippi: Imperiled	Mississippi: Forrest, George, Greene, Jackson, Perry
Reptiles				
Alabama Red-Belly Turtle	<i>Pseudemys alabamensis</i>	Endangered	Mississippi: Endangered	Mississippi: Jackson
Black Pine Snake	<i>Pituophis melanoleucuc spp. Lodingi</i>	Candidate	Mississippi: Imperiled	Mississippi: Forrest, George, Marion, Perry

Table G.2-1: Federally Listed Threatened or Endangered Species in Louisiana Parishes and Mississippi Counties Associated with Proposed SPR Sites in Mississippi

Common Name	Scientific Name	Federal Status	Mississippi and Louisiana Status ^a	Counties/Parishes Where Species May Exist ^b
Eastern Indigo Snake	<i>Drymarchon corais couperi</i>	Threatened	Mississippi: Critically imperiled	Mississippi: Forrest (P), George (P), Greene (P), Jackson (P), Marion, Perry (P)
Gopher Tortoise	<i>Gopherus polyphemus</i>	Threatened	Mississippi: Imperiled	Mississippi: Forrest, George, Greene, Jackson, Lamar, Marion, Perry, Walthall
Green Sea Turtle	<i>Chelonia mydas</i>	Endangered	Mississippi: No definable occurrences, nonbreeding	Mississippi: Jackson
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	Endangered	Mississippi: Critically imperiled (nonbreeding)	Mississippi: Jackson
Loggerhead Sea Turtle	<i>Caretta caretta</i>	Threatened	Mississippi: Critically imperiled (breeding); imperiled (nonbreeding)	Mississippi: Jackson
Ringed Map Turtle	<i>Graptemys oculifera</i>	Threatened	Mississippi: Imperiled	Mississippi: Copiah, Marion
Yellow-Blotched Map Turtle	<i>Graptemys flavimaculata</i>	Threatened	Mississippi: Imperiled	Mississippi: Forrest, George, Greene, Jackson, Perry

Not listed: No state status; species is not classified as threatened or endangered by Louisiana.

^a State status for Mississippi is provided for every species; state status for Louisiana is provided for only those species also present or potentially present in at least one Louisiana parish where SPR facilities are proposed.

^b Includes only counties in Mississippi where SPR facilities are proposed.

(P) Potentially or historically present in the county.

G.2.1 Birds

G.2.1.1 Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is a large bird of prey with an average wingspan of about 7 feet (2 meters). The adult male and female are similar in appearance, with a dark brown body and wings, and a distinctive white head and tail. This species is federally listed as threatened, although delisting has been proposed.

The bald eagle may be found throughout the continental United States and Alaska. It is most likely to be found in areas with large expanses of aquatic habitat with forested shorelines or cliffs where it selects supercanopy roost trees. The bald eagle is an opportunistic forager. Although it prefers fish, it will eat a great variety of mammals, amphibians, crustaceans, and birds, including many species of waterfowl (Buehler 2000).

The bald eagle nests almost exclusively at the edges of lakes, rivers, or seacoasts. It generally nests in tall trees or cliffs near the water's edge, although it occasionally nests on the ground. Nests are often reused in successive years. The breeding season generally begins in the spring (earlier in southern states), with the young fledging after about 6 months (USFWS 1983; USFWS 1995). According to comments submitted to DOE by the USFWS (James 2005), nesting activity occurs from September to January with young fledged usually by midsummer. Although resident breeding populations occur along the eastern Gulf Coast, the bald eagle in Mississippi is likely to be a nonbreeding migrant (NatureServe 2005).

The bald eagle is highly sensitive to human noise and interference (USFWS 1983; USFWS 1995). It is most sensitive during the first 12 weeks of the nesting cycle. Disturbance during nesting may lead to nest abandonment or reduced hatching and survival rates. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest, lessening their likelihood of survival (Watson 2005).

G.2.1.2 Brown Pelican

The brown pelican (*Pelecanus occidentalis*) is a large water bird with a massive bill and throat pouch. Its wings and body are grayish-brown. The nonbreeding adult has a whitish head and neck, often with some yellow. The hindneck of a breeding adult is dark chestnut (NGS 1983, Palmer 1962). A larger individual has a wingspread of more than 7 feet (2 meters) (USFWS 2005).

The brown pelican is a fish eater, and it is found almost exclusively in coastal areas along the southern east coast, the Gulf of Mexico, and throughout the west coast. It prefers to feed in shallow estuarine waters and use sand spits, offshore sand bars, and islets for nocturnal roosting. Dry roosting sites are essential to suitable habitat (NatureServe 2005). Nests usually are built on coastal islands, on the ground or in small bushes and trees (Palmer 1962).

The brown pelican is a federally listed endangered species. Populations in California, Texas, and Louisiana were devastated by pesticide poisoning from dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE), and other compounds throughout the 1950s and 1960s; nevertheless, eastern and Gulf Coast populations of the brown pelican appear to be stable and possibly have been increasing in recent years. Contaminant levels in both populations are below the threshold for reproductive failure, but the populations are still very vulnerable to pesticide pollution (Anderson and Hickey 1970). Other threats include the disturbance of nesting birds by humans, a decline in fish populations, increased water turbidity resulting from dredging, oil and chemicals spills, entanglement in fishing gear, and extreme weather conditions. Recently, habitat degradation has affected both roosting and nesting. For example, nesting efforts have failed in the Gulf Coast because of erosion at the nesting sites (NatureServe 2005).

The brown pelican is classified as vulnerable in Texas and imperiled in Louisiana. The State of Mississippi has no listed conservation status for the species, although the species is found in Jackson and Harrison Counties.

G.2.1.3 Interior Least Tern

The least tern (*Sterna antillarum*) is the smallest North American tern, with an average body length of about 9 inches (23 centimeters). The breeding adult is mainly gray, topped by a black cap and nape and a white forehead. The least tern is classified by the USFWS as endangered in Louisiana in areas along the Mississippi River and its tributaries, Mississippi along the Mississippi River, and all of Texas except in areas within 50 miles (80.5 kilometers) of the coast (USFWS 2005).

There are two recognized subspecies of the least tern, one of which—the interior least tern (*Sterna antillarum athalassos*)—is found in Texas, Louisiana, and Mississippi. This subspecies includes interior populations of the bird (not a taxonomic variation), which tend to be more critically endangered because of habitat loss caused by large-scale water management projects that destroy breeding grounds (NatureServe 2005).

Breeding grounds for the least tern are found locally throughout the Mississippi River system. Nesting occurs on and near the river with eggs often resting directly on sandbars (Aycock 2005). Good nesting areas are above the high-tide mark, have shells or stones for egg camouflage, and are near a plentiful source of small fish (Burger and Gochfeld 1990). Hatching success is easily disrupted by poor weather, tides, predation, and human disturbance.

The breeding season of the least tern is from May through August, although adult birds may roost near the nesting sites for up to a month before laying occurs (usually in May or June). The least tern that breeds in the southern Atlantic states migrates to wintering grounds in the Caribbean between August and September (NatureServe 2005).

The primary prey of the least tern is small fish from shallow rivers, streams, and lakes. When available, crustaceans, insects, mollusks, and annelids may also form part of the diet (Whitman 1988).

G.2.1.4 Mississippi Sandhill Crane

The Mississippi sandhill crane (*Grus canadensis pulla*) is an endangered subspecies. Like other sandhill cranes, the Mississippi subspecies is a tall, about 4 feet (1 meter), long-necked crane that is uniformly gray-brown except for a red crown. The Mississippi subspecies is darker than other sandhill cranes (Valentine and Lohofener 1991). The entire wild population of this subspecies, which consists of slightly more than 100 birds, is found on and near the Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, MS.

The habitats preferred by Mississippi sandhill crane include open savannas, swamp edges, young pine plantations, and wetlands along edges of pine forests (NatureServe 2005). The diet of this species consists primarily of aquatic invertebrates, reptiles, amphibians, insects, and aquatic plants (Ehrlich et al. 1992).

G.2.1.5 Piping Plover

The piping plover (*Charadrius melodus*) is a small, sandy-colored shorebird similar in appearance to a sandpiper. Distinguishing field marks of this species include yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the base of its neck (USFWS 2005). The piping plover is federally listed as threatened in Mississippi.

A migratory species, the piping plover overwinters on beaches, mudflats, and sandflats along the Atlantic coast and the Gulf of Mexico including barrier island beaches and spoil islands on the Gulf Intracoastal Waterway (USFWS 2005). Critical habitat for the wintering piping plover has been proposed for the following several specific locations in Jackson County, MS (USFWS 2001c):

- **Unit MS-10:** Ocean Springs West. 1.2 miles (1.9 kilometers) of shoreline in Jackson County. This unit extends from U.S. 90 and includes the shore of Biloxi Bay following the shoreline southeast to the Ocean Springs Harbor inlet. The shoreline of this unit is privately owned.
- **Unit MS-11:** Ocean Springs East. 1.6 miles (2.6 kilometers) of shoreline in Jackson County. This unit extends from Weeks Bayou and includes the shore of Biloxi Bay following the shoreline southeast to Halstead Bayou. The shoreline of this unit is privately owned.
- **Unit MS-12:** Deer Island. 9.1 miles (14.6 kilometers) of shoreline in Harrison County. The entire unit is on Deer Island. This unit includes privately owned Mississippi Sound shoreline.

- **Unit MS–13:** Round Island. 1.6 miles (2.6 kilometers) of shoreline in Jackson County. This unit includes privately owned Mississippi Sound shoreline.
- **Unit MS–14:** Mississippi Barrier Islands. 81.1 miles (130.5 kilometers) of shoreline in Harrison and Jackson Counties. This unit includes shoreline of the Mississippi Sound and Gulf of Mexico on Cat, East and West Ship, Horn, Spoil, and Petit Bois Islands. Approximately 24.8 miles (39.9 kilometers) are privately owned, and 59.4 miles (95.6 kilometers) are part of Gulf Islands National Seashore.
- **Unit MS–15:** North and South Rigolets. 3.7 miles (5.9 kilometers) of shoreline in Jackson County, MS, and Mobile County, AL. This unit extends from the southwestern tip of South Rigolets Island and includes the shore of Point Aux Chenes Bay, the Mississippi Sound, and Grand Bay following the shoreline east around the western tip, then north to the South Rigolets Bayou; then from the southeastern corner of North Rigolets Island north to the northeastern most point of the island. Approximately 2.7 miles (4.3 kilometers) are in Mississippi and 1.0 mile (1.6 kilometers) is in Alabama. Almost half the Mississippi shoreline length is in the Grand Bay National Wildlife Refuge.

The piping plover begins to arrive at wintering habitats in July and remains through September. Although a few plovers remain throughout the year, sightings are rare in late May, June, and early July (USFWS 2001c).

G.2.1.6 Red-Cockaded Woodpecker

The red-cockaded woodpecker (*Picoides borealis*) is a federally listed endangered species found in mature and old-growth pine forests in the southeastern United States. The red-cockaded woodpecker is black and white with a ladder back and distinctive white cheek patches (USFWS 2003b). The species is named for barely visible red streaks called “cockades” on the head of the adult male (NatureServe 2005).

The red-cockaded woodpecker has specific habitat requirements that include open pine woodlands or savannahs with large, old pines. Large pines are required because cavity nests are built only in inactive pine heartwood. Nesting trees must be in open stands with little or no hardwood midstory and few or no overstory hardwoods (USFWS 2003b). Foraging occurs in older pine stands within 0.5 mile (0.8 kilometer) of a colony (Aycock 2005).

The red-cockaded woodpecker lives in family groups that usually include a breeding pair and nonbreeding helpers. Most helpers are male. Mating typically occurs in November and December and March through May, and egg laying usually occurs in April and early May. Incubation lasts about 10 to 12 days (Hooper et al. 1980) and hatchlings remain in the nest for 26 to 29 days (NatureServe 2005).

According to the 1985 revision of the recovery plan for this species, there were approximately 14,068 red-cockaded woodpeckers living in 5,627 groups in 11 states (USFWS 2003b). USFWS established criteria for delisting the species based on the status and size of primary and secondary core populations named in the recovery plan. Table G.2.1.6-1 shows the locations of core populations of red-cockaded woodpeckers in Mississippi.

Table G.2.1.6-1: Locations of Designated Core Red-Cockaded Woodpecker Populations in Mississippi

Designated Core Population Type	Population Locations in Mississippi
Primary	Chickasawhay Ranger District, De Soto National Forest (includes parts of Jones, Wayne, and Green Counties)
	Bienville National Forest (includes parts of Jasper, Newton, Scott, and Smith Counties)
Secondary	De Soto Ranger District, De Soto National Forest (includes parts of Pearl River, Forrest, Perry, Greene, George, Stone, Harrison, and Jackson Counties)
	Homochitto National Forest (includes parts of Amite, Adams, Copiah, Franklin, Jefferson, Lincoln, and Wilkinson Counties)

G.2.2 Fish

G.2.2.1 Bayou Darter

The bayou darter (*Etheostoma rubrum*) is a threatened fish species found in western Mississippi in the Bayou Pierre and the lower reaches of its tributaries: White Oak Creek, Foster Creek, and Turkey Creek (USFWS 2005). The largest concentrations of the 2-inch (5.1-centimeter) fish are found in the sections of Bayou Pierre and Foster Creek in Copiah County, north of state highway 548 (Page and Burr 1991). Although the population density was stable in the 1980s and 1990s, continuing geomorphic changes have shifted the distribution upstream (Ross et al. 2001).

The typical habitat of the bayou darter includes creeks and small to medium rivers. The adult bayou darter is commonly collected near heads of gravel riffles in water less than 6 to 12 inches (15 to 30 centimeters) deep, which reflects the bayou darter’s preference for stable, moderately swift riffles of large gravel and rock (USFWS 1990b). In the winter, the bayou darter is often found near logs, cobble, and boulders, which may provide refuge during periods of high stream flow (Ross et al. 1990, 1992).

The female usually starts spawning after its first year, and it spawns at least twice per reproductive season, and lives 3 years (Burriss and Bagley 1983; USFWS 1990b; Knight and Ross 1992). Clutch size ranges from 20 to 75 ova depending on the size of the female (USFWS 2005). Reproduction occurs mid-April or early May to mid-August at a water temperature of 68 to 86 degrees Fahrenheit (20 to 30 degrees Celsius). The juvenile has been collected from late July to late August, but it also has been reported as early as June. The peak-spawning season is April to late May, or early June during rising water temperatures 72 to 84 degrees Fahrenheit (22 to 29 degrees Celsius) (Burriss and Bagley 1983; USFWS 1990b; Knight and Ross 1992). After spawning, the bayou darter buries its eggs for protection (Ross and Wilkins 1993).

G.2.2.2 Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is a threatened anadromous fish species found in Gulf coastal waters from Louisiana to Florida. Primitive in appearance, the Gulf sturgeon has external bony plates, an extended snout, and four large barbels. Adults range from 4 to 8 feet (1.2 to 2.4 meters) in length, with the adult female measuring larger than the male (USFWS 2003a).

The Gulf sturgeon preys on benthic invertebrates and small fishes. Feeding is believed to occur only during the winter and spring in offshore or estuarine waters (Cross 1992).

USFWS has designated certain Gulf of Mexico rivers and tributaries as critical habitat for the Gulf sturgeon; it spends the first 2 years of its life in these habitats, and later it returns to breed. Spawning habitats are generally fresh water (sometimes tidal) and usually over a bottom of hard clay, rubble, gravel, or shell. Eggs of the Gulf sturgeon are demersal (heavy, sinking to the bottom) and adhesive (USFWS 2003a). In Mississippi, the designated critical habitats include major portions of the Pascagoula, Leaf, Chickasawhay, Pearl, and Bogue Chitto Rivers (USFWS 2003a).

G.2.2.3 Pallid Sturgeon

The endangered pallid sturgeon (*Scaphirhynchus albus*) is a large fish, up 73 inches (186 centimeters), with a flat, shovel-like snout that has four fringed barbells. The pallid sturgeon has 37 to 43 dorsal rays and 24 to 28 anal rays. It is similar to the shovelnose sturgeon, but it has several distinct differences such as the paucity of scale-like scutes on the belly, a larger head, a wider mouth, smaller eyes, and a paler gray-white color above and on the sides (Page and Burr 1991). The pallid sturgeon is one of the largest fish species found in the Missouri/Mississippi River drainage (Gilbraith et al. 1988). Its diet consists of aquatic invertebrates (Carlson et al. 1985).

The pallid sturgeon's habitat consists of large, turbid free-flowing rivers or reservoirs. In a river or reservoir, the pallid sturgeon is most often found in strong current over firm gravel or sandy substrate (USFWS 1989a; Kallemeyn 1981). The pallid sturgeon's preferred temperature range is from 32 to 86 degrees Fahrenheit (0 to 30 degrees Celsius) (Dryer and Sandoval 1993).

The pallid sturgeon's range is quite large, covering about 3,515 miles (5,656 kilometers) of river through 13 states including Louisiana and Mississippi (Dryer and Sandoval 1993). In Louisiana, the most frequent occurrence of the pallid sturgeon is in the Mississippi and Atchafalaya Rivers, where the Atchafalaya diverges from the Mississippi River (Dryer and Sandoval 1993).

The spawning season for the pallid sturgeon lasts from July to August. The male becomes sexually mature at 3 to 4 years of age (Kallemeyn 1981), and the female becomes sexually mature at 7 years. It takes several years for eggs to mature between spawnings (Conte et al 1988). Little other information is available to describe the spawning requirements for the pallid sturgeon, so these requirements are often assumed to be similar to those of the shovelnose sturgeon. The shovelnose sturgeon spawns over rock, rubble, or gravel in the main channel of the Missouri and Mississippi Rivers and their major tributaries, or in the wing dams in the main stem of larger rivers (Christiansen 1975; Elser et al. 1977; Moos 1978; Helms 1974). In addition, in June the shovelnose sturgeon responds to increased waterflow from melting snow by migrating to spawn (Berg 1981).

G.2.2.4 Pearl Darter

The pearl darter (*Percina aurora*) is a candidate endangered fish. It has a blunt snout, horizontal mouth, and large eyes set high on its head. Both sexes have a black spot at the base of the caudal fin, and the breeding male has dark bands on and at the base of the dorsal fin (Ross, in press). The female pearl darter reaches a maximum of 2.3 inches (57 millimeters) in length, and the male reaches a maximum length of 2.6 inches (6.6 centimeters) (Suttkus et al. 1994).

Historically, the pearl darter inhabited the Pearl and Pascagoula drainage systems in Mississippi and Louisiana. No pearl darters have been collected from the Pearl River drainage system since 1973, and it is now believed to exist only in the Pascagoula River drainage system, where specimens are rarely found

(NatureServe 2005). In surveys since 1983, pearl darters have been found only in the Pascagoula, Chickasawhay, Chunky, Leaf, and Bouie Rivers and Okatoma and Black Creeks in Mississippi (USFWS 2001a). The only documented location where spawning is known to occur is in the Leaf River in the vicinity of Eastabuchie and the confluence of the Bouie and Leaf Rivers near Hattiesburg (USFWS 2001a).

Although the habitat requirements of the pearl darter are not well known, the choice may be similar to those of the channel darter. The channel darter generally inhabits rivers and large creeks in areas of moderate current, usually over sand and gravel substrates. These habitat conditions are typical of the lower ends of riffles or the edges of deep channels (NatureServe 2005). The pearl darter is deemed to be threatened by changes in the flow regime of its host rivers, by pollutant loadings from streambank erosion and nonpoint source runoff, and the potential for catastrophic losses resulting from oil toxicity or chemical spills (USFWS 2001a).

G.2.3 Invertebrates

G.2.3.1 Alabama Heelsplitter Mussel

The Alabama heelsplitter (*Potamilus inflatus*), also known as the inflated heelsplitter, is a bivalve mollusk with an adult shell size of approximately 5.5 inches (14 centimeters) in length. Shells are typically brown or black, and they may be streaked with green rays in juveniles (NatureServe 2005). The specific feeding habits of the heelsplitter are unknown, but its prey likely includes detritus, diatoms, phytoplankton, and zooplankton. As with other freshwater mussels, the heelsplitter feeds by filtering food particles from the water column (Churchill and Lewis 1924).

The Alabama heelsplitter prefers stable and soft substrata including sand, sandy-gravel, mud, and silt (Stern 1976; Hartfield 1988). It tends to collect on the protected side of bars, and it is found in water up to 20 feet (6 meters) deep (Hartfield 1988). Historically, the Alabama heelsplitter was found in the Pearl River of Mississippi, as well as some rivers in Alabama and Louisiana (Hurd 1974; Stern 1976; Hartfield 1988). Currently, this species is not abundant in any of its historical range.

Little is known about the life history of this species. The reproductive cycle is similar to that of other freshwater mussels; the male releases sperm into the water column, which are in turn taken in by the female's siphons during feeding and respiration. The female keeps the fertilized eggs until the larvae (glochidia) develop. After the larvae are fully developed, the mussel glochidia are released into the water, where they must attach to an appropriate type of fish while they further develop into juvenile mussels (Hartfield 1988). Studies have indicated that the freshwater drum (*Aplodinotus grunniens*) is a suitable host for heelsplitter glochidia (Roe et al. 1997).

G.2.3.2 Camp Shelby Burrowing Crayfish

The Camp Shelby burrowing crayfish (*Fallicambarus gordonii*) is a nonpetitioned candidate species. All known occurrences of this species are in flat, woodland pitcher plant wetlands, locally referred to as pitcher plant bogs, in central Perry County, MS (Fitzpatrick 1987, 1991). In particular, all known habitat for the species occur on U.S. Forest Service lands leased by U.S. Army National Guard. No SPR development is proposed in this area of Perry County.

G.2.3.3 Fat Pocketbook Mussel

The fat pocketbook mussel (*Potamilus capax*) is endangered through its range in the United States (USFWS 2005). A freshwater mussel, the fat pocketbook prefers a mixture of sand, silt, and clay beds in

flowing water 2 inches to 8 feet deep (5 centimeters to 2.4 meters) (Parmalee 1967; Jenkinson and Ahlstedt 1988). Its lifecycle is unknown, but its reproductive anatomy is believed to be similar to the others in the *Lamsilinae* subfamily (Ortman 1912). It is a long-term breeder and is fertile during the late summer from July through October. (Ortman 1914) Nearly all mussels require a host, usually a fish, during the parasitic larval portion of the lifecycle. A host for this species has not been conclusively identified (USFWS 1989b, NatureServe 2005), but the red drum (*Sciaenops ocellatus*) is a suspected host (Aycock 2005).

The fat pocketbook was once common from Louisiana and Mississippi in the south to Minnesota, Wisconsin, and New York in the north. It is now presumed extinct in Minnesota and Wisconsin, and there is a high likelihood that it is also extinct in New York (NatureServe 2005). Before 1970, the fat pocketbook was most commonly found in the Mississippi River above St. Louis, MO, the Wabash River in Indiana, and the St. Francis River in Arkansas (Dennis 1985). Since 1970, the range has decreased and the mussel seems to be primarily restricted to the St. Francis River, with very scattered populations in the Wabash and Ohio Rivers and southeastern Missouri (NatureServe 2005). The Mississippi River is the one exception because, although the population has decreased significantly, a new population was recently discovered in Jefferson County (Jones et al. 2005).

The depletion of fat pocketbook mussel populations in many of the rivers once inhabited results largely from navigation and flood management activities. It is especially vulnerable to perturbations from channel maintenance because it is a fairly large mussel species and requires flowing water for survival. Its absence in the upper Mississippi River suggests that it may be particularly sensitive to dredging activities. Siltation and pollution are two other factors that probably have had an effect, although less than dredging, on the declining populations (USFWS 1989b).

G.2.4 Mammals

G.2.4.1 Gray Myotis (Gray Bat)

Literature gathered for this biological assessment indicates that the gray bat is unlikely to be present in Mississippi. For example, the range of the gray bat as characterized by USFWS (2005) and NatureServe (2005) either does not include Mississippi or includes only the northeast corner of the state. One source (USFWS 2000) indicated that, based on historical records, the gray bat potentially is present in Perry County where the proposed Richton site would be located.

Roost sites of this species are nearly exclusively restricted to caves year round (Barbour and Davis 1969). No caves within the known range of this species have been identified in areas where SPR activities are proposed.

G.2.4.2 Louisiana Black Bear

The endangered Louisiana black bear (*Ursus americanus luteolus*) is one of 16 recognized subspecies of the American black bear (Hall 1981). Like other black bears, the Louisiana black bear has long black hair, and it may weigh more than 600 pounds (272 kilograms) (USFWS 1992). It is distinguished from other black bears by its longer, narrower, and flatter skull, and by its proportionately large molar teeth (Nowak 1986).

The Louisiana black bear prefers bottomland hardwood forests. It is found primarily in the Tensas and Atchafalaya River basins in Louisiana, areas that have been proposed as designated critical habitat. In fact, these areas of Louisiana are the locations of the only known breeding populations of the Louisiana black bear (Bowker and Jacobson 1995). Other areas with suspected occurrences of Louisiana black

bears include the Loess Bluffs portion of the Mississippi River corridor in southwestern Mississippi and the adjacent Tunica Hills of Louisiana, as well as smaller areas in the lower East Pearl River and lower Pascagoula River basins of southern Mississippi (Wooding et al. 1993). According to the Sierra Club (Gillette 2005), the Louisiana black bear has been sighted several times recently in Vancleave, Jackson County, MS.

G.2.5 Marine Mammals

The onshore portion, including the directional drilling from onshore to open water in the Gulf of Mexico associated with the proposed SPR Richton site would not affect marine mammals. The construction and operation of the offshore brine disposal pipeline and operation of the brine diffusion system may affect marine mammal species. The location of the offshore pipeline and the diffuser system would not reach the depths of Gulf of Mexico where the majority of these species can be found because the diffuser systems are at an approximately 30-foot (9-meter) depth. Also, the dispersion of the brine discharge into the Gulf of Mexico would dissipate before reaching these depths.

G.2.5.1 Gervais Beaked Whale

The Gervais beaked whale (*Ziphius cavirostris*) is a pelagic species associated with the continental shelf and deep oceanic waters, but it is also closely associated with the Gulf Stream waters. Little is known about this species, but sexual maturity is believed to occur when the whale reaches 15 feet (4.5 meters) in length. The whale is believed to live about 27 years. Its diet consists mainly of squid and deepwater fishes (Wynne et al., 1999).

G.2.5.2 Goose-Beaked Whale

The goose-beaked whale (*Ziphius cavirostris*), also known as Cuvier's beaked whale, is typically found in waters that are greater than 1,000 meters (3,280 feet) in depth. The goose-beaked whale is a pelagic species that is associated with the continental shelf and deep oceanic waters, but it is also closely associated with the Gulf Stream waters. Little is known about the species, but it is believed to travel in pods of 2 to 25 animals, typically avoiding vessels. Sexual maturity is believed to occur at 7 to 11 years, with breeding in the spring and birth of a single calf occurring every 2 to 3 years after a 12-month gestation. The goose-beaked whale is believed to lactate for 12 months and live more than 35 years. Its diet consists mainly of deepwater fish and squid (Wynne et al., 1999).

G.2.5.3 Pygmy Sperm Whale

The pygmy sperm whale (*Kogia breviceps*) is a pelagic, deep-water species that inhabits the areas near the continental shelf edge, slope, and deep oceanic waters. It is found throughout the Gulf of Mexico in these waters. The pygmy sperm whale is not as social as other species, and it is typically found alone or in small groups. The male reaches sexual maturity at 2.7 to 3.0 meters (8.9 to 9.8 feet) in length; the female reaches sexual maturity at 2.6 to 2.8 meters (8.5 to 9.1 feet) in length. A single calf is born after an 11-month gestation period, and lactation lasts about 12 months. The pygmy sperm whale has a diet of mainly squid, fish, and crustaceans (Wynne et al., 1999).

G.2.5.4 Dwarf Sperm Whale

The dwarf sperm whale (*Kogia simus*) is a pelagic, deep-water species that inhabits areas near the continental shelf edge, slope, and deep oceanic waters. It is found throughout the Gulf of Mexico in these waters. The dwarf sperm whale is not as social as other species, and it is typically found alone or in small groups. It reaches sexual maturity at 2.1 to 2.2 meters (6.9 to 7.2 feet) in length. A single calf is born

after a 9.5 month gestation period, and lactation lasts about 12 months. The diet of the dwarf sperm whale consists mainly of squid, fish, and crustaceans (Wynne et al., 1999).

G.2.5.5 Sperm Whale

The sperm whale (*Physeter macrophalus*) is pelagic, deep-water species that inhabits the areas near the continental slope. It is found throughout the Gulf of Mexico along the continental slope, and along the Atlantic seaboard associated with Gulf Stream features. Female and young sperm whales form breeding schools of 10 to 80 animals, while sexually inactive males form bachelor schools; older males are typically solitary. The female reaches sexual maturity at 7 to 11 years; the male reaches maturity at 19 years. A single calf is born every 3 to 6 years after a 14-month gestation period, and lactation lasts between 12 to 24 months. The diet of the sperm whale consists mainly of squid, but it also eats fish (Wynne et al., 1999).

G.2.5.6 Atlantic Spotted Dolphin

The Atlantic spotted dolphin (*Stenella frontalis*) is a tropical species found in a variety of areas throughout the Gulf of Mexico. It ranges from coastal to pelagic environments, typically over the continental shelf and slope, and it is usually associated with the Gulf Stream. The Atlantic spotted dolphin reaches sexual maturity at 8 to 15 years, breeding in fall and spring. One calf is born to a female every 1 to 2 years after a 12-month gestation period; lactation typically lasts 3 to 5 years. The dolphin may live 25 to 30 years. The Atlantic spotted dolphin is a gregarious species, and it can be found in groups (fewer than 20) of other dolphins and small whales along the coast and in larger groups (fewer than 100) offshore. The diet of the Atlantic spotted dolphin consists of squid and a variety of fish (Wynne et al., 1999).

G.2.5.7 Rough-Toothed Dolphin

The rough-toothed dolphin (*Steno bredanensis*) is a tropical, pelagic species found seaward of the continental slope. Little is known about the species, but it is thought to be sexually mature at 10 to 14 years, and it may live as long as 32 years. The rough-toothed dolphin is believed to travel in pods of 10 to more than 100, and it associates with other species such as the spinner dolphin, bottlenose dolphin, and pilot whale. Sometimes the rough-toothed dolphin is associated with large mats of Sargassum. The diet of the rough-toothed dolphin diet consists of deepwater octopus, squid, and fish (Wynne et al., 1999).

G.2.5.8 Killer Whale

The killer whale (*Orcinus orca*) can be found in both coastal and ocean waters ranging from tropical to polar. The killer whale is a highly social animal that travels in pods of 3 to 55 animals, and it often cooperates in hunting and feeding efforts. The species is sexually mature at 10 to 15 years, mating year round. The female gives birth to a single calf every 3 to 8 years after a 17-month gestation period; lactation typically lasts about 12 months. Individuals may live more than 50 years. The killer whale has a diverse diet that includes fish, birds, squid, turtle, and other marine mammals (Wynne et al., 1999).

G.2.5.9 False Killer Whale

The false killer whale (*Pseudorca crassidens*) is pelagic species found in the deeper waters of the Gulf of Mexico, seaward of the continental shelf. The false killer whale is a social species that can be found in groups from 10 to more than 100 with the same species or with other dolphin species. It is sexually mature at 8 to 14 years, and the female has a single calf every 3 to 4 years after a 16-month gestation

period. This species has been known to be aggressive toward other smaller dolphins. The diet of the false killer whale consists mainly of squid and fish (Wynne et al., 1999).

G.2.5.10 Short-Finned Pilot Whale

The short-finned pilot whale (*Globicephala macrorhynchus*) can be found in a variety of water depths, and it is typically associated with squid, its main prey. The short-fin is a tropical species that is usually associated with the Gulf Stream, and it can be found in pelagic or coastal environments, possibly moving inshore during the summer months. The short-finned pilot whale is a social species that can be found in groups of 10 to more than 100, and it is often associated with the bottlenose dolphin. The species is believed to be sexually mature at 6 to 12 years, breeding every 3 years. The female gives birth to a single calf after a 15- to 16-month gestation period. Lactation lasts about 20 months, and an individual whale may live between 50 to 70 years. The diet of the short-finned pilot whale consists primarily of squid, but it also has been known to prey on fish (Wynne et al., 1999).

G.2.5.11 Pygmy Killer Whale

The pygmy killer whale (*Feresa attenuata*) is a pelagic species found in the deeper waters of the Gulf of Mexico seaward of the continental shelf. Little is known about the life of this whale, but its diet is believed to consist mostly of fish, and it has been observed preying on squid. The pygmy killer whale is a gregarious species that typically associates in groups of 10 to 50 individuals. The pygmy killer whale has shown aggressive tendencies, but typically it is wary of boats (Wynne et al., 1999).

G.2.5.12 West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is a slow-moving aquatic mammal with gray to brown skin, a small head, flexible flippers, and a large tail. Its large rounded body weighs on average 441 to 1,102 pounds (200 to 500 kilograms), and it is approximately 9.8 to 13.1 feet (3 to 4 meters) long (Nowak 1991). Its diet is primarily submergent, emergent, and floating vegetation, although it varies according to plant availability. The West Indian manatee may live several decades (O'Shea and Ludlow 1992).

The West Indian Manatee is present in the coastal areas from the southeastern United States to northeastern South America. In the southeastern United States, the manatee occurs primarily in Florida and southeastern Georgia; however, individual manatees may also range as far north as Rhode Island on the Atlantic coast (Reid 1996) and as far west as Texas on the Gulf Coast. Some believe the manatee in Texas may be a wanderer from the Mexican population. An individual manatee captured in Texas was linked to the Florida population through deoxyribonucleic acid (DNA) testing (Ettel undated). The West Indian manatee is federally listed as endangered in Florida, Georgia, Puerto Rico, and Texas.

The West Indian manatee's habitat comprises shallow coastal waters, estuaries, bays, rivers, and lakes, although it seems to prefer rivers and estuaries to marine habitats (Lefebvre et al. 1989). In addition, the West Indian manatee sometimes travels through dredged canals or quiet marinas. In the north during October to April, the manatee congregates in warmer waters because it cannot tolerate prolonged exposure to water colder than 68 degrees Fahrenheit (20 degrees Celsius). The West Indian manatee prefers water depths of at least 3.3 to 6.6 feet (1 to 2 meters); however, along the coast the manatee is often in water 9.8 to 16.4 feet (3 to 5 meters) deep. It also prefers not to be in water with strong currents, and it is consistently associated with freshwater (Lefebvre et al. 1989). Because the young are born in the water, sheltered bays, coves, and canals are important for the West Indian manatee's reproductive success (O'Shea and Ludlow 1992).

While the female manatee is sexually mature at a minimum age of 4 to 5 years, it does not breed successfully until the age of 7 to 9 years. The male manatee breeds at 9 to 10 years, although it may mature physically a few years earlier. The species mates promiscuously. A single calf is born in spring or early summer after a gestational period of approximately 12 to 14 months, and typically an interval of 3 to 5 years passes before a female gives birth to another calf (possibly 2 years if a calf is lost early). The calf is weaned by the age of 1 to 2 years (O'Shea and Ludlow 1992).

G.2.5.13 Bottlenose Dolphin

The bottlenose dolphin (*Tursiops truncatus*) typically is found in coastal or offshore waters. In the coastal environment, the bottlenose dolphin can be found in warm, shallow inshore waters of bays and rivers. When offshore, it usually is in deep waters over the continental shelf and slope. The female bottlenose dolphin reaches sexual maturity at 5 to 10 years; the male reaches maturity at 8 to 12 years. The species breeds during fall and spring, and produces one calf every 3 to 6 years after a 12-month gestation period. Lactation typically lasts 12 to 18 months, and the dolphin may live more than 50 years. The bottlenose dolphin is a social species, and along the coast it can be found in small groups (less than 10) and larger groups offshore (10 to more than 100). This species can usually be found in mixed groups with pilot whales and right whales. The bottlenose dolphin's diet consists of fish, invertebrates, and squid (Wynne et al., 1999).

G.2.6 Plants

Louisiana quillwort is an endangered, semi-aquatic, seedless plant related to ferns. It has a shallowly rooted, two-lobed stem and numerous grassy leaves of approximately 0.6 to 1.6 inches (1.5 to 4 centimeters) long. It produces reproductive spores in the spring and fall (NatureServe 2005).

This species is found in shallow blackwater streams in riparian woodland and headwater pine forest. The plants are found on stable sand and gravel bars, moist overflow channels with silty sand substrates, and low, sloping banks near and below water level (NatureServe 2005).

According to the USFWS recovery plan prepared in 1996, reproducing populations of Louisiana quillwort are known to exist only in Washington and St. Tammany Parishes in southeastern Louisiana and Perry and Jackson Counties in Mississippi (Larke 1996). The Mississippi population is found in the following locations:

- **Jackson County**—De Soto National Forest, Red Creek Wildlife Management Area; approximately 50 plants in overflow channels near the head of a branch of Bayou Billie.
- **Perry County**—De Soto National Forest, Camp Shelby National Guard Training Site, Pascagoula River watershed; approximately 2,500 plants in five colonies near the headwaters of Pearces Creek; 1,500 plants along a small tributary to Joes Creek; and 20 plants near an intermittent stream draining into Whiskey Creek (Larke 1996).

A more recent information source (NatureServe 2005) describes distribution of this species as consisting of 9 localized populations in St. Tammany and Washington Parishes in Louisiana and more than 50 populations in 10 counties in Mississippi. According to comments submitted by the USFWS (James 2005), this species is present in Forrest, George, and Greene Counties in Mississippi. Specific locations were not identified.

G.2.7 Reptiles

G.2.7.1 Alabama Red-Belly Turtle

The Alabama red-belly turtle (*Pseudemys alabamensis*) has an orange or reddish plastron and a brown to olive carapace with yellow, orange, or reddish streaks and mottling. The skin is olive to black with yellow or light orange stripes, and the adult is usually 8 to 12 inches (20 to 30.5 centimeters) long (NatureServe 2005; Dobie 1985). Aquatic plants are the primary food source of red-belly turtle (Mount 1975).

Although this species is primarily (though not historically) restricted to the northern Mobile Bay and associated tributary streams in Alabama, it was recently recorded in Mississippi as well (NatureServe 2005). James (2005) identified locations in Jackson County, MS, as the lower Pascagoula River and its tributaries, Bluff Creek, and the Escatawpa River. Currently, the red-belly turtle is most abundant in river channels and the quiet backwaters of the upper Mobile Bay, particularly in areas with dense submerged vegetation and water no more than 6.6 feet (2 meters) deep (McCoy and Vogt 1985). The female red-belly lays clutches of between three and nine eggs each from May to July (Behler and King 1979; Dobie and Bagley 1988). Preferred nesting sites include sand banks, natural levees, and along rivers (Dobie and Bagley 1988; Nelson 2003).

G.2.7.2 Black Pine Snake

The black pine snake (*Pituophis melanoleucus lodingi*) inhabits upland longleaf pine forests that once covered the southeastern United States. It prefers areas with sandy, well-drained soils with an overstory of longleaf pine, a fire-suppressed midstory, and a dense herbaceous ground cover (Duran 1998b). The snake is rarely found in riparian areas, hardwood forests, or closed canopy conditions (Duran 1998a). A petition to list the black pine snake was published on May 11, 2004.

The current population of the black pine snake occurs in fragmented areas in Mississippi and Alabama. The species is probably extinct in Louisiana (NatureServe 2005). The reason for its decline is the deforestation of many of the pine forests throughout the southeastern United States—the forests now cover only 5 percent of their original land area (Frost 1993), and they have been converted into urban developments, agriculture, and pine plantations. The largest populations of the black pine snake are now found on private land and in the De Soto National Forest in Mississippi (NatureServe 2005).

G.2.7.3 Eastern Indigo Snake

The eastern indigo snake is a threatened species currently known to occur throughout Florida and the coastal plain of Georgia (USFWS 1991). Although the USFWS Threatened and Endangered Species System (TESS) does not include Mississippi in this species' current range (USFWS 2005), other sources suggest that it may occur in six Mississippi counties where SPR activities are proposed. A list prepared by the U.S. Fish and Wildlife Service (2000) identifies the eastern indigo as present in Marion County and potentially present or historically recorded in Forrest, Greene, George, Jackson, and Perry Counties.

The eastern indigo snake is a large, shiny bluish-black snake with some red or cream coloring on the chin and sides of the head (USFWS 1991). With a maximum length of about 8 feet (2.4 meters), it is the longest North American snake (NatureServe 2005).

The principal habitat of the eastern indigo snake includes high, dry, well-drained sandy soils, closely paralleling the sandhill habitat preferred by the gopher tortoise. The eastern indigo snake uses gopher

tortoise burrows and other subterranean cavities as dens and for egg laying. In warmer months, these snakes may be found near streams and swamps (USFWS 1991).

G.2.7.4 Gopher Tortoise

The gopher tortoise (*Gopherus polyphemus*) is the only tortoise indigenous to the southeastern United States. It is relatively large. The carapace length is often 5.9 to 11 inches (15 to 28 centimeters), but it can measure up to 15 inches (38 centimeters). It has a smooth, dark-brown to grayish-black shell. The gopher tortoise is primarily an herbivore, but it sometimes eats insects, carrion, and fruit (NatureServe 2005).

The preferred habitat of the gopher tortoise is characterized by well-drained, sandy soils suitable for burrowing; abundant herbaceous ground cover; and generally open canopy and sparse shrub cover that allow sunlight to reach the forest floor (Landers 1980). The gopher tortoise digs burrows that average approximately 14.8 feet (4.5 meters) long and about 6.6 feet (2 meters) deep (Diemer 1989). Burrows, which are used for shelter and nesting, generally can be identified by a mound of excavated subsoil at the mouth of the burrow. Nesting occurs from late April to mid-July (mainly mid-May to mid-June) (Iverson 1980). The adult female lays only one clutch per year, but she does not necessarily nest every year. Hatching occurs in August and September, and the offspring demonstrate temperature-dependent sex determination (Burke et al. 1996).

The gopher tortoise is found only in the southeastern United States, and its population has declined rapidly over the past century. It is estimated that the population is now only 80 percent of what it was 100 years ago, and the species is listed as threatened west of the Mobile and Tombigbee Rivers in Alabama, Mississippi, and Louisiana (Auffenberg and Franz 1982; NatureServe 2005). The most important cause of the decline is habitat loss and degradation caused by urban development and agricultural conversion, although mining has also affected the gopher tortoise population in some areas (NatureServe 2005). Road kill, a byproduct of urban development, is also a minor problem.

G.2.7.5 Green Sea Turtle

The green sea turtle (*Chelonia mydas*) has a brown carapace covered in dark, wavy markings, radiating mottled markings, or large dark brown blotches. Young are black or dark brown with white undersides. Mature adults are usually 35 to 48 inches (90 to 122 centimeters) up to more than 60 inches (153 centimeters) in length. The length of the hatchling carapace is usually between 1.6 and 2.4 inches (4 and 6 centimeters) (Conant and Collins 1991). This turtle most commonly feeds in shallow, low-energy waters containing abundant submerged vegetation. Adults are primarily herbivores, while juveniles are more invertivorous. The green sea turtle is federally threatened.

The green sea turtle is a long distance migrant preferring tidal flats, pelagic zones, and isolated sand dunes. It prefers to nest on high-energy beaches with deep sand (NatureServe 2005). Every 2 to 4 years, the female lays between 1 and 8 clutches, each averaging 90 to 140 eggs, at approximately 2-week intervals. Nesting occurs between March and October in the Caribbean-Gulf of Mexico region, with a peak in May and June (Ehrhart and Witherington 1992). The green sea turtle is known to feed in the submerged vegetation near the Gulf Islands National Seashore in Mississippi (Spencer 2006).

G.2.7.6 Kemp's Ridley Sea Turtle

The Kemp's Ridley sea turtle (*Lepidochelys kempii*) is a small endangered sea turtle found in shallow coastal and estuarine waters, including those of the Gulf of Mexico. The adult is olive green above and yellow below, and the young are gray above and yellow below. The shell is nearly round and the limbs

are flattened flippers. The shell length is usually between 22.8 and 27.6 inches (58 and 70 centimeters) for adults and 1.5 and 1.7 inches (3.8 to 4.4 centimeters) for hatchlings (Conant and Collins 1991).

In coastal waters, the Kemp's Ridley sea turtle is usually found over sand or mud bottoms where it feeds on crabs. Nests are built on elevated dunes, especially on beaches backed up by large swamps or bodies of open water having seasonal, narrow ocean connections (NatureServe 2005).

During the nesting season from April to July, the female lays one to four clutches of about 100 eggs at intervals of 10 to 28 days. Eggs hatch in an average of 50 to 55 days (CSTC 1990).

G.2.7.7 Loggerhead Sea Turtle

The loggerhead sea turtle (*Caretta caretta*) is a reddish-brown sea turtle found in a variety of habitats including open seas to more than 500 miles (805 kilometers) from shore, bays, estuaries, lagoons, creeks, and mouths of rivers, mainly in warm temperate and subtropical regions (NatureServe 2005). The adult has a carapace length typically between 27.6 and 49.2 inches (70 and 125 centimeters), and hatchlings have a shell length of 1.6 to 2 inches (4 to 5 centimeters) (Dodd 1988, 1992; Conant and Collins 1991).

The female loggerhead sea turtle nests on open sandy beaches above the high-tide mark, seaward of well-developed dunes. High-energy and steeply sloped beaches with gradually sloped offshore approaches are favored (CSTC 1990). Between 50,000 to 70,000 clutches are deposited each year in southeastern states (Meylan et al. 1995). Despite some natural fluctuation in the size of the loggerhead population, numbers appear to be declining in some areas largely because of habitat destruction and incidental take by shrimp trawlers. The nesting population in the southeastern United States is believed to be declining (CSTC 1990, Taylor 1992).

Every 2 to 3 years, a mature female lays between 1 and 9 clutches of around 120 eggs at intervals of 2 weeks. Nesting occurs mainly at night, often at high tide, from April to early September. The eggs hatch in 8 to 9 weeks in the southeastern states, with the sex of the hatchlings is determined by incubation temperatures, with the ratio strongly biased toward females in Atlantic coastal waters. Hatchlings emerge from the nest a few days after hatching, typically during darkness (Wibbels et al. 1991, Mrosovsky and Provancha 1992).

G.2.7.8 Ringed Map Turtle

The ringed map turtle or ringed sawback turtle (*Graptemys oculifera*) is small. Typically, the male is 4 inches (10 centimeters) and the female is 7.1 inches (18 centimeters) in plastron length. It has a yellow ring bordered with dark olive-brown on its upper shell. Its undershell is yellow, and it has a yellow dot behind its eye, yellow stripes from its orbit backwards, and another yellow strip on its lower jaw (Cagle 1953). In 1986, this turtle was federally listed as threatened (USFWS 1992).

The preferred riverine habitat of the ringed map turtle includes many logs, a moderate current, and large, high riparian sand and gravel bars for laying eggs in nests (USFWS 1992). Because the ringed map turtle spends most of its day basking in the sun, it requires a channel wide enough for the sun to reach the logs from during the day (McCoy and Vogt 1980, Dickerson and Reine 1996). In addition, the ringed map turtle must have high water quality to support its main food sources, which include insects, mollusks, and crustaceans (NatureServe 2005). This species is not found in tributaries or tidal areas.

The ringed map turtle is present in the Pearl River system in Mississippi, specifically in the main streams of the Pearl River and the Bogue Chitto River. The turtle's range is from near the upstream mouth of the

Pearl River to Neshoba County, MS, and from the upstream confluence of the Bogue Chitto River and the Pearl River to near Franklinton, LA (Jones 1991).

In total, the population size of the ringed map turtle is likely greater than 10,000 (Dickerson and Reine 1996). In the Pearl River, a mark-and-recapture study estimated the population at 137 to 549 turtles per mile (85 to 341 per kilometer) (Jones and Hartfield 1995). Another study estimated (40 turtles per mile (25 turtles per kilometer) in the Pearl River (Lindeman 1999). Dickerson and Reine (1996) estimated the population in two upper Pearl River sections at greater than 119 basking turtles per mile (74 basking turtles per kilometer). In 1999, the population of ringed map turtles in the Bogue Chitto River was estimated at between 5,411 and 16,348 (NatureServe 2005). The population per distance in the Pearl River is highest above Ross Barnett Reservoir and below the confluence with the Strong River in Simpson County (Matthews and Moseley 1990). The highest population is in the Bogue Chitto River, downstream from Franklinton (NatureServe 2005).

The ringed map turtle lays a clutch in June and then most likely another clutch later. The clutch averages about 3 to 4 eggs (Kofron 1991) (4 to 8 eggs according to Matthews and Moseley (1990)). The male is typically mature at 3.5 years, while the female is mature at 10 to 16 years (Jones and Hartfield 1995).

G.2.7.9 Yellow-Blotched Map Turtle

The yellow-blotched map turtle (*Graptemys flavimaculata*) is named for yellow or orange blotches in the center of each olive to light greenish-brown shell plate. Some individuals have yellow bars, circles, or semicircles in place of blotches. Plates along the edge of the shell have orange bars or semicircles. The juvenile and adult male have prominent spine-like projections flanked by irregular orange blotches on the first four central shell plates. These spines are much smaller on the female. The sexes also differ significantly in size, with shells ranging from about 3.5 to 4.7 inches (9 to 12 centimeters) in the male and from about inches 3.9 to 8.3 inches (10 to 21 centimeters) for the female (Jones 1993).

The yellow-blotched map turtle inhabits rivers and large creeks with moderate currents, abundant basking sites, and sandbars. This species prefers habitats with sand, clay, or rocky bottoms with limestone ledges along banks (McCoy and Vogt 1987). It also uses oxbow lakes, semipermanent ponds, or temporary flood pools (Jones 1996). It is not usually found in smaller streams shaded by bank vegetation for much of the day. Nesting occurs on sandbars or in small clearings along the bank of a river such as on a clay bank with a steep slope (Horne et al. 2003). The nesting season is from mid to late May through early to mid August (NatureServe 2005).

The yellow-blotched map turtle is found only in rivers of southeastern Mississippi, including the following sites:

- Leaf River from the U.S. Highway 84 bridge in Covington County (Cliburn 1971) downstream to the confluence of the Leaf and the Chickasawhay Rivers;
- Chickasawhay River upstream to Enterprise in Clarke County (McCoy and Vogt 1987);
- Pascagoula River from its point of origin in George County, south to where the river forks into the East and West Pascagoula channels near Vancleave, Jackson County;
- West Pascagoula River to just south of the I-10 bridge (Dobie 1991); and
- East Pascagoula River from the downstream to approximately 1 mile (1.6 kilometers) north of the I-10 Bridge (Jones 1993).

Small populations also have been reported in the lower Escatawpa River in Jackson County (Jones 1993); Tallahala Creek in Perry County; and Red Creek in Jackson County (Cliburn 1971).

Habitat alteration resulting from channel modification and water quality degradation from siltation and pollution are the primary causes for the decline of this species. Channel modification removes materials used for basking and water quality degradation impairs feeding resources. This species is also threatened by commercial collection for retail sale (USFWS 1992).

G.3 FIELD OBSERVATIONS

| This section presents observations made by ICF International staff during field visits to the Bruinsburg and Richton sites.

G.3.1 Bruinsburg, MS

| Four biologists from ICF International conducted a pedestrian survey of the Bruinsburg candidate site on November 21, 2005. Proposed pipeline ROW surveys were continued on November 22, 2005. Surveys of the proposed ROWs were conducted by following the routes by car and making vegetative and land use observations along the route at predetermined way points.

G.3.1.1 Bruinsburg Candidate Site

The Bruinsburg site is 10 miles west of Port Gibson, MS, off of Rodney Road. The site is situated within the Northern Holocene Meander Belt and the Bluff Hills Ecoregions of Mississippi (Chapman et al. 2004). Approximately two-thirds of the proposed Bruinsburg site is located in a relatively flat landscape, which is currently occupied by cultivated cotton fields, cypress swamp, and deciduous forest. Two intermittent streams converge to form Mammy Judy Bayou, which is the only permanent stream within the proposed boundaries. Areas adjacent to the Bayou are permanently flooded, while the remaining areas show signs of intermittent or semipermanent flooding. The remaining third of the proposed site, where the administrative buildings, pumps, and brine pond would be located, is an upland forested area outside of the floodplain of the Mississippi River.

The study area has the following principal habitat types:

- Cypress swamp;
- Cultivated row-crop (cotton fields);
- Palustrine forested wetlands; and
- Mixed hardwood forest.

Each of the principal habitat types in the study area are described below, and table G.3.1.1-1 lists plant species observed on site.

Cypress Swamp: Inundated portions of the site are characterized by a cypress swamp ecosystem with duckweed floating in the 3 to 4 feet (0.9 and 1.2 meters) of standing water. Spanish moss was prevalent on the branches of the bald cypress trees. Drier areas surrounding the cypress swamps contained freshwater emergent wetland vegetation dominated by sedges and grasses. The natural hydrology of the site has been altered by a levee extending across the center of the site separating Mammy Judy Bayou from the cotton fields to the north. Beaver dams have further altered the hydrography by creating temporary ponds along the intermittent streams crossing the center portion of the site.

Cultivated Row-Crop: Large portions of the site were actively maintained as cultivated cotton fields. The center of the fields held a large shed surrounded by farm equipment. At the time of the site visit, cotton had already been harvested. Remnants of the harvested crop remained on the field to retain soil during the winter months.

Palustrine Forested Wetlands: Portions of the forest that were not inundated during the site visit displayed signs of periodic inundation through vegetative composition, water marks on trees, and tree buttressing. These forested wetland areas were characterized by white oak, box elder, and tupelo trees. The intermittent or semipermanent forested wetland areas on the site were dominated by a white oak and hickory canopy. Other trees common throughout the forest included sweet gum, basswood, water oak, tupelo, and box elder. The understory included holly, bamboo, and arrowwood, while groundcover consisted of various grasses and sedges, horsetail, clearweed, and smartweed.

Table G.3.1.1-1: Plant Species Observed at the Bruinsburg Storage Site

Common Name	Scientific Name	Vegetative Layer
Cypress Swamp		
Bald Cypress	<i>Taxodium distichum</i>	Canopy
Spanish Moss	<i>Tillandsia usneoides</i>	Epiphyte
Duckweed	<i>Lemna minor</i>	Floating aquatic plant
Palustrine Forested Wetland		
White Oak	<i>Quercus alba L.</i>	Canopy
Hickory	<i>Carya spp.</i>	Canopy
Post Oak	<i>Quercus stellata</i>	Canopy
Cherry	<i>Prunus sp.</i>	Canopy
Tupelo	<i>Nyssa aquatica</i>	Canopy
Honey Locust	<i>Gleditsia triacanthos</i>	Canopy
Sycamore	<i>Platanus occidentalis</i>	Canopy
Box Elder	<i>Acer negundo</i>	Canopy
Sweetgum	<i>Liquidambar styraciflua</i>	Canopy
Southern Arrowwood	<i>Viburnum dentatum</i>	Understory
Holly	<i>Ilex spp.</i>	Understory
Horsetail	<i>Equisetum arvense L.</i>	Groundcover
Smartweed	<i>Polygonum coccineum</i>	Groundcover
Clearweed	<i>Pilea pumila</i>	Groundcover
Lizard Tail	<i>Saururus cernuus</i>	Groundcover
Water Locust	<i>Gleditsia aquatica</i>	Canopy
Eastern Cottonwood	<i>Populus deltoides</i>	Canopy
Pecan	<i>Carya illinoensis</i>	Canopy
Black Willow	<i>Salix nigra</i>	Canopy

Mixed Hardwood Forest: The proposed administrative buildings would be located on the west side of the site. This area is characterized by steep rolling hills and ravines covered with mixed hardwood/pine forests. The area appeared previously disturbed due to the presence of bamboo mixed in the interior of the upland forest. The forest is dominated by oaks and hickories intermingled with pine. The understory is composed of herbaceous cover, shrubs, and seedlings.

G.3.1.2 Bruinsburg Raw Water Intake Structure

The area along the proposed raw water pipeline ROW was similar to that of the area surrounding the proposed site. The raw water intake (RWI) structure would be located on the Mississippi River to the south west of the candidate site. The RWI would be located on or adjacent to the protective levee system that runs along the Mississippi River. The area is mostly forested along the levee, with similar species composition to that of the storage facility. Nearby some forested areas have been cleared and planted with corn or soybean to attract deer during hunting season. The beachfront along the east side of the Mississippi River is approximately 20 feet (6.1 meters) below the top of the levee system. The beachfront is a narrow strip of sand extending approximately 20 feet (6.1 meters) from the bottom of the levee to the river.

G.3.2 Richton, MS

Four biologists from ICF International conducted a pedestrian survey of the project area on October 17 and 18, 2005. The biologists walked over the proposed site and RWI structure. The proposed pipeline ROWs were observed at road intersections at a distance from vehicles. Except for the proposed ROW to Pascagoula terminal, which would follow an existing pipeline ROW, the proposed routes of the ROWs had not been defined precisely.

None of the species addressed by the biological assessment (see section G.2) were observed directly during the mid-October site inspection.

G.3.2.1 Richton Candidate Site

The proposed Richton storage site would be about 350 acres (140 hectares), which includes a 300-foot (91-meter) buffer cleared for security purposes and an access road. The site is an actively managed pine plantation. The slash pine plantation, which is estimated to be between 10 to 20 years old, covers approximately 312.4 acres (133.2 hectares), or 88 percent, of the site. The overgrown fields, which include portions of former timber stands and cropland, occupy 22.6 acres (9.15 hectares), or 7 percent. Forested, open-water, and emergent wetlands flank a manmade pond located on the western site boundary. These wetlands are limited to the perimeter of the pond. Another forested and emergent wetland area is associated with a small depression and Pine Branch, which is an intermittent creek that originates in the center of the site and flows south to cross beneath Highway 42. The stream channel and the depression in the southwestern portion of the site are palustrine forested wetland areas, while the pond contains submergent and emergent wetlands, with a small area of forested wetlands.

The study area includes the following principal habitat types:

- Ponds (open water);
- Evergreen forest (slash-pine plantation);
- Palustrine emergent and forested wetlands; and
- Old fields (former pine plantation and row crops).

Each of the principal habitat types in the study area are described below, and table G.3.2.1-1 lists plant species observed on site.

Table G.3.2.1-1: Plant Species Observed at Richton Storage Site

Common name	Scientific Name	Vegetative Layer
Evergreen Forest - 176.5 acres (71.4 hectares) (72 percent of the site)		
Slash Pine	<i>Pinus elliottii</i>	Canopy
Blackberry	<i>Rubus argutus</i>	Understory/Ground cover
Poison Ivy	<i>Toxicodendron radicans</i>	Understory/Ground cover
Trumpet Creeper	<i>Campsis radicans</i>	Understory/Ground cover
Old Field - 47.5 acres (19.2 hectares) (19 percent of the site)		
Chinese Tallow Tree	<i>Triadica sebifera</i>	Understory/Ground cover
Horseweed	<i>Conyza canadensis</i>	Understory/Ground cover
Thistle	<i>Carduus</i>	Understory/Ground cover
Goldenrod	<i>Solidago spp.</i>	Understory/Ground cover
Deciduous Forest and Palustrine Wetlands - 21.8 acres (8.8 hectares) (9 percent of the site)		
Red Maple	<i>Acer rubrum</i>	Canopy
Chinese Tallow Tree	<i>Sapium sebiferum</i>	Understory/Ground cover
Sweet Gum	<i>Liquidambar styraciflua</i>	Canopy
Tupelo	<i>Nyssa aquatica</i>	Canopy
Smartweed	<i>Polygonum roccineum</i>	Understory/Ground cover
Greenbriar	<i>Smilax spp.</i>	Understory/Ground cover
Palustrine Wetlands		
Sedge	<i>Carex spp.</i>	Ground cover
Pitcher Plant	<i>Sarracenia spp.</i>	Ground cover
Soft Rush	<i>Juncus effuses</i>	Ground cover
Smartweed	<i>Polygonum coccineum</i>	Ground cover
Bulrush	<i>Scirpus spp.</i>	Ground cover
Spike Rush	<i>Eleocharis quadrangulata</i>	Ground cover

Ponds: The manmade pond, located on the western portion of the site, is fed by a stream that originates offsite. The pond appears to be large enough to support common aquatic species.

Evergreen Forest: The evergreen forest is an even-aged, managed timber stand canopy dominated almost entirely of slash pine. Limited understory is present in the slash pine plantation because of the dense mat of pine needles and timbering activities. At locations where the mobile timber-harvesting base was sent up, the debris (branches and wood chips) may cover up to an acre along the roadside within the slash pine plantation. Numerous timber access roads crisscross the site, and they are littered with branches, bark, and wood chips from the timber-harvesting activities.

Palustrine Emergent and Forested Wetlands: The wetlands on the site are associated with a manmade pond, an intermittent stream channel, and a topographical depression. The forested wetland community associated with Pine Branch is primarily made up with red maple in the canopy and a variety of sedge, rush, bulrush, and pitcher plants within and adjacent to the stream channel. At the time of the survey, the stream channel did not contain any standing water; however, standing water was present in Pine Branch on the south side of Highway 42.

Old Field: The old fields occupied the southeast portion of the site, and they included old timber stands and fallow fields. The old fields adjacent to the chicken farm appeared to be old croplands because no evidence of former timber stands was observed and historical information indicates that the area was

formerly cropland (DOE 1992). The old fields north of the chicken farm were old slash pine timber stands, deduced because of the evenly spaced stumps located throughout the area.

G.3.2.2 Raw Water Intake Structure

The Richton RWI structure is proposed on the Leaf River. The opposing bank had a large beach area void of vegetation, suggesting seasonal changes in depth and width. The bank of the proposed raw water intake structure location had a vertical drop of approximately 30 feet (9.1 meters) to the water surface. The site was a mature deciduous mixed hardwood and pine forest typical of the area. Effects of Hurricane Katrina were dramatic—the mature forest had only 20 percent of its canopy remaining intact. Many of the trees still standing are likely to die within a year or so because of canopy damage.

G.4 HABITAT ASSESSMENT AND POTENTIAL EFFECTS

This section evaluates whether the proposed SPR development activities would take place in areas where threatened, endangered, and candidate species are known to exist or where they may exist based on the natural history information presented in section G.2. For any element of the SPR proposal located in known or potential threatened, endangered, or candidate species habitat, the nature and potential for effects on the species are described. The assessment considers potential mitigation measures that DOE would implement for each element of the proposed action.

In sections G.4.1 and G.4.2, separate assessments are provided for the Bruinsburg and Richton sites, respectively. Section G.4.3 provides an overall summary of impacts for both sites.

G.4.1 Bruinsburg, MS

The assessment for the Bruinsburg site evaluates the potential effects on threatened, endangered, and candidate species by each element of the proposed action listed in table G.4.1-1.

Table G.4.1-1: Elements of the Proposed Action and Location of Bruinsburg Site

Element of Proposed Action	Location by County or Parish
Bruinsburg site	<i>Mississippi:</i> Claiborne
Pipeline and power line ROW from Bruinsburg to Peetsville	<i>Mississippi:</i> Claiborne, Copiah, Lincoln
Pipeline ROW from Bruinsburg to Anchorage	<i>Mississippi:</i> Adams, Claiborne, Jefferson, Wilkinson <i>Louisiana:</i> East Baton Rouge, East Feliciana, West Baton Rouge, West Feliciana
Power line ROW from Bruinsburg to Entergy's Grand Gulf substation	<i>Mississippi:</i> Claiborne
Raw water intake and associated pipeline and power line ROWs	<i>Mississippi:</i> Claiborne
Brine disposal pipeline ROW	<i>Mississippi:</i> Claiborne
Marine terminal in Anchorage	<i>Louisiana:</i> West Feliciana

Evaluation findings for these components of the Bruinsburg site are presented for each species below.

G.4.1.1 Birds

G.4.1.1.1 Bald Eagle

Of the locations listed in table G.4.1-1 USFWS (2000), and the Mississippi and Louisiana Natural Heritage programs report the bald eagle only in Jackson, Warren, and Wilkinson County in Mississippi (MMNS 2002) and East Baton Rouge and West Feliciana Parishes in Louisiana (LNHP 2004). This includes the proposed crude oil pipeline to Anchorage. Data provided by MNHP identify the closest recorded occurrence of the bald eagle to be 9 miles (14 kilometers) from the proposed crude oil pipeline to Anchorage. Information submitted by USFWS (James 2005) identifies the bald eagle as potentially present Statewide in Mississippi, and this species is conservatively assumed to be potentially present throughout Louisiana as well. Natural history data indicate that any bald eagle in the region likely is a nonbreeding seasonal migrant (NatureServe 2005). A non-nesting transitory bald eagle would be expected to avoid human activity and move to undisturbed areas. DOE would consult with USFWS and state wildlife agencies if bald eagle nests were identified during preconstruction surveys.

G.4.1.1.2 Interior Least Tern

Interior least terns breed locally throughout the Mississippi River system. Nesting occurs on and near the river with eggs often resting directly on sandbars (Aycock 2005). Of the elements of the proposed action listed in table G.4.1-1, only the RWI structure with connecting RWI pipeline and power line, and the crude oil pipeline tie-in to the Entergy facility in Vicksburg would be built near the Mississippi River.

Data provided by MNHP (2006) show no known nesting areas within 2 miles (3 kilometers) of the raw water intake structure. Because this area is potential suitable habitat, DOE would complete a preconstruction survey to verify there are no signs of active nesting. If nesting activity is verified, construction of the RWI structure would be timed to avoid the period when the terns would be nesting. Operation and maintenance of the raw water intake involve little human activity and would not affect interior least terns in the area.

MNHP identified one nesting area approximately 3 miles (5 kilometers) downstream from the Entergy facility at Vicksburg. The area immediately surrounding the Entergy facility is not suitable habitat for the interior least tern because it is an urbanized area with frequent human disturbance. The construction, operation, and maintenance of the proposed tie-in to the Entergy facility would not affect the least interior tern.

G.4.1.1.3 Red-Cockaded Woodpecker

According to the recovery plan for the red-cockaded woodpecker (USFWS 2003b), the Homochitto National Forest in southwestern Mississippi contains a secondary core population of this species. Two elements of the proposed activity would pass thorough or near the Homochitto National Forest. The pipeline ROW from Bruinsburg to the Peetsville station would pass through the National Forest in Copiah and Lincoln Counties parallel to existing ROWs, and the pipeline ROW from Bruinsburg to Anchorage would pass near the National Forest in Adams and Wilkinson Counties parallel to an existing ROW. In these four counties, the red-cockaded woodpecker has been reported only in Lincoln and Wilkinson (MMNS 2002). MNHP (2006) confirms two occurrences of the red-cockaded woodpecker within 2 miles (3 kilometers) of the crude oil pipeline to Peetsville, and one within 2 miles (3 kilometers) of the crude oil pipeline to Anchorage. All of these populations are located in Homochitto National Forest.

In consultations with USFWS, MNHP, and U.S. Forest Service (USFS), DOE reviewed proposed pipeline alignments to discuss potential impacts to the red-cockaded woodpecker population. These consultations

did not reveal specific concerns of impacts to known red-cockaded woodpecker population. The proposed pipelines follow existing ROWs, and they would affect disturbed habitat. The USFS (Howell 2006) confirmed that the proposed pipeline to Peetsville would not cross potential red-cockaded woodpecker habitat. The Red-cockaded woodpecker has specific habitat requirements of pine stands over 60 years of age for nesting and 30 years of age for foraging. If mature pine stands of 30 years or more are identified in preconstruction ROW alignment surveys, DOE would have a biologist survey the area for red-cockaded woodpecker nesting cavities and foraging activity. Nesting cavity trees would be marked and, if feasible, the ROW alignment adjusted to avoid impacts to stands more than 30 years old within 0.5 miles (0.8 kilometers) of the nesting cavity (Aycock 2005). DOE would engage in further consultation with USFWS and MNHP to avoid impacts to the red-cockaded woodpecker along the proposed ROW.

G.4.1.2 Fish

G.4.1.2.1 Bayou Darter

Of the counties listed in table G.4.1-1 where elements of the Bruinsburg site and its associated infrastructure would be located, the bayou darter is present only in Claiborne, Copiah, and Hinds Counties in Mississippi. Elements of the proposed action in these counties are the Bruinsburg site, the pipeline ROW from Bruinsburg to the Jackson terminal, the pipeline ROW from Bruinsburg to Peetsville, the pipeline ROW from Bruinsburg to Anchorage, the brine disposal system, and the raw water intake system.

The range of the bayou darter is limited to Bayou Pierre and three of its tributaries including White Oak Creek, Turkey Creek, and Foster Creek. The pipelines to the Jackson terminal and the Entergy docks would be directionally drilled under Bayou Pierre. None of these water bodies would be crossed through open water construction or otherwise affected by any element of the proposed action; therefore, the proposed action would not affect this species.

G.4.1.2.2 Gulf Sturgeon

Critical habitat for the Gulf sturgeon has been designated in two counties where infrastructure associated with the proposed Bruinsburg site would be located: Copiah and Hinds Counties. The pipeline ROW from Bruinsburg to Peetsville would pass through the southwest corner of Copiah County. Designated critical habitat for the Gulf sturgeon in Copiah County is located in the Pearl River, which forms the eastern boundary of Copiah County. Because the ROW from Bruinsburg to Peetsville would not cross the Pearl River, it would not affect the Gulf sturgeon or its designated critical habitat.

The endpoint of the pipeline ROW from Bruinsburg to the Jackson terminal would be a connection to the Capline pipeline in Hinds County. Hinds County, like Copiah County discussed above, is bordered to the east by the Pearl River. Because the ROW from Bruinsburg to the Jackson terminal would end in Hinds County and would not cross the Pearl River, this element of the proposed action would not affect the Gulf sturgeon or its designated critical habitat.

The Gulf sturgeon is found in coastal waters from Florida to Louisiana (USFWS 2003a), potentially including waters that have not been designated as critical habitat. Among all counties and parishes where infrastructure associated with the Bruinsburg site would be located (see table G.4.1-1), the Gulf sturgeon reportedly occurs in two Louisiana parishes, East Feliciana and East Baton Rouge, where no designated critical habitat exists (LNHP 2004). Available information sources do not identify specific Gulf sturgeon habitat areas in these parishes.

The pipeline ROW from Bruinsburg to Anchorage would cross two surface water bodies in Louisiana: Thompson Creek, which forms the border of East and West Feliciana Parishes; and the Mississippi River, which lies on the border of East and West Baton Rouge Parishes. Both of the surface water bodies are assumed to provide suitable habitat for the Gulf sturgeon. Impacts to the sturgeon and its habitat would be avoided by the use of directionally drilling.

G.4.1.2.3 Pallid Sturgeon

The pallid sturgeon inhabits larger channels of the Mississippi-Missouri River system. Five counties in Mississippi (Claiborne, Jefferson, Adams, Warren, and Wilkinson) and four parishes in Louisiana (East Baton Rouge, East Feliciana, West Baton Rouge, and West Feliciana) border the Mississippi River within the known range of the pallid sturgeon. Elements of the proposed action located on or adjacent to the Mississippi River in these counties and parishes include the Bruinsburg RWI, the pipeline ROW from Bruinsburg to the Entergy power plant, the pipeline ROW from Bruinsburg to Anchorage, and the Anchorage marine terminal.

Construction Impacts

Construction of the RWI on the Mississippi would have no effect on the pallid sturgeon. Construction activities would temporarily disturb a small area of the Mississippi River bottom and resuspend sediments; however, impacts on water quality would be negligible because of the large size and flow rate of the Mississippi in this area. Impacts on habitat characteristics would be inconsequential because of the small size of the area affected. Any potential construction impacts would be minimized with the use of onshore erosion barriers, instream silt curtains, postconstruction restoration, and other measures.

Portions of the pipeline and power line ROWs from Bruinsburg to Anchorage and to the Entergy power plant would pass near the Mississippi River. Construction of these two ROWs would not affect the pallid sturgeon. Construction-related soil runoff would not affect the Mississippi River habitat of the Gulf sturgeon because the pipeline ROWs would not pass sufficiently close to the river for construction activities to have an effect.

The pipeline crossing of the Mississippi River would be constructed using directional drilling. With this method, the pipeline would be placed beneath the river without excavation or any other instream activity; therefore, construction of the pipeline would not affect the pallid sturgeon.

Construction of the Anchorage terminal would have no effect on pallid sturgeon. Construction would be located more than 300 feet (100 meters) from the river and standard erosion and runoff control best management practices would be used during construction to mitigate these impacts. In addition, the Mississippi River at Baton Rouge is highly turbid and any increase in turbidity resulting from construction activities would not significantly affect water quality or the quality of the pallid sturgeon's habitat in the river.

Operation and Maintenance Impacts

Operation of the RWI would have the potential to entrain and impinge young sturgeon and their prey. If this alternative were selected, DOE would work with USFWS to design the raw water intake with appropriate mesh size, intake velocity, and other technologies to minimize or avoid adverse impacts. Because the planned 1.2 million barrels per day (MMBD) raw water withdrawal would be a small fraction of the total flow, there would be no significant changes in the sturgeon habitat due to operation of the RWI.

Operation and maintenance of the portion of the crude oil pipeline ROW beneath the Mississippi River would have no impact. Because directional drilling would be used to construct the pipeline below the riverbed, no instream maintenance activities would be required.

Operation and maintenance of the Anchorage terminal would cause potential instream noise and disturbance impacts (e.g., related to tanker loading and navigation) and present a risk of oil spills. The increase in tanker navigation to the existing docks at Anchorage resulting from SPR operations would be very small and infrequent; therefore, the operation and maintenance of the marine terminal would have no effect on the pallid sturgeon.

G.4.1.3 Invertebrates

G.4.1.3.1 Alabama Heelsplitter Mussel

The Alabama heelsplitter is found in the Amite River in Louisiana, including a portion of the river in East Baton Rouge Parish. Although the pipeline ROW from Bruinsburg to Anchorage would pass through East Baton Rouge Parish, it would not cross or pass near the Amite River; therefore, none of the proposed actions would affect the Alabama heelsplitter.

G.4.1.3.2 Fat Pocketbook Mussel

A population of the fat pocketbook mussel was recently discovered in the Mississippi River and associated tributaries in Jefferson County, MS (Aycocock 2005; NatureServe 2005). As shown in table G.4.1-1, the proposed activity in Jefferson County associated with development of the Bruinsburg site is construction of the pipeline ROW from Bruinsburg to Anchorage. The pipeline ROW would not intersect the Mississippi River in Jefferson County, but it would cross two small tributaries, Coles Creek and Fairchilds Creek. Based on the information provided by MNHP (2006), this species is not present in the Mississippi River at the RWI location in Copiah County, which is roughly 15 miles (24.1 kilometers) upstream from the mouth of Coles Creek.

Construction Impacts

Fat pocketbooks in the Mississippi River adjacent to Jefferson County would not be affected by construction of the pipeline ROW from Bruinsburg to Anchorage because the pipeline would not cross the river in this area. The species might be affected in Coles Creek or Fairchilds Creek at the pipeline crossings; MNHP (2006) identified these water bodies as an area of concern. Because these tributaries are small, conventional construction methods (e.g., open-ditch excavation) would be used to bury the pipeline below the streambeds. During construction of the stream crossings at Coles and Fairchilds Creeks, excavation might directly affect fat pocketbooks, if present. In addition, construction would temporarily disrupt sand, silt, or clay streambed habitat favored by the species. If construction were to occur during the reproductive stage (July to October) of the species, construction might drive away red drum or other fish hosts of its larval stage.

A small bridge would be built for the brine access road to Coles Creek. Construction of the bridge may have a temporary affect on the mussels because some instream disturbance would occur even with the best management practices to control siltation. The streambed would be restored after construction, and the bridge would be constructed of grates to allow sunlight to reach the stream surface. Operation and maintenance of the road would occur infrequently and would not affect the mussels.

DOE would have a qualified biologist survey the area of the two proposed crossings. If the mussels are identified in the area of the crossings, they would be relocated to suitable habitat upstream of the crossing

or construction would be avoided during the reproductive season, or both. Relocation of freshwater mussels has been documented as a successful strategy to avoid impacts during instream construction disturbances (Reutter et al. 2001). Erosion barriers, silt curtains, and other best management practices would be used to limit downstream siltation. After construction, the streambeds would be restored to their original condition.

Operation and Maintenance Impacts

Operation and maintenance of the pipeline ROW from Bruinsburg to Anchorage would have no effect on the fat pocketbook. These activities would include periodic inspection and debris removal. These activities would be infrequent and cause minimal disturbance to the mussel and its habitat.

G.4.1.4 Mammals

G.4.1.4.1 Louisiana Black Bear

The range of the Louisiana black bear once included all of Louisiana and lower Mississippi where the Bruinsburg site and its associated infrastructure would be located. Today, the only known breeding populations are in Louisiana in the Tensas and Atchafalaya River basins (Bowker and Jacobson 1995). These areas have been designated as critical habitat. Other areas with suspected occurrences of Louisiana black bears include the Loess Bluffs portion of the Mississippi River corridor in southwestern Mississippi and the adjacent Tunica Hills of Louisiana, as well as smaller areas in the lower East Pearl River and lower Pascagoula River basins of southern Mississippi (Wooding et al. 1993).

The Bruinsburg site and its associated infrastructure are not located in the designated critical habitat of the Louisiana black bear; however, the pipeline ROW from Bruinsburg to Anchorage passes through southwest Mississippi and adjacent areas of Louisiana where a population of the bears is suspected. In addition, suitable habitat for the Louisiana black bear is present in every county in Mississippi, as well as East and West Feliciana Parishes in Louisiana, where infrastructure for the proposed Bruinsburg site would be located. The Louisiana black bear is not likely to occur in the populated areas of East and West Baton Rouge Parishes in Louisiana.

Construction Impacts

Development, operation, and maintenance of the Bruinsburg site and its associated infrastructure would have no effect on the Louisiana black bear. If any Louisiana black bears are present in areas of suitable habitat in the planned pipeline ROWs (e.g., in southwest Mississippi and adjacent areas of Louisiana), they could be expected to avoid construction and other temporary human activities.

Construction of the pipeline ROWs would contribute to habitat fragmentation, which has been cited as a concern for this species (James 2005). Pipelines would be buried and the ROW would not impose a barrier to the movement of this species, so it is expected there would be no effect on the species.

Operation and Maintenance Impacts

Operation and maintenance of the ROWs would include periodic inspection and clearing of excessive vegetation. These activities would be minimal and would not affect the Louisiana black bear, if present. The Louisiana black bear would be expected to avoid the Bruinsburg site and RWI; thus, operation and maintenance activities at these locations would not affect this species.

G.4.1.4.2 West Indian Manatee

Although the West Indian manatee along the Gulf of Mexico coast in the United States occurs primarily in Florida, individuals range as far west as Texas. Of the locations listed in table G.4.1-1, the West Indian manatee has been reported only in East Baton Rouge Parish in Louisiana. The pipeline ROW from Bruinsburg to Anchorage is the only element of the proposed action in table G.4.1-1 that would be located in East Baton Rouge Parish. The Anchorage terminal would be located in West Baton Rouge Parish directly across the Mississippi River from East Baton Rouge Parish.

The pipeline ROW crossing of the Mississippi River from East Baton Rouge Parish to the Anchorage terminal is in a segment of the Mississippi River with significant navigational traffic and industrial activity. This segment of the river does not possess characteristics of the manatee’s preferred habitat, which consists of shallow sheltered bays and coves without strong currents and with abundant aquatic vegetation. Further, the proposed crude oil pipeline would be directionally drilled under the river and would have no affect on the species.

Construction, operation, and maintenance activities associated with the Anchorage terminal would take place more than 300 feet (100 meters) from the river, and standard erosion and runoff control best management practices would be used during construction to mitigate these impacts. In addition, the Mississippi River at Baton Rouge is highly turbid and any increase in turbidity resulting from construction activities would not significantly affect water quality. Operation and maintenance of the marine terminal would cause potential instream noise and disturbance impacts (e.g., related to tanker loading and navigation) and would present a risk of oil spills. The increase in tanker navigation to the existing docks at Anchorage resulting from SPR operations would be very small; therefore, the routine operation and maintenance at the docks would have no effect on the manatee.

G.4.1.5 Marine Mammals

No offshore elements are associated with the proposed Bruinsburg site; no marine mammals would be affected other than the West Indian manatee discussed above.

G.4.1.6 Reptiles

The ringed map turtle is present in the Pearl River in Mississippi, including the portion of the Pearl River that forms the eastern boundary of Copiah and Hinds Counties (Jones 1991). Two elements of the proposed action listed in table G.4.1-1 would be located in Copiah and Hinds Counties. The pipeline ROW from Bruinsburg to Peetsville would pass through the southwest corner of Copiah County, and the pipeline ROW from Bruinsburg to the Jackson terminal would end in central Hinds County. Neither of these elements of the proposed action would cross the Pearl River; therefore, the proposed action would not affect the ringed map turtle or its habitat in the Pearl River.

G.4.2 Richton, MS

The assessment for the proposed Richton candidate site evaluates the potential effects on threatened, endangered, and candidate species by each element of the proposed action listed in table G.4.2-1.

Table G.4.2-1: Elements of the Proposed Action and Location of Richton Site

Element of Proposed Action	Location by County or Offshore Area
Richton site and associated access road	Perry
Pipeline ROW from Richton to Pascagoula	Perry, Greene, George, Jackson

Table G.4.2-1: Elements of the Proposed Action and Location of Richton Site

Element of Proposed Action	Location by County or Offshore Area
Pipeline ROW from Richton to Liberty Station	Perry, Forrest, Lamar, Marion, Walthall, Pike, Amite
RWI structure and associated access road, pipeline, and power lines on the Leaf River	Perry
Power lines and associated ROW from utility lines south of Leaf River to RWI	Perry
Marine terminal in Pascagoula (docks and storage tanks)	Jackson
RWI structure in Pascagoula/Jackson	
Storage tanks at Liberty Station	Amite
Offshore brine pipeline and diffuser	Gulf of Mexico

Assessment findings for these components of the proposed Richton site are presented for each species below.

G.4.2.1 Birds

G.4.2.1.1 Bald Eagle

Information submitted by USFWS (James 2005) identifies the bald eagle as potentially present statewide in Mississippi. Based on the online database provided by Mississippi Natural Heritage Program (MNHP) (MMNS 2002), the bald eagle has been confirmed in two counties, George and Jackson, where development of the pipeline ROW from Richton to Pascagoula, the Pascagoula terminal and the RWI structure in Pascagoula are proposed. Further analysis conducted by MNHP reports no known bald eagles within 2 miles (3 kilometers) of the proposed pipeline, terminal or RWI (MNHP 2006). The closest documented bald eagle nests are 5 to 6 miles (8 to 10 kilometers) away. Approximately 20 percent of the proposed pipeline ROW is composed of palustrine forested wetlands which are suitable habitat for nesting and foraging bald eagles. The proposed Pascagoula terminal and RWI structure would be built on emergent wetlands, which are rarely used by the bald eagle for nesting. Because the bald eagle may be present Statewide, potential impacts on this species have been evaluated for all elements of the proposed action in table G.4.2-1. Natural history data indicate that bald eagles occurring in Mississippi are likely to be nonbreeding seasonal migrants (NatureServe 2005).

Construction Impacts

Construction activities would not affect bald eagles because none are known to nest within 2 miles (3 kilometers) of the site or any of proposed ROWs or other infrastructure, and range data indicate that most bald eagles in Mississippi are likely nonbreeding. Because no nesting activity is anticipated, it is assumed that the construction activities would have no effect on the species.

Operation and Maintenance Impacts

Operation and maintenance activities would have no effect on the species. The proposed elements located near documented bald eagles are the proposed pipeline to Pascagoula, the Pascagoula terminal, and RWI structure. The proposed pipeline to Pascagoula would be collocated along an existing ROW. Operation and maintenance activities would be the same as current activities along this ROW. The Pascagoula terminal and RWI structure would be located on disturbed land adjacent to a naval station. Operation and maintenance activities would be less than current human activity levels at the naval station. Bald eagles that would move to areas near these proposed elements would be tolerant of human activity and noise.

G.4.2.1.2 Brown Pelican

Of the locations listed in table G.4.2-1, the brown pelican has been recorded only in Jackson County, MS. (MMNS 2002). The proposed pipeline ROW from Richton to Pascagoula, the Pascagoula terminal, and the offshore brine pipeline in and adjacent to Jackson County includes habitat types potentially suitable for the brown pelican. The RWI structure in Pascagoula would be located on an existing pier that does not have suitable habitat for the brown pelican. The power line from a Pascagoula substation to the terminal on Singing River Island would cross estuarine waters, which are potential feeding habitat for the brown pelican. Records indicate one known occurrence of the brown pelican approximately 1,700 feet (500 meters) from the proposed pipeline to Pascagoula. The area of that section of the pipeline is in open water.

Construction Impacts

In Jackson County, MS, suitable habitat for brown pelicans is confined to the Gulf shore and associated barrier islands, sandbars, and wetlands. The terminus of the crude oil pipeline, along with the existing Plantation Pipeline, at Pascagoula, MS, is located in an industrially developed area of the Gulf Coast. Pipeline construction activities in this area would not affect undisturbed habitat and would have no effect on the brown pelican.

The proposed power line to the Pascagoula terminal crosses industrial and estuarine water. Construction of the power line would not affect the brown pelican. It would not disturb suitable nesting habitat areas and would only temporarily affect a small area of potential feeding habitat.

The offshore segments of the crude oil pipeline to Pascagoula and the brine disposal pipeline pass within 1,700 feet (500 meters) of one known brown pelican area and may pass through other areas inhabited by the brown pelican. No activity is permitted within 2,300 feet (700 meters) of nesting brown pelicans (USFWS 2005). If the Richton site is chosen for development, a biologist would accompany the alignment survey crew to identify brown pelican roosts along the proposed brine disposal pipeline ROW. If any brown pelican roosting sites are identified during the alignment survey, the construction would be scheduled to avoid roosting times (March through July). Assuming that construction activities can be avoided in or near rookeries, there would be no effect on brown pelicans.

Operation and Maintenance Impacts

Operation and maintenance of the crude oil distribution pipeline would be comparable to existing activities associated with the Plantation pipeline. The pipeline would be buried and human activity would be minimal; therefore, there would be no effect on the brown pelican.

Operation and maintenance of the power lines to the Pascagoula terminal would not affect the brown pelican. Brown pelicans fly along the shoreline and feed in estuarine waters. The power lines would be slight obstruction to flight, but would affect an area only 1.6 miles (2.6 kilometers) long.

The offshore segments of the crude oil pipeline to Pascagoula and the brine disposal pipeline would be buried, and minimal maintenance activity would be necessary; therefore, operation and maintenance of the pipeline would have no effect on the brown pelican.

G.4.2.1.3 Mississippi Sandhill Crane

The only wild population of the Mississippi sandhill crane is located at the Mississippi sandhill crane National Wildlife Refuge in western Jackson County, MS. The only elements of the proposed action in Jackson County are the pipeline ROW from the Richton to Pascagoula, the brine pipeline ROW to the Gulf of Mexico, and the Marine Terminal at Pascagoula. All of these elements would be located more than 5 miles to the east of the refuge. At this distance, no effect on the Mississippi sandhill crane or its habitat are expected to result from construction, operation, or maintenance of the crude oil distribution pipeline, brine disposal pipeline, or marine terminal.

G.4.2.1.4 Piping Plover

As shown in table G.4.2-1, the marine terminal and RWI structure at Pascagoula and the oil distribution and brine disposal pipeline ROWs would be the only elements of the proposed action in Jackson County, MS, where the piping plover is known to occur. Designated critical habitat is located on barrier islands and shores around the Gulf of Mexico. None of the proposed elements cross designated critical habitat of the piping plover. The brine disposal pipeline passes near designated critical habitat on Horn Island, part of Gulf Islands National Seashore (GUIS). The proposed pipelines in Jackson County, MS, cross beaches, mudflats, or sandflats that may also be potential feeding habitat for the piping plover.

Construction Impacts

Construction of the proposed brine disposal pipeline would be away from designated critical habitat on Horn Island. The construction of this section of the pipeline would not impact the designated critical habitat or the piping plover because it is located in open water away from the designation boundary. DOE would work with US FWS and GUIS to avoid impacts to the piping plover. In other potential piping plover habitat areas, construction impacts would be avoided by use of directional drilling under beaches, mudflats, or sandflats. Using this construction method, construction would not affect the piping plover and its habitat. Because the pipeline would be buried, there would be no long-term construction effects.

Operation and Maintenance Impacts

Operation of the pipeline would not affect the species, its behavior, or the quality of its habitat. The pipeline would be a static structure buried under ground, and it would not produce noise or other effects that would disturb the plover. Maintenance activities would be minor, and they would not affect this species.

G.4.2.1.5 Red-Cockaded Woodpecker

National Forest lands in Mississippi are home to four primary and secondary core populations of the red-cockaded woodpecker. These and other core populations throughout the southeastern United States are monitored to assess recovery of the species. None of the core populations in Mississippi is located in areas that would be affected by development of the Richton site and associated infrastructure. Table G.4.2.1.5-1 shows that in all counties where elements of the proposed action for the Richton site would be located, all activities would occur outside of designated core population areas.

Elements of the proposed action, including the pipeline ROWs from Richton to Pascagoula and Richton to Liberty Station, would pass through areas with potential suitable habitat of low- to medium-density pine forests. Analysis provided by MNHP found no occurrences of the red-cockaded woodpecker within 2 miles (3 kilometers) of any proposed element (MNHP 2006). The proposed ROW to Pascagoula

follows an existing pipeline ROW where mature stands suitable for the red-cockaded woodpecker are not likely to be found. The crude oil pipeline to Liberty largely does not follow an existing ROW. If mature pine stands of 60 years or more are identified in preconstruction ROW alignment surveys, DOE would use a biologist to survey the area for red-cockaded woodpecker nesting cavities and foraging activity. Nesting cavity trees would be marked and the ROW alignment would be adjusted to avoid impacts to stands more than 30 years old within 0.5 miles (0.8 kilometers) of the nesting cavity (Aycock 2005).

Table G.4.2.1.5-1: Proximity of Red-Cockaded Woodpecker Designated Core Populations to Elements of Proposed Action for the Richton Site

County	Elements of the Proposed Action for the Richton Site	Location of Designated Core Population	SPR Elements Located in Designated Core Population Areas
Amite	<ul style="list-style-type: none"> Pipeline ROW from Richton to Liberty Station Storage tanks at Liberty Station 	Homochitto National Forest	None
Forrest	<ul style="list-style-type: none"> Pipeline ROW from Richton to Liberty Station 	De Soto National Forest	None
George	<ul style="list-style-type: none"> Pipeline ROW from Richton to Pascagoula 	De Soto National Forest	None
Greene	<ul style="list-style-type: none"> Pipeline ROW from Richton to Pascagoula 	De Soto National Forest	None
Jackson	<ul style="list-style-type: none"> Pipeline ROW from Richton to Pascagoula Marine terminal in Pascagoula RWI structure in Pascagoula Brine disposal pipeline ROW to Gulf of Mexico 	De Soto National Forest	None
Perry	<ul style="list-style-type: none"> Richton candidate site Pipeline and power line ROWs and RWI structure on Leaf River Pipeline ROW from Richton to Pascagoula Pipeline ROW from Richton to Liberty Station 	De Soto National Forest	None

G.4.2.2 Fish

G.4.2.2.1 Gulf Sturgeon

Four proposed elements of the Richton site and its associated infrastructure may directly affect federally designated critical habitat of the Gulf sturgeon: (1) the raw water intake on the Leaf River in Perry County, (2) the raw water intake on the Gulf of Mexico in Pascagoula, (3) the pipeline ROW from Richton to Pascagoula in Greene County, and (4) the pipeline ROW from Richton to Liberty Station in Forrest and Marion Counties. The potentially impacted designated critical habitat areas are located in the Leaf, Chickasawhay, Pearl, Pascagoula, and Bogue Chitto Rivers, and in the Mississippi Sound of the Gulf of Mexico. Spawning generally occurs in the rivers where the streambed is hard clay, rubble, gravel, or shell (USFWS 2003a). After spawning, the adult Gulf sturgeon migrates downstream to specific areas of the lower Pascagoula River system and Mississippi Sound and remains until November (Heise et al 2004). This anadromous species may be found in the designated critical habitat year-round because the young spend their first 2 years in the river where they were spawned (USFWS 2003a).

Construction Impacts

A RWI structure would be located on the Leaf River in Perry County and the power lines for the RWI structure and site would cross the Leaf River. Construction of this RWI would affect the designated critical habitat at this location and the area immediately downstream. For example, excavation would disturb the Leaf River streambed, remove vegetation, and temporarily raise turbidity and reduce dissolved oxygen levels. These potential effects would be mitigated with the use of onshore erosion barriers, instream silt curtains, postconstruction restoration, and other measures. Construction would be scheduled to avoid spawning periods (mid February to April) and limited to high water periods. Construction of the power lines across the Leaf River is not expected to have any additional effect on the sturgeon.

Another RWI structure would be located on Singing River Island, Pascagoula, MS in the Mississippi Sound of the Gulf of Mexico. The RWI structure would be located in the area of an existing pier. The water surrounding the pier is designated critical habitat for the gulf sturgeon. The aquatic habitat in this area is low quality due to frequent disturbance by boat and dredging activity. Construction of the RWI structure would disturb and suspend sediments, temporarily raising turbidity and reducing dissolved oxygen levels. Construction would take place within a cofferdam to reduce these impacts. Additionally, construction would be timed to take place during the summer months when the Gulf sturgeons have migrated to inland rivers and estuaries. Construction impacts are not expected to adversely affect the Gulf sturgeon although it would temporarily affect designated critical habitat.

Construction activities in the pipeline ROW from Richton to Pascagoula would have no effect on designated critical habitat of the Gulf sturgeon. The ROW would cross designated critical habitat in one location, the Chickasawhay River in Greene County. This crossing would be constructed using directional drilling to avoid disturbing sensitive habitat. Because no direct impact on the river would take place, construction of the pipeline ROW from Richton to Pascagoula would have no effect on the Gulf sturgeon.

The pipeline ROW from Richton to Liberty Station would intersect designated critical habitat for the Gulf sturgeon in the Leaf River in Forrest County, the Pearl River in Marion County, and the Bogue Chitto River in Pike County. All of these crossings would be constructed with directional drilling, which would prevent any effect on designated critical habitat at these locations. Smaller upriver tributaries, such as Tallahala Creek, would be crossed using conventional methods. Sedimentation and turbidity would be minimized through best management practices, and they would be a temporary disturbance. DOE would avoid instream construction methods of pipeline ROWs near Gulf sturgeon designated critical habitat during spawning.

Operation and Maintenance Impacts

Operation and maintenance of the RWI may have a serious adverse affect on the Gulf sturgeon, especially during low-flow periods. DOE has conducted informal consultation with the USFWS and Mississippi Natural Heritage Program on the proposed withdrawal. Both agencies expressed serious concerns about water flow and the Gulf sturgeon. The Mississippi Natural Heritage Program stated that “because of the importance of the Leaf River near Hattiesburg to spawning and juvenile sturgeon, it is recommended that water withdrawals be discontinued if discharge from the Leaf River reaches 30 percent of the mean daily discharge.” DOE reviewed the daily average streamflow data for the Leaf River for a 21-year period from 1983 through 2004 and determined that the mean daily discharge was 3,770 cubic feet per second and that 30 percent of that flow was 1,131 cubic feet per second. During the same 21-year period, the daily discharge was less than the 30 percent minimum instream flow recommended by the Mississippi Natural Heritage about 27 percent of the time.

During times of low-flow in the Leaf River, the withdrawal would be supplemented with water from the Gulf of Mexico. Up to 50 percent (500 MMB) of the water required for cavern construction could come from the Mississippi Sound of the Gulf of Mexico. Withdrawal of water from the Leaf River would be reduced or terminated in order to maintain minimum instream flow requirements. If low-flow situations require Leaf River withdrawal to be terminated, cavern development would continue at a slower pace with the 500 MMB supplied by the Gulf of Mexico.

Although the level of water in the Leaf would be maintained at or above a minimum instream flow as determined by the Biological Opinion, the change in natural flow would alter the designated critical habitat by reducing water depth and width, increasing pollutant concentrations, and altering water temperatures and water quality. These changes may expose breeding areas, limit adult migration movements, and/or increase mortality of eggs, larval and juvenile sturgeon. Intake of water would affect water volumes downstream and lower water depth in pools at the confluence of the Leaf and Chickasawhay Rivers where adult sturgeon rest with nonspawning individuals until fall when they return to salt water (Heise et al 2004).

The raw water withdrawal may cause impingement of young Gulf sturgeon in the Leaf River. The intake of the RWI would be designed for a maximum intake velocity of 0.5 feet (0.15 meters) per second with 0.5 inch (1.3 centimeter) square mesh and equipped with a compressed air backwash system to remove impinged organisms and debris. Impingement of young Gulf sturgeon would cause bodily harm that may result in mortality.

The raw water intake in the Mississippi Sound may also affect the Gulf sturgeon and its designated critical habitat. The aquatic habitat around the proposed RWI structure is low quality and heavily impacted by the existing pier, dredging, and boat traffic. This would not be important habitat for the Gulf sturgeon. Only adult and sub-adult sturgeons are found in the Gulf of Mexico and Mississippi Sound. An adult or sub-adult Gulf sturgeon would be able to escape the intake velocity of 0.5 feet (0.15 meters) per second. If a sturgeon were to be impinged by the withdrawal of water, the intake structure is equipped with traveling screens that would return the fish back to the water. The impingement of a Gulf sturgeon may cause bodily harm that may result in mortality. The withdrawal of water from the Mississippi Sound would have no effect on the designated critical habitat of the Gulf sturgeon. The Mississippi Sound is tidally influenced so withdrawal of water would not lower water levels or change water quality.

Maintenance of the pipeline ROWs constructed with directional drilling would not affect the Gulf sturgeon or its designated critical habitat because no instream activities would take place. Maintenance of ROWs constructed in upstream tributaries by conventional methods also would not affect the Gulf sturgeon or its designated critical habitat because instream activities are minor and infrequent.

G.4.2.2.2 Pearl Darter

The pearl darter is believed to exist only in the Pascagoula River drainage system, which includes the Leaf River, Black Creek, and the Pascagoula River (NatureServe 2005). A 2005 study on the distribution of the pearl darter confirmed its presence throughout the Leaf River (Slack et al 2005). Elements of the proposed action in this drainage system include the raw water intake on the Leaf River, the pipeline ROW from Richton to Pascagoula, and the pipeline ROW from Richton to Liberty Station.

Construction Impacts

The pearl darter has been documented throughout the Leaf River to the lower Pascagoula drainage, but little is known about its specific habitat requirements or spawning behavior (Slack et al. 2005).

Construction of the RWI on the Leaf River may temporarily increase water turbidity and temperature downstream. Increased turbidity has the potential to adversely affect pearl darters and other fish species downstream by making the habitat less suitable for feeding and reproduction (USFWS 2001a). These temporary impacts would be mitigated with erosion and sedimentation best management practices, as well as habitat restoration, but the construction of the RWI may affect the pearl darter.

The pipeline ROW from Richton to Liberty Station would cross the Leaf River in Forrest County in the general area where pearl darters are known to spawn. No construction effects would occur at this location because directional drilling would be used to place the pipeline beneath the riverbed without instream activity. The pipeline ROW from Richton to Liberty station would also cross Black Creek in Lamar County and Tallahala Creek in Perry County. These crossings would be constructed with either directional drilling or the conventional open-ditch excavation method. If directional drilling is used, the pipeline ROW would not affect pearl darters, because no activity would be required in the creek. Conventional construction methods might affect the pearl darter in the short-term. Excavation would temporarily remove vegetation and other beneficial characteristics of the streambed and streambanks. Water quality also might be impacted locally during construction. These impacts would be mitigated with erosion barriers and silt curtains that reduce downstream sediment transport. The affected streambed and streambanks would be restored to the extent practicable following construction; therefore, in the long term, the construction would have no effect on pearl darter habitat in Black Creek or Tallahala.

Where the pipeline ROW from Richton to Pascagoula would cross surface waters of the Pascagoula River drainage system (i.e., at the Chickasawhay River), directional drilling would be used to avoid impacts in the river. Because no excavation would take place in the river, no effects are expected.

Operation and Maintenance Impacts

Operation of the RWI may affect the pearl darter. The water withdrawal would be expected to have negligible impacts on the river while it is flowing near or above its overall average flow rate of 4,100 cubic feet per second (116 cubic meters per second). During periods of low-flow, however, the withdrawal may constitute up to 11 percent of the river's flow. Changes in flow would alter water depth, channel width, water temperatures, and pollutant concentrations downstream. These types of alterations are identified as a major threat to pearl darter population (USFWS 2001a).

The water intake would also cause entrainment and impingement of pearl darters as well as their feeding resources. The RWI would have a maximum intake velocity 0.5 feet (0.15 meters) per second with 0.5 inch (40mm) mesh screen. Standard length of the adult pearl darter ranged from 1 inch (30 mm) to 2 inches (50 mm) in sampling of the Leaf River in 2004 (Slack et al. 2005). An adult darter would be able to swim through the mesh screens. Due to its small size, the pearl darter might suffer impingement on the screens, which would cause bodily harm likely to lead to death.

Maintenance of the pipeline crossings constructed with directional drilling would not involve instream activities and no effects would be expected. Where the crossings are constructed using conventional methods, the crossings would be periodically inspected and maintained. For example, it may be necessary to remove debris from the river channel in the ROW. These maintenance activities would be minimal and infrequent, and they would have no effect on the pearl darter.

G.4.2.3 Invertebrates

The only endangered, threatened, or candidate invertebrate species in counties where the proposed Richton site and its associated infrastructure would be located is the Camp Shelby burrowing crayfish. The only known population of this species is in Perry County, MS. As discussed in section G.2.3.2, no

SPR development is proposed in this area of Perry County. The proposed action would not affect this species.

G.4.2.4 Mammals

G.4.2.4.1 *Gray Myotis (Gray Bat)*

The literature review identified some evidence that the gray bat may occur in Perry County, MS. Elements of the Richton alternative in Perry County include the proposed Richton site, the raw water intake and pipeline, power lines and associated ROWs, and the pipeline ROWs from Richton to Pascagoula and Liberty Station. Most information sources indicate that all proposed SPR construction and operation would occur well outside the species' current range. In addition, the proposed development locations do not include caves, which are the year-round roosting sites for this species. Therefore, construction, operation, and maintenance of the Richton site and associated pipelines and other structures would have no effect on the gray bat.

G.4.2.4.2 *Louisiana Black Bear*

All elements of the proposed action listed in table G.4.2-1 are located within the historical range of the Louisiana black bear. The literature review identified one source (Wooding et al. 1993) that named the lower East Pearl River and lower Pascagoula River basins of southern Mississippi as possible current range for the Louisiana black bear. An additional source (Gillette 2005) referred to recent sightings in Jackson County, MS, within the lower Pascagoula River basin. The crude oil pipeline to Pascagoula is the only proposed action in the lower Pascagoula River basin. Analysis provided by the Mississippi Natural Heritage Program did not identify any known occurrences of Louisiana black bear within 2 miles (3 kilometers) of any proposed element associated with the Richton site. This species is a highly mobile, habitat generalist that avoids humans, and the proposed crude oil pipeline to Pascagoula is co-located on an existing pipeline ROW. Therefore, any Louisiana black bears remaining in southeast Mississippi near the proposed action would be expected to avoid the temporary activities of constructing and maintaining the pipeline ROW, and there would be no effect on this species.

G.4.2.5 Marine Mammals

The operation of the brine disposal system would have no effect on the Gervais beaked whale, goose-beak whale, pygmy sperm whale, dwarf sperm whale, sperm whale, rough-toothed dolphin, killer whale, false killer whale, short-finned pilot whale, and pygmy killer whale. These species are found in deeper waters than the brine diffuser contours (see Appendix B, Brine Discharge Modeling). The Atlantic spotted dolphin, bottlenose dolphin, and West Indian manatee may visit the project area. These species are highly mobile species that can be found in a variety of areas throughout the Gulf. These species would avoid or leave areas disturbed by pipeline construction, pipeline maintenance or brine diffusion if they found the area intolerable.

G.4.2.6 Plants

As discussed in section G.2.6.1, the Louisiana quillwort recovery plan report stated that the only known reproducing populations of Louisiana quillwort in Mississippi are in the De Soto National Forest in Jackson and Perry Counties (Larke 1996). No elements of the proposed action are located in the specific areas of Jackson and Perry Counties identified in the recovery plan; therefore, construction, operation, and maintenance of the Richton site and associated infrastructure would not affect this species. However, results of an uncited species distribution summary presented by NatureServe (2005) indicated that Louisiana quillwort may be more widely distributed in Mississippi than reported by the recovery plan. If

populations of Louisiana quillwort are identified (e.g., from interagency consultations or public participation) and verified in the areas affected by proposed activities, appropriate mitigation measures would be identified and implemented to ensure that there are no effects.

G.4.2.7 Reptiles

G.4.2.7.1 Alabama Red-Belly Turtle

Although the Alabama red-belly turtle is found primarily in Alabama, in 2005 it was identified in the lower Pascagoula River and two of its tributaries in Mississippi (James 2005). One of these tributaries, the Escatawpa River, would be crossed by the pipeline ROW from Richton to Pascagoula if the Richton candidate site is chosen for development. MNHP identified two known occurrences of Alabama red-belly turtle populations located within 1 mile (2 kilometers) from the proposed crude oil pipeline to Pascagoula crossing of the Escatawpa River.

Construction Impacts

Directional drilling would be used to construct the crossing of the Escatawpa River. Directional drilling would be set up away from the river and habitat of the Alabama red-belly turtle and, therefore, nearby populations of the Alabama red-belly turtle would not be affected.

Operation and Maintenance Impacts

Because the Escatawpa River crossing would be constructed with directional drilling, maintenance would not involve instream activities, and no effects on the turtles would be expected.

G.4.2.7.2 Black Pine Snake

Of the counties listed in table G.4.2-1, the black pine snake reportedly occurs in Forrest, George, Marion, and Perry Counties in Mississippi. If the Richton candidate site is chosen for development, elements of the proposed action in these counties include the Richton candidate site, the RWI intake and pipeline ROW, power line ROWs, a portion of the pipeline ROW from Richton to Liberty Station, and a portion of the pipeline ROW from Richton to Pascagoula. The black pine snake has been documented within 2 miles (3 kilometers) of the proposed Richton site in Perry County (Clark 2005; MNHP 2006).

Construction Impacts

Each of these elements of the proposed action identified above would affect forest lands that would be suitable for the species. If the black pine snake is present in these locations, it generally would be expected to avoid human activity during construction; however, disturbance and direct mortality are possible consequences of excavation, earth moving, and other construction activities. Because this species has been confirmed within 2 miles (3 kilometers) of the site, DOE would survey the site for evidence of black pine snakes. Individuals would be relocated to nearby suitable habitat areas under supervision of USFWS. DOE would conduct habitat assessments of the proposed RWI and ROWs to determine if surveys for black pine snakes are necessary. Individuals would be relocated under supervision of USFWS.

Operation and Maintenance Impacts

Following construction, the black pine snake would be expected to favor adjacent habitat areas unaffected by SPR infrastructure and operations. The Richton site and ROWs would not be a barrier to the black

piners snake or its prey; the snake could still use these areas for hunting, and it might continue to inhabit pipeline ROWs. Therefore, operation and maintenance of the Richton site and associated infrastructure would have no effect on the species.

G.4.2.7.3 Eastern Indigo Snake

As discussed in G.2.7.3, the eastern indigo snake is unlikely to be found in the proposed project area because records indicate the range in Mississippi is historical. Comments received from USFWS (2005) and MNHP (2006) do not mention the species as being potentially impacted by the proposed Richton project. Further analysis conducted by MNHP (2006) did not find any populations within 2 miles (3 kilometers) of the proposed project elements. It is unlikely that the eastern indigo snake would be found in the areas affected by the proposed Richton site, and so there would be no effect on this species.

G.4.2.7.4 Gopher Tortoise

Of the locations listed in table G.4.2-1, the gopher tortoise has been recorded in eight counties: Forrest, George, Greene, Jackson, Lamar, Marion, Perry, and Walthall. Elements of the proposed action in these counties include the proposed Richton site, the raw water intake and pipeline, power line ROWs, all of the pipeline ROW from Richton to Pascagoula, and a portion of the pipeline ROW from Richton to Liberty Station. Analysis provided by Mississippi Natural Heritage Program confirms 26 recorded occurrences of gopher tortoises within or with ranges intersecting a 2 mile (3 kilometer) buffer of the proposed elements in gopher tortoise range. Half of these records are associated with the ROW to Pascagoula. Habitat suitable for the gopher tortoise may be found at all elements within gopher tortoise range. As discussed in section G. 2.7.4, the gopher tortoise prefers locations with dry sandy soils, abundant ground cover, and a sparse canopy. Although seldom seen above ground, the presence of gopher tortoises is indicated by large conspicuous burrows.

Construction Impacts

Construction activities such as excavation and the operation of large earthmoving equipment have the potential to unearth, smother, or compact gopher tortoise burrows, and therefore, construction would affect this species.

All proposed elements within gopher tortoise range and on moderately well-drained to excessively well-drained sandy soils would be surveyed by a biologist for tortoise burrows. If the tortoise or its burrows are found, DOE would contact the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) and the USFWS to avoid harm to this federally threatened species. All burrows identified during preconstruction field assessments would be marked and cogon grass, an invasive species that destroys tortoise habitat (Van Loan et al. 2002), would be mapped and treated with chemicals approved for use around tortoises. Where possible, clearing and construction activities would be precluded within a 25-foot (8-meter) radius around each burrow. The crude oil pipeline to Liberty, RWI pipeline and power lines largely do not follow an existing ROW. Alignments may be adjusted to avoid relatively large clusters of burrows. When burrows cannot be avoided, tortoises would be relocated only with concurrence of the USFWS and MDWFP, and according to strict protocols and within seasonal windows specified by these agencies. During construction, special care should be taken to avoid cogon promulgation (MNHP 2006).

Operation and Maintenance Impacts

After development, the Richton site would be poor habitat for the gopher tortoise, and this species generally would not be expected onsite. The moderately to excessively well-drained sandy soils of the

maintained pipeline and power line ROWs and cleared security area around the Richton site would provide preferred habitat for the gopher tortoise. These areas may attract more tortoise than its preconstruction condition. DOE would monitor these areas for the presence of gopher tortoise mounds and control the invasion and spread of cogon grass. Only herbicides approved for use around tortoises would be used in gopher tortoise habitat areas to avoid poisoning food resources (MNHP 2006). With proper monitoring and procedures, operation and maintenance activities may improve habitat quality for gopher tortoises.

G.4.2.7.5 Green Sea Turtle

The green sea turtle has been reported feeding on the seagrass beds located off the northern shore of the Gulf Islands National Seashore (GUIS). The brine disposal pipeline ROW and brine diffusion have the potential to affect the green sea turtle.

The RWI structure in Pascagoula would be located on the existing pier on Singing River Island where green sea turtles are known to inhabit. The area has been previously disturbed by surface hardening, and the aquatic environment is frequently disturbed by dredging and boat activities. There are no known seagrass beds or other submerged aquatic vegetation in the area. Therefore, the green sea turtle would not be affected by the RWI at Pascagoula.

Construction Impacts

Construction of the pipeline would suspend sediments that could affect seagrass beds and feeding areas for the green turtle on the north shores of GUIS. DOE would consult with NOAA Fisheries to minimize impacts to nearby seagrass beds and compensate/mitigate for permanent impacts. The green sea turtle is a highly mobile species that would be able to avoid and seek out additional food resources during construction of the pipeline. Seagrass beds are located off the shore of the other barrier islands in the Gulf of Mexico and in near shore estuarine areas.

Operation and Maintenance Impacts

Operation and maintenance of the offshore portion of the brine disposal pipeline would have no effect on the green sea turtle because the pipeline would be a buried static structure. Operation of the offshore the brine disposal system would have no effect on the feeding habitat of the green sea turtle. The brine diffuser is located 5 miles (8 km) south of GUIS and the area of influence of the brine plume (defined as the isoconcentration of +1 ppt salinity increase) is about 2 miles (3 kilometers) south of the Mississippi Sound. The seagrass beds are located on the wave protected, north side of the barrier islands. The area of influence of the brine disposal plume does not reach the GUIS shore and would not affect the sea grass beds on the north side of the islands.

G.4.2.7.6 Kemp's Ridley Sea Turtle

The Kemp's Ridley sea turtle inhabits estuarine waters of the Gulf coast, potentially including areas of Jackson County, MS. Nesting occurs on coastal beaches and dunes. The components of the proposed Richton site development with a potential to affect these habitats is the brine disposal pipeline and RWI structure at Pascagoula. Based on data provided by MNHP, the closest recorded nesting area is 7 miles (11 kilometers) from the Pascagoula RWI structure and brine disposal pipeline in the Grand Bay National Estuarine Research Reserve. The RWI structure would be built on an existing pier that has hardened surfaces and is frequently disturbed by dredging and boat activities. Construction and operation of the RWI structure would not affect the Kemp's Ridley Sea Turtle because the area is not suitable feeding or nesting habitat. Construction and operation of the brine disposal pipeline would not affect undocumented

nesting areas because the pipeline would be directionally drilled from an inland area to open water to avoid excavations along the shoreline.

Offshore pipeline construction would temporarily disturb potential feeding habitat for the Kemp's Ridley sea turtle; however, the turtle could feed at the nearby Grand Bay National Estuarine Research Reserve during the temporarily disturbance.

G.4.2.7.7 Loggerhead Sea Turtle

The loggerhead sea turtle nests on Gulf Coast beaches, including those of Jackson County, MS and GUIs, where the proposed Richton brine disposal pipeline would pass. The RWI structure in Pascagoula would be built on an existing pier that does not have suitable nesting or feeding habitat for the loggerhead sea turtle. Construction and operation of the brine disposal pipeline would not affect nesting because the pipeline would be directionally drilled from an inland area to open water to avoid excavations along the shoreline, and would not cross GUIs.

The loggerhead sea turtle has been reported feeding in the seagrass beds located off the northern shore of GUIs. The brine disposal pipeline ROW and brine diffusion have the potential to affect the loggerhead turtle.

Construction Impacts

Construction of the pipeline would suspend sediments that could affect seagrass beds and feeding areas for the loggerhead sea turtle, on the north shores of GUIs. DOE would consult with NOAA Fisheries to minimize impacts to nearby seagrass beds and compensate/mitigate for permanent impacts. The loggerhead sea turtle is a highly mobile species that would be able to avoid and seek out additional food resources during construction of the pipeline. Seagrass beds are located on the north shore of barrier islands located to the west of the ROW area, and in near-shore estuarine areas.

Operation and Maintenance Impacts

Operation and maintenance of the offshore portion of the brine disposal pipeline would have no effect on the loggerhead sea turtle because the pipeline would be a buried static structure. Operation of the offshore the brine disposal system would have no effect on the feeding habitat of the loggerhead sea turtle. The brine diffuser is located 5 miles (8 km) south of GUIs and the area of influence of the brine plume (defined as the isoconcentration of +1 ppt salinity increase) is about 2 miles (3 kilometers) south of the Mississippi Sound. The seagrass beds are located on the wave protected, north side of the barrier islands. The area of influence of the brine disposal plume does not reach the GUIs shore and would not affect the sea grass beds on the north side of the islands.

G.4.2.7.8 Ringed Map Turtle

The ringed map turtle is found in the Pearl River system of Mississippi and Louisiana. Of the elements of the proposed action listed in table G.4.2-1, only the pipeline ROW from Richton to Liberty station crosses the Pearl River system. Analysis by MNHP did not find any records of the turtle within 2 miles (3 kilometers) of the proposed crossing. Because directional drilling would be used to construct the Pearl River crossings, construction, operation, and maintenance of the pipeline ROW from Richton to Liberty Station would not affect the ringed map turtle.

G.4.2.7.9 Yellow-blotched Map Turtle

The range of the yellow-blotched map turtle includes river segments in five counties listed in table G.4.2-1: Forrest, George, Greene, Jackson, and, Perry Counties. Water bodies potentially affected by SPR activities within these counties include the Leaf, Chickasawhay, and Escatawpa Rivers and Tallahala Creek (see section G.2.7.8). Data provided by MNHP confirmed recent records of populations at all of these water bodies. Elements of the Richton site development in this species' range include the Richton site, the raw water intake on the Leaf River, power line ROW, all of the pipeline ROW from Richton to Pascagoula, and a portion of the pipeline ROW from Richton to Liberty Station. No yellow-blotched map turtle habitat occurs at the Richton site or in the raw water pipeline ROW.

Construction Impacts

Potential construction impacts on the yellow-blotched map turtle may occur during construction of pipeline crossings across rivers in the species' range and during construction of the raw water intake on the Leaf River. The pipeline ROW from Richton to Pascagoula would cross the Chickasawhay and Lower Escatawpa Rivers in areas known to be inhabited by the yellow-blotched map turtle. In addition, the pipeline ROW from Richton to Liberty Station would cross yellow-blotched map turtle habitat in Tallahala Creek in Perry County and in the Leaf River in Forrest County.

The Richton to Pascagoula pipeline crossings at the Chickasawhay River and the Escatawpa River would be constructed using directional drilling. This method would prevent construction from affecting the yellow-blotched map turtle in these locations because no activity would occur within the rivers.

Where the pipeline ROW from Richton to Liberty Station would cross Tallahala Creek in Perry County, conventional construction methods would be used, which may affect the turtle. Temporary habitat disturbance in the immediate work zone would be unavoidable. Instream excavation would resuspend sediment and temporarily degrade water quality and increase downstream sedimentation. These moderate short-term impacts would be minimized by the use of best management practices. For example, silt curtains would be placed immediately downstream from the construction site. After construction, instream habitat would be restored, and there would be no long-term effect on the turtle.

Directional drilling would be used where the pipeline ROW from Richton to Liberty Station would cross the Leaf River in Forrest County. Because this construction method does not involve instream activity, no effect on the yellow-blotched map turtle would occur in this location.

Construction of the RWI on the Leaf River may affect the yellow-blotched map turtle. Any turtles in the work zone would be moved to an adjacent undisturbed area upstream each day prior to the start of work. Best management practices, such as the use of a cofferdam, would be used instream and stream side to minimize water quality and sedimentation impacts. After completion of the raw water intake structure, the streambed would be restored to the extent possible to minimize long-term impacts of construction. Although there may be short-term effects, in the long-term construction would not affect the turtle.

Operation and Maintenance Impacts

Where pipelines are constructed using conventional methods, maintenance activities would include periodic inspection and potential clearing of obstacles. These infrequent and minor activities would have no effect on the yellow-blotched map turtle.

Operation of the raw water intake during cavern development would withdraw up to 1.2 MMBD (50.4 million gallons per day). DOE would supplement withdrawal from the Leaf River with water from the Gulf of Mexico when flows decline to the minimum instream flow as determined by the USFWS. Withdrawal of water from the Leaf River would degrade water quality by reducing the capacity of the

river to assimilate wastes from nonpoint pollution sources and permitted discharges. Impaired water quality is implicated in the decline of the yellow-blotched map turtle through adverse effects to its food resources. In addition, withdrawal of water may affect the species by entraining or impinging small turtles or their invertebrate prey. Impinged turtles would be removed by periodic expulsion of compressed air. Impingement may cause bodily harm which could lead to death of some individuals. During normal to above average flows, the entrainment or impingement of yellow-blotched map turtle's prey food resources would be a small portion of the available resources. During extreme low flow periods, entrainment or impingement of prey may stress the species, but such periods are expected to be temporary.

G.4.3 Assessment Summary

Tables G.4.3-1 and G.4.3-2 identify the threatened, endangered, and candidate species that may be affected by each element of the proposal to develop the Bruinsburg site. The potential for effects for each element was estimated based on information about the presence or absence of the species or suitable habitat in areas that would be affected. The evaluation also considered the potential mitigation factors. Table G.4.3-1 identifies whether construction activities may affect species. Table G.4.3-2 summarizes whether operation and maintenance activities may affect species. Similar potential effect summaries for the Richton site are presented in tables G.4.3-3 and G.4.3-4.

Table G.4.3-5 summarizes the number of species that may be affected by construction and operations and maintenance for both of the proposed sites in Mississippi. This summary shows that the fat pocketbook mussel may be affected by construction activities for the Bruinsburg site and associated infrastructure. This assessment is uncertain because the presence of the fat pocketbook at the potentially affected location has not been confirmed, and it is uncertain whether directional drilling would be used to completely avoid the potential impacts. The summary shows no effects are expected to the least interior tern and red-cockaded woodpecker based on current available data on population locations. DOE would survey for these species if potential habitat areas are identified during preconstruction alignment surveys. Operation and maintenance of the Bruinsburg site may affect the pallid sturgeon during raw water withdrawals, which could entrain or impinge larval or juvenile sturgeon.

The development of the Richton site may affect five species during construction and three species during operation and maintenance. The gopher tortoise and black pine snake may be affected during construction of the site and certain pipeline ROWs. These impacts would be short term and operation and maintenance of the site or ROWs are not expected to affect these species. Maintained pipeline ROWs may improve and expand preferred habitat for the gopher tortoise. The Gulf sturgeon, pearl darter, and yellow-blotched map turtle may be affected by the construction of the RWI structure and certain pipeline water body crossings. The operation of the RWI structure would cause alterations to the Leaf River flow, which may seriously affect these species dependent on the Leaf River.

Overall, selection of the Richton site may affect a greater number of federally listed threatened, endangered, and candidate species than selection of the Bruinsburg site. Consideration of potential threatened and endangered species effects during selection of SPR development alternatives would not be based only on the number of species affected. Additional factors considered would include the likelihood of affecting the species, the availability and feasibility of mitigation measures, the duration of effects, the likelihood of recovery, and other considerations.

Table G.4.3-1: Summary of Potential Construction-Related Impacts to Threatened, Endangered, and Candidate Species from Development of the Bruinsburg Candidate Site

Species	Site	Bruinsburg to Peetsville ROW	Bruinsburg to Anchorage ROW	Bruinsburg to Jackson Terminal ROW	Bruinsburg to Entergy Power Plant ROW	RWI and ROW	Brine Disposal ROW	Anchorage Marine Terminal
Birds								
Bald Eagle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Interior Least Tern	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Red-Cockaded Woodpecker	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Fish								
Bayou Darter	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Gulf Sturgeon	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Pallid Sturgeon	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Invertebrates								
Alabama Heelsplitter	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Fat Pocketbook	No effect	No effect	May affect	No effect	No effect	No effect	No effect	No effect
Mammals								
Louisiana Black Bear	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
West Indian Manatee	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Reptiles								
Ringed Map Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect

Table G.4.3-2: Summary of Potential Operation and Maintenance Impacts to Threatened, Endangered, and Candidate Species from Development of the Bruinsburg Candidate Site

Species	Site	Bruinsburg to Peetsville ROW	Bruinsburg to Anchorage ROW	Bruinsburg to Jackson Terminal ROW	Bruinsburg to Entergy Power Plant ROW	RWI and ROW	Brine Disposal ROW	Anchorage Terminal
Birds								
Bald Eagle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Interior Least Tern	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Red-Cockaded Woodpecker	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Fish								
Bayou Darter	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Gulf Sturgeon	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Pallid Sturgeon	No effect	No effect	No effect	No effect	No effect	May affect	No effect	No effect
Invertebrates								
Alabama Heelsplitter	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Fat Pocketbook	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Mammals								
Louisiana Black Bear	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
West Indian Manatee	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Reptiles								
Ringed Map Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect

Table G.4.3-3: Summary of Potential Construction-Related Impacts to Threatened, Endangered, and Candidate Species from Development of the Richton Candidate Site

Species	Site	Richton to Pascagoula ROW	Richton to Liberty Terminal ROW	Leaf River RWI and ROW	Power Lines ROW	Liberty Terminal	Pascagoula Terminal and RWI	Brine Diffuser and ROW ^a
Birds								
Bald Eagle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Brown Pelican	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Mississippi Sandhill Crane	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Piping Plover	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Red-Cockaded Woodpecker	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Fish								
Gulf Sturgeon	No effect	No effect	No effect	May affect	No effect	No effect	May affect	No effect
Pearl Darter	No effect	No effect	May affect	May affect	No effect	No effect	No effect	No effect
Invertebrates								
Camp Shelby Burrowing Crayfish	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Mammals								
Gray Myotis (Gray Bat)	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Louisiana Black Bear	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Marine Mammals								
Atlantic Spotted Dolphin	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Plants								
Louisiana Quillwort	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Reptiles								
Alabama Red-Belly Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Black Pine Snake	May affect	May affect	May affect	May affect	May affect	No effect	No effect	No effect
Eastern Indigo Snake	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Gopher Tortoise	May affect	May affect	May affect	May affect	May affect	No effect	No effect	No effect

Table G.4.3-3: Summary of Potential Construction-Related Impacts to Threatened, Endangered, and Candidate Species from Development of the Richton Candidate Site

Species	Site	Richton to Pascagoula ROW	Richton to Liberty Terminal ROW	Leaf River RWI and ROW	Power Lines ROW	Liberty Terminal	Pascagoula Terminal and RWI	Brine Diffuser and ROW^a
Green Sea Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Kemp's Ridley Sea Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Loggerhead Sea Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Ringed Map Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Yellow-Blotched Map Turtle	No effect	No effect	May affect	May affect	No effect	No effect	No effect	No effect

Table G.4.3-4: Summary of Potential Operation and Maintenance Impacts to Threatened, Endangered, and Candidate Species from Development of the Richton Candidate Site

Species	Site	Richton to Pascagoula ROW	Richton to Liberty Terminal ROW	Leaf River RWI and ROW	Power Lines ROW	Liberty Terminal	Pascagoula Terminal and RWI	Brine Diffuser and ROW
Birds								
Bald Eagle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Brown Pelican	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Mississippi Sandhill Crane	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Piping Plover	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Red-Cockaded Woodpecker	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Fish								
Gulf Sturgeon	No effect	No effect	No effect	May affect	No effect	No effect	May affect	No effect
Pearl Darter	No effect	No effect	No effect	May affect	No effect	No effect	No effect	No effect
Invertebrates								
Camp Shelby Burrowing Crayfish	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Mammals								
Gray Myotis (Gray Bat)	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Louisiana Black Bear	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Marine Mammals								
Atlantic Spotted Dolphin	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Plants								
Louisiana Quillwort	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Reptiles								
Alabama Red-Belly Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Black Pine Snake	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Eastern Indigo Snake	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect

Table G.4.3-4: Summary of Potential Operation and Maintenance Impacts to Threatened, Endangered, and Candidate Species from Development of the Richton Candidate Site

Species	Site	Richton to Pascagoula ROW	Richton to Liberty Terminal ROW	Leaf River RWI and ROW	Power Lines ROW	Liberty Terminal	Pascagoula Terminal and RWI	Brine Diffuser and ROW
Green Sea Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Gopher Tortoise	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Kemp's Ridley Sea Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Loggerhead Sea Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Ringed Map Turtle	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Yellow-Blotched Map Turtle	No effect	No effect	No effect	May affect	No effect	No effect	No effect	No effect

Table G.4.3-5: Summary of the Number of Species Potentially Affected

Potential for Effect	Number of Species			
	Bruinsburg, MS		Richton, MS	
	Construction	Operation and Maintenance	Construction	Operation and Maintenance
No effect	10	10	16	18
May affect	1	1	5	3

G.5 RECOMMENDATIONS

The evaluation summarized in section G.4 considered how some potential effects would be minimized, avoided, or, more accurately, forecasted by the use of preconstruction field investigations, mitigation measures, and other precautionary measures. The recommendations below summarize the types of measures identified in section G.4 that would lessen the potential for effects due to the development of the SPR candidate sites in Mississippi. Additional measures may be identified during detailed planning if either of the candidate sites is selected for development.

G.5.1 Bruinsburg, MS

- Conduct preconstruction habitat assessments of proposed elements to determine if surveys are needed for the bald eagle, interior least tern, and red-cockaded woodpecker.
- Conduct field survey to determine whether the fat pocketbook mussel is present in Coles Creek or Fairchilds Creek at the locations of proposed crossings of the pipeline ROW from Bruinsburg to Anchorage. If present, identify suitable habitat upstream where the mussel could be relocated if directional drilling is not a feasible construction method.
- Notify the USFWS and the appropriate state wildlife officials if any protected species are observed either during preconstruction field surveys or during construction.
- Where a proposed pipeline ROW would intersect a surface water body where one or more endangered, threatened, or candidate species has been confirmed, use directional drilling to construct the pipeline crossing, if possible. The feasibility of directional drilling should be evaluated for the following crossings:
 - The crossings of Coles Creek and Fairchilds Creek by the pipeline ROW from Bruinsburg to Anchorage if the fat pocketbook mussel is found to be present in these creeks.
 - The crossing of Thompson Creek by the pipeline ROW from Bruinsburg to Anchorage if the Gulf sturgeon is confirmed to be present.
- When directional drilling is not used to construct a pipeline crossing of a surface water where an endangered, threatened, or candidate species may be present, use best available methods to minimize water quality impacts and downstream siltation.
- When construction, operation, or maintenance activities would occur in areas identified as habitat for a threatened, endangered, or candidate species, schedule activities, to the extent practicable, to avoid sensitive life-cycle stages (e.g., spawning, nesting) identified in section G.2.

G.5.2 Richton, MS

- Complete formal consultation with the USFWS or NOAA Fisheries, or both, as mandated under Section 7 of the Endangered Species Act for any potential adverse effects to the Gulf sturgeon, pearl darter, and yellow-blotched map turtle from water withdrawal. DOE would prepare a biological assessment and implement any requirements prepared during formal consultation by the USFWS or NOAA Fisheries, or both. DOE would coordinate these specific mitigation measures during the application process for a Surface Water Diversion Permit Application to the MDEQ, a Section 404 permit from the USACE, and a formal Section 7 Consultation with the USFWS and NOAA Fisheries.
- Use a supplemental water source from the Gulf of Mexico to help mitigate the impacts to the Gulf sturgeon, pearl darter, and the yellow-blotched map turtle from the RWI on the Leaf River. DOE would coordinate with the USFWS, NOAA Fisheries, and Mississippi Wildlife, Fisheries, and Parks to establish a minimum in-stream flow (MIF) for the Leaf River. Preliminary discussions indicate the MIF may be set at 30 percent of the mean daily discharge, which DOE estimated to be 1,131 cubic feet/second (32 cubic meters). If flow declined to the MIF, then withdrawal from the Leaf would be terminated and all water for solution mining would be withdrawn from the Gulf of Mexico. Water withdrawal for maintenance and drawdown would also follow the same procedure, except that during a National Emergency, DOE may need to withdraw from the Leaf River.
- Conduct a preconstruction habitat assessment on proposed elements and survey on moderately well-drained to excessively well-drained sandy soils for the gopher tortoise burrows. Relocate wildlife within the burrows before construction under supervision of USFWS. Where possible, adjust pipeline ROW alignments to avoid large clusters of burrows. Control invasion and spread of cogon grass. Use only herbicides safe for use around tortoises in preferred habitat areas.
- Conduct preconstruction habitat assessment and survey for the black pine snake at the proposed Richton storage site. If found, relocate individuals to nearby suitable habitat areas during construction, as recommended by USFWS.
- Conduct habitat assessments along proposed pipeline ROWs to determine if surveys are needed for the black pine snake, red-cockaded woodpecker, piping plover, brown pelican, or Louisiana quillwort.
- Notify USFWS and the appropriate State wildlife officials if any protected species are observed either during preconstruction field surveys or during construction.
- Where a proposed pipeline ROW would intersect a surface water body where one or more endangered, threatened, or candidate species has been confirmed, use directional drilling to construct the pipeline crossing, if possible. The feasibility of directional drilling should be evaluated for the following crossings:
 - Black Creek in Lamar County by the pipeline ROW from Richton to Liberty Station; and
 - Tallahala Creek in Perry County by the pipeline from Richton to Liberty Station.
- When directional drilling is not used to construct a pipeline crossing of a surface water where an endangered, threatened, or candidate species may be present, use best available methods to minimize water quality impacts and downstream siltation.

- When construction, operation, or maintenance activities would occur in areas identified as habitat for a threatened, endangered, or candidate species, schedule activities, to the extent practicable, to avoid sensitive life-cycle stages (e.g., spawning, nesting) identified in section G.2.

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