

**A SURVEY FOR  
RED-COCKADED WOODPECKERS  
(*PICOIDES BOREALIS*)**

**ALONG POTENTIAL RAILROAD  
ROUTES TO SERVE THE PROPOSED  
SOUTH CAROLINA STATE PORTS  
AUTHORITY'S DANIEL ISLAND  
MARINE CARGO TERMINAL**

**DANIEL ISLAND, THOMAS ISLAND,  
AND THE CAINHOY PENINSULA,  
BERKELEY COUNTY, SOUTH  
CAROLINA**



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To  
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## I. INTRODUCTION

The South Carolina State Ports Authority proposes to build a marine cargo terminal on the southern tip of Daniel Island in Berkeley County, South Carolina (Figure 1). The proposed cargo terminal would be serviced by a rail line that would run between the terminal and the existing Sea Coast Rail Line near its intersection with S.C. State Highway 98. Several alternative rail routes have been proposed, each of which would cross various portions of Daniel Island, Thomas Island, and the Cainhoy Peninsula (Figure 2).

This area is comprised of a variety of habitat types, including xeric sandhill scrub and pine woodland in uplands where hardwood succession is controlled by prescribed burning or other means. In uplands where management is lacking, a mixture of pine (*Pinus* spp.) and hardwood species (*Quercus* spp., *Carya* spp., etc.) dominates. Much of the area consists of wetland habitats, including pine flatwoods, bottomland hardwoods, depression meadows, pond pine (*Pinus serotina*) woodlands, pond cypress (*Taxodium ascendens*) ponds, pocosin, tidal creeks, and brackish marsh. Land use on Thomas Island, Daniel Island, and the Cainhoy Peninsula includes several small communities, scattered residential sites, industrial sites, and agricultural fields. A large portion of the area remains undeveloped, including the Francis Marion National Forest. Development has accelerated dramatically since the completion of the Mark Clark Expressway (I-526) and is likely to continue to do so.

Certain plant and animal species are protected by the Endangered Species Act (ESA) as administered and enforced by the U.S. Fish and Wildlife Service (USFWS). The ESA requires USFWS to establish a list of protected animal and plant species and to prepare recovery plans for



Figure 1.

LOCATION MAP

NOT TO SCALE

Provided by:



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listed species. Section VII of the ESA requires that consultation with the USFWS be conducted when activities have the potential to impact listed species. Federal and state permits, as well as other federal activities may invoke consideration of protected species. The South Carolina Heritage Trust Program (SCHTP), under the direction of the South Carolina Department of Natural Resources (SCDNR), monitors animal and plant species listed as threatened, endangered, and under status review by USFWS, as well as additional state species of special concern. On July 20, 1998, Sabine and Waters, Inc. contacted Ms. Michelle Taylor of SCDNR to inquire as to the documented locations of protected species within the project area. The response to that inquiry is provided in Appendix 1.

#### **The Red-cockaded Woodpecker**

The red-cockaded woodpecker (*Picoides borealis*) (RCW) is a species indigenous to mature pine forests of the southeastern United States. The RCW is 18-20 centimeters long with a wing span of 35-38 centimeters (USFWS 1995) ("The Red Book"). Its plumage is characterized by black and white horizontal stripes on its back, white cheeks and underparts, and black-streaked flanks. The head is distinguished by a black cap and stripe on the side of the neck and a black throat. In males, there is a small red patch of feathers on each side of the black cap, the so-called red "cockade". Fledgling males have a red crown patch after the first post-fledgling molt. RCWs forage primarily on insects, including ants, beetles, wood-boring insects, and caterpillars.

Nesting and egg laying occurs during April, May, and June with possible renesting into July. The female lays an average of 3-5 eggs in her mate's roosting cavity. Young fledge approximately 38 days after hatching. Brood rearing is typically a cooperative effort carried out

by a social unit of RCWs called a "group". The group consists of the parents and some of the male offspring from previous clutches, and commonly are comprised of 3-5 birds.

Suitable nesting habitat is provided by open pine stands with a minimum age of 80-120 years. A number of different southern pine species may be used, although longleaf pine (*Pinus palustris*) appears to be preferred when available. Roosting/nesting cavities are excavated in living pines, which are frequently infected with red-heart disease. The ages of cavity trees may range from 63 to 300+ years in longleaf pines, and 62-200+ years in loblolly and other pine species. Active, completed cavity trees have numerous small "resin wells" created by the birds and which exude sap. This behavior of creating and maintaining flowing resin wells is believed to be a cavity defense mechanism against predators. Foraging habitat generally consists of pine and pine-hardwood stands 30 years of age or older. RCWs prefer pine trees 10 inches or larger in diameter and tend to avoid stands with dense, well-developed understories. The aggregate of cavity trees and a 200-foot buffer around that aggregate constitutes what is referred to as a "cluster". The average cluster covers approximately 10 acres, with a range of 3-60 acres, and consists of 1 to 20 or more cavity trees. The average territory for a group is 200 acres, but may range from 60 to more than 600 acres.

The RCW was described as being abundant in the early 1800's by naturalists of the time, but by 1970, investigators indicated that the species may be declining toward extinction. The decline is believed to be attributable to loss of old-growth pine forest with trees 80 years of age and older and to the encroachment of hardwood midstory in clusters due to fire suppression. Because of the continued decline, in 1970 the RCW was declared an endangered species. More

detailed information on life history and other characteristics of the RCW are provided in Appendices 2 and 3.

The Francis Marion National Forest at one time supported approximately 477 RCW groups, the second largest population (Watson et al. 1993). In 1989, Hurricane Hugo destroyed 87% of the active RCW cavity trees on the Forest and killed 63% of the woodpeckers. The storm also destroyed 59% of the RCW foraging habitat, nesting habitat, and potential cavity trees. As a result of the installation of artificial cavities and intensive management, the population has increased steadily from post Hugo numbers, but nesting and foraging habitat remains extremely limiting in many areas. Much of the area on the Cainhoy peninsula, Thomas Island, and Daniel Island were subjected to the same devastation that befell Francis Marion National Forest.

Because of the documented presence of RCWs on the property of Cainhoy Plantation and Amoco Chemical Corporation (Appendix 1)(SCHTP), the known large RCW population on the Francis Marion National Forest, anecdotal information about their presence on other privately owned properties in the Cainhoy area, and the presence of suitable habitat in the vicinity, the potential exists for the construction and operation of the proposed railroad routes to have direct and/or indirect impacts on the RCWs and/or their habitat. Since such impacts might result in the incidental take of RCWs and, as a result, violation of the Endangered Species Act, Sabine and Waters, Inc. was contracted by URS Greiner, Inc. on behalf of the South Carolina State Ports Authority to conduct a survey of Daniel Island, Thomas Island, and the Cainhoy area. The purpose of the survey was to determine the presence and distribution of RCWs and the potential impacts of the various railroad routes. This report presents the result of that survey.

## II. METHODS

### Surveys

Surveys for RCWs were conducted between August 6 and September 9, 1998 following methodologies recommended in "Guidelines for Preparation of Biological Assessments and Evaluations for the Red-Cockaded Woodpecker" (the "Blue Book")(USFWS 1989). "Suitable" RCW habitat was defined as pine or pine-hardwood (50 percent or more pine) stands  $\geq 30$  years of age. The suitability of habitat was evaluated by an initial examination of infrared aerial photography using standard aerial photo interpretation techniques followed by reconnaissance field surveys of potential habitat by foot and/or vehicle. Once suitable RCW habitat was identified, an additional evaluation was made to determine whether suitable RCW nesting habitat was present. Suitable nesting habitat was defined as pine stands over 60 years of age, or younger stands containing scattered or clumped old-growth trees. Suitable nesting habitat was then surveyed by walking parallel line transects through stands and looking for RCW cavity trees. Spacing between transects ranged between 50 and 100 yards, the interval depending on restrictions placed on visibility by tree spacing and understory density, but always resulting in 100 percent coverage. Spacing between transects was reduced in the vicinity of discovered cavity trees to optimize the likelihood of finding all cavity trees associated with that group. Trees were flagged, numbered, and precisely located using the global positioning system (GPS) for mapping and future reference.

Information on cluster locations and tree data for RCWs on the Francis Marion National Forest was provided by the U.S. Forest Service (USFS)(Appendix 4). All clusters which had the potential of being impacted by the alternative rail segments were revisited by Sabine and Waters,

Inc. to confirm the activity status of trees as reported by USFS in recent years. In addition the clusters and immediate areas were surveyed to locate any new trees. Each alternative rail segment which passed through the Francis Marion was walked, one surveyor on each side, to locate and document all RCW trees that fell within 250 feet of the flagged centerline of those segments. All RCW cavity trees that fell within the 500-foot corridor of the preferred alternative (Alternative Route 5) were located using GPS. The remainder of RCW cavity trees occurring in the Francis Marion between SC Road 98 and SC Road 41 were also located using GPS (Figure 2).

#### **Timber Inventory and Foraging Analyses**

Available RCW foraging habitat is defined as pine and pine-hardwood stands over 30 years of age contiguous to and within 0.5 miles of the center of an RCW cluster (USFWS 1989). On U.S.D.A. Forest Service property, such as the Francis Marion National Forest, foraging habitat must be managed for within 0.75 miles of the geometric centers of RCW clusters. This more stringent requirement is mandated by the "Final Environmental Impact Statement for the Management of the Red-cockaded Woodpecker and its Habitat on National Forests in the Southern Region" (USDA Forest Service 1995). Adequate habitat must be provided on Forest Service property even if foraging circles extend onto property owned by others, unless cooperative agreements have been negotiated between the Forest Service and those landowners. Foraging habitat is considered noncontiguous if it is separated from the cluster or other foraging habitat by nonforaging habitat  $\geq$  330 feet wide.

Following these definitions, all available RCW foraging habitat for which current data were not available was sampled by qualified forestry technicians following "Blue Book"

specified techniques. At each sampling plot, technicians determined number of pine stems  $\geq 10$  inches dbh/acre and basal area (BA)/acre using a 10-factor prism. Homogenous stands were sampled at a density of 1 plot per 4 acres, while heterogeneous stands were sampled at a density of 1 plot per 2 acres. A representative dominant tree at every tenth plot in each stand was sampled with an increment borer to determine stand age. Timber inventory data were processed using Timber Management Inventory (TMI) software to produce timber data for each stand (Appendix 5). Stand data for the Amoco tract and Francis Marion National Forest were provided by Amoco Chemical Corporation and the U.S. Forest Service, respectively.

To determine the pre- and post-project availability of RCW foraging habitat associated with each railroad alternative, Sabine and Waters, Inc. followed the procedures outlined in *A Technique for Using PC-ARC/INFO GIS to Determine Red-cockaded Woodpecker Foraging Areas on Private Lands* (Lipscomb and Williams 1996). All tree locations obtained using the GPS were first converted to an ARC/INFO point file. Because of the lack of banding data and behavioral observations, RCW trees were grouped into clusters using a technique described by Harlow et al. (1983) and modified by Lennartz and Metteauer (1986). Using this method, clusters can be defined as the active trees that can be encompassed by a circle 1,500 feet in diameter. Circles cannot overlap and must contain at least one active tree. The Geographic Information System (GIS) was then used to calculate the geometric center (the mean of the x and y coordinates) of the trees for each group. Potential foraging ranges (0.5 mile on private property; 0.75 mile on the Francis Marion) for each group were delineated by generating a buffer around each group center using the ARC/INFO BUFFER command. Because RCWs are territorial, overlapping foraging ranges must be partitioned and allocated to a particular group. The intersecting areas between any two groups were divided into two equal areas in ARCEDIT.

When all overlapping areas were partitioned, the resulting coverage was unioned with the stand inventory data. ARCPLT commands RESELECT and STATISTICS were then used to determine the amount of foraging habitat available to each RCW group before and after the proposed projects.

### III. RESULTS

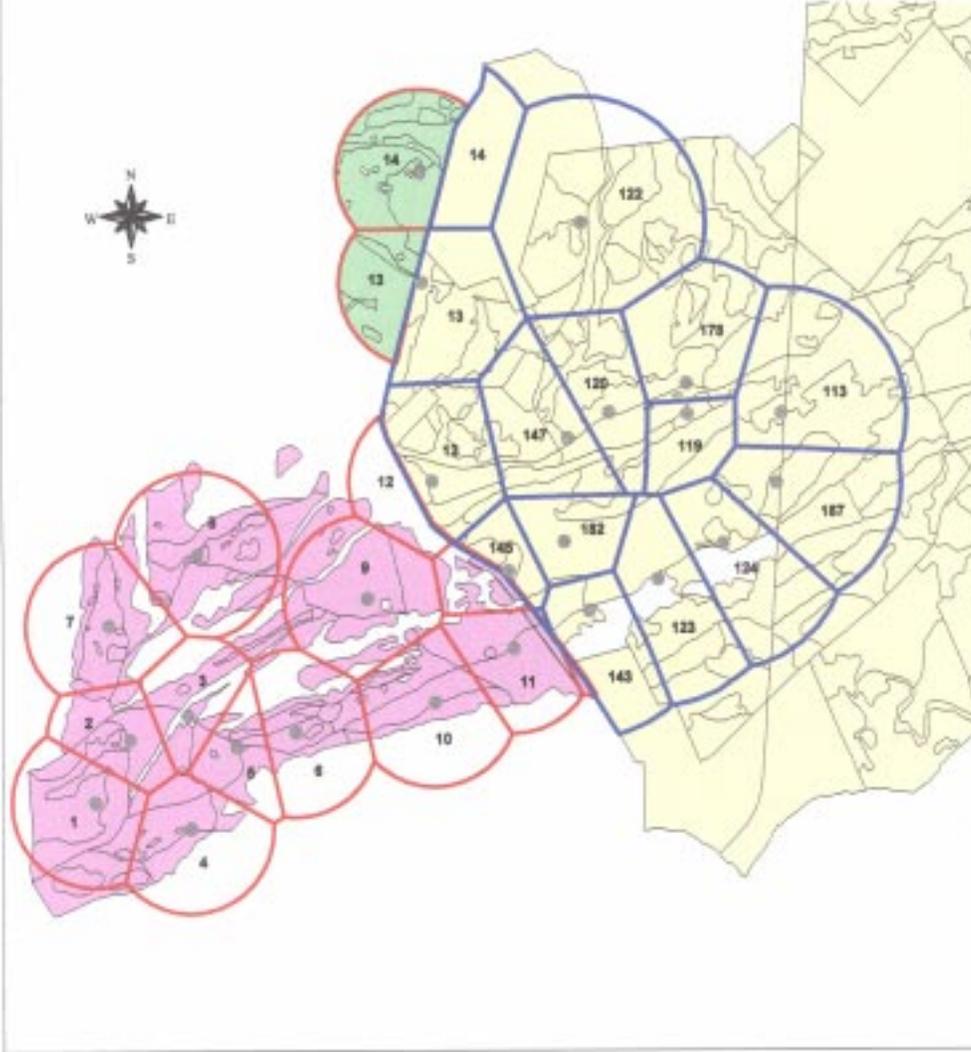
#### RCW Surveys

A total of 18 active RCW clusters were identified with foraging circles that would be intersected by at least one of the proposed alternative rail segments (Figure 2). All of these clusters were located northwest of Jack Primus Road (SC Road 119) on the properties of Cainhoy Plantation, Amoco Chemical Corporation, and Francis Marion National Forest (Figure 3).

Four inactive RCW cavity trees were discovered on the Jack Primus Tract, just east of Jack Primus Road (Figure 4). This tract was formerly part of Cainhoy Plantation and now owned by The Beach Company, Charleston, SC. Three of the trees located had previously been flagged and tagged. The other tree was not marked and may have been unknown previously. All of the trees were inactive when the site was surveyed August 31-September 1 and appeared to have been inactive for some time. All trees were located in uplands forested with sparsely stocked longleaf and loblolly pines. Much of the area appears to have been extensively thinned within the past several years leaving only scattered hardwoods consisting of live oak, turkey oak, and scattered xeric shrubs such as sparkleberry (*Vaccinium arboreum*).

The majority of previously undocumented RCW cavity trees were discovered on the property of Cainhoy Plantation, owned by Peter Lawson-Johnston, New York, NY (Figures 3 and 4). A total of 84 RCW cavity trees were located during our surveys between August 6 and August 28, 1998 (Table 1). The overwhelming majority of those trees were located in forested uplands dominated by longleaf pine, although a few were located on or just inside the margins of

FIGURE 3  
 URS GEINER  
 DANIEL ISLAND  
 BERKELEY COUNTY, SOUTH CAROLINA



LEGEND

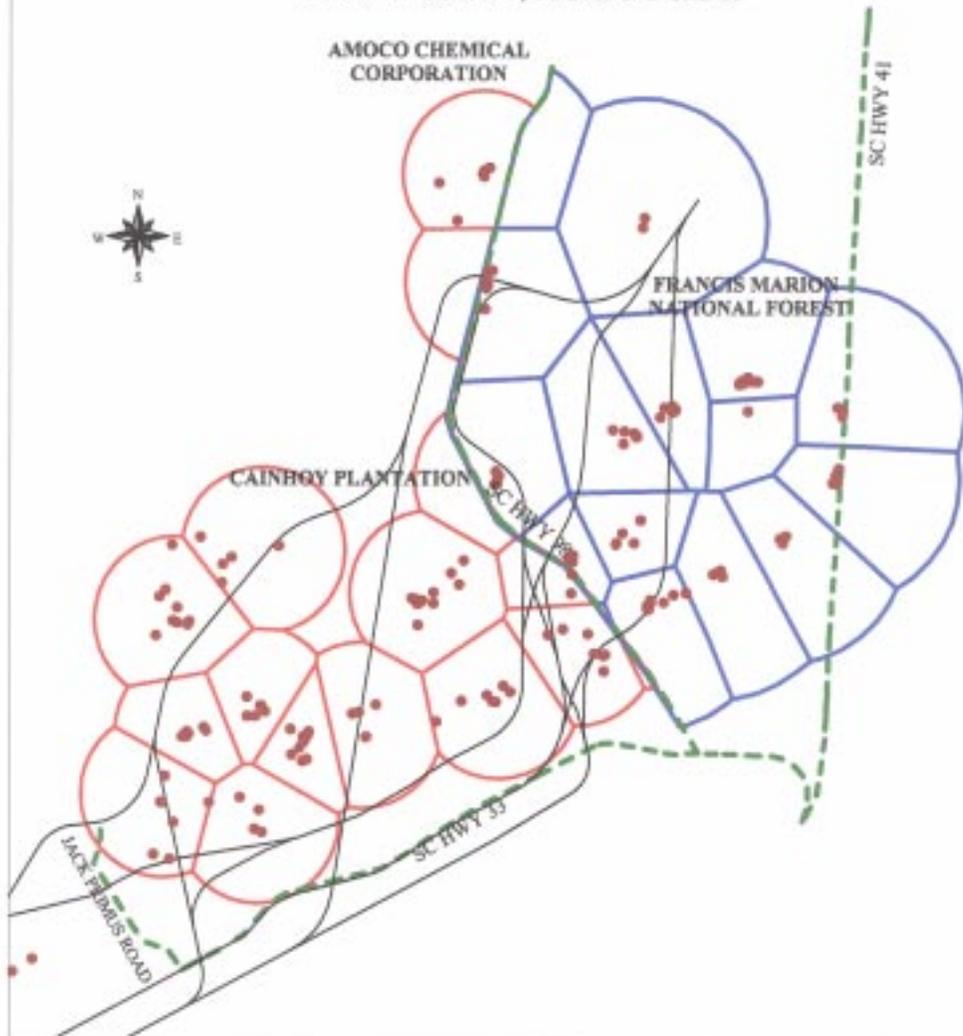
- Cluster Centers
- Partitions 3/4th mile
- Partitions 1/2 mile
- Ownership
- AVOCADO CHEMICAL CORPORATION
- FRANCIS MARION NATIONAL FOREST

0 2000 4000 Feet



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FIGURE 4  
 URS GEINER  
 DANIEL ISLAND  
 BERKELEY COUNTY, SOUTH CAROLINA



LEGEND

-  1/4 mile parceling
-  1/2 mile parceling
-  Trees/Creeks/Trees
-  Alternative Rail Segments
-  Main Roads

0 2000 4000 Feet



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Table 1. Red-cockaded woodpecker cavity trees located on the Francis Marion National Forest and Cainhoy Peninsula in the vicinity of alternative rail segments to serve the proposed South Carolina State Ports Authority's Daniel Island Marine Cargo Terminal, Berkeley County, South Carolina.

Tree Number	Activity Status	Stage of Completion	State Plane Grid System	
			X coordinate	Y coordinate
CP1	Active	Cavity	2352137	404558.6
CP2	Active	Cavity	2351628	404249
CP3	Inactive	Cavity	2350796	404070.5
CP4	Possibly active	Cavity	2355376	405013.9
CP5	Inactive	Start	2355054	405572.4
CP6	Inactive	Start	2355349	405511.9
CP7	Inactive	Start	2355412	405547.3
CP8	Possibly active	Cavity	2354860	406192
CP9	Possibly active	Cavity	2354347	408097.4
CP10	Active	Cavity	2354321	407478.1
CP11	Possibly active	Cavity	2354057	406348.2
CP12	Active	Cavity	2353575	406173.5
CP13	Inactive	Start	2349991	403423.2
CP14	Active	Cavity	2351805	404060.9
CP15	Possibly active	Cavity	2351904	404053.6
CP16	Possibly active	Start	2352368	404366.9
CP17	Inactive	Advanced start	2344376	399903.1
CP18	Active	Cavity	2344129	400011.5
CP19	Inactive	Cavity	2341391	399053.4
CP20	Inactive	Cavity	2340870	399206
CP21	Active	Cavity	2344287	400608.6
CP22	Inactive	Advanced start	2343674	401019.7
CP23	Inactive	Cavity	2342662	400850.5
CP24	Active	Cavity	2343887	403595.1
CP25	Possibly active	Cavity	2344163	403605.1
CP26	Possibly active	Cavity	2345328	402367.3
CP27	Active	Sub-Start	2345579	402587.9
CP28	Active	Only resin wells	2345721	402800.4
CP29	Active	Cavity	2345742	402807.6
CP30	Active	Cavity	2345703	402939
CP31	Active	Advanced start	2345846	403004.4

Table 1. (cont'd)

Tree Number	Activity Status	Stage of Completion	State Plane Grid System	
			X coordinate	Y coordinate
CP32	Active	Sub-Start	2345857	403004.5
CP33	Active	Cavity	2345305	403181.7
CP34	Inactive	Start	2345821	402222.8
CP35	Inactive	Start	2345674	402165.6
CP36	Possibly active	Cavity	2345877	403110.2
CP37	Active	Cavity	2347714	402919.3
CP38	Active	Cavity	2347740	402940.4
CP39	Active	Cavity	2347280	403676.5
CP40	Active	Advanced start	2340964	406152
CP41	Active	Cavity	2341981	406498.8
CP42	Active	Sub-Start	2341985	406497.4
CP43	Possibly active	Cavity	2342045	406607.7
CP44	Active	Advanced start	2341659	406561.9
CP45	Active	Cavity	2341500	406618.5
CP46	Active	Cavity	2341652	407035.1
CP47	Inactive	Cavity	2341283	407598.8
CP48	Inactive	Start	2341483	409027.7
CP49	Active	Cavity	2341089	407385.8
CP50	Inactive	Sub-Start	2342395	409273.5
CP51	Active	Cavity	2342507	403237.4
CP52	Active	Advanced start	2342583	403141.1
CP53	Inactive	Start	2341517	400226.1
CP54	Possibly active	Cavity	2341136	400854.9
CP55	Possibly active	Advanced start	2341110	400860.2
CP56	Active	Cavity	2341251	401684.7
CP57	Active	Cavity	2341944	402939.9
CP58	Inactive	Start	2341961	403099.7
CP59	Inactive	Cavity	2341885	403026.7
CP60	Active	Cavity	2342013	403050.3
CP61	Inactive	Cavity	2341799	402938.3
CP62	Active	Advanced start	2343890	404212.8
CP63	Active	Cavity	2344321	403931.6
CP64	Inactive	Start	2344354	403926.3
CP65	Active	Cavity	2344475	403744.5

Table 1. (cont'd)

Tree Number	Activity Status	Stage of Completion	State Plane Grid System	
			X coordinate	Y coordinate
CP66	Inactive	Start	2348042	403959.7
CP67	Inactive	Start	2343087	407834.8
CP68	Inactive	Advanced start	2343114	408415.2
CP69	Active	Cavity	2343406	408633.5
CP70	Inactive	Start	2350866	408529.2
CP71	Active	Start	2349197	407332.4
CP72	Active	Cavity	2349315	407249.1
CP73	Active	Cavity	2349321	407299.1
CP74	Inactive	Start	2340468	408130.6
CP75	Active	Cavity	2349899	407517.8
CP76	Active	Cavity	2349903	407170.9
CP77	Inactive	Cavity	2349544	407257.1
CP78	Inactive	Advanced start	2349484	407220.4
CP79	Possibly active	Start	2349381	407161
CP80	Active	Cavity	2350730	407764.3
CP81	Inactive	Start	2349398	406485.3
CP82	Active	Cavity	2344926	408994.2
CP83	Active	Start	2344898	409010.5
CP84	Active	Cavity	2347497	403721.9
JP1	Inactive	Cavity	2336974	395891.8
JP2	Inactive	Start	2336340	395489.5
JP3	Inactive	Cavity	2334154	394944.6
JP4	Inactive	Cavity	2334885	394254.2
AM1	Inactive	Cavity	2351697	421008.4
AM2	Possibly active	Cavity	2351529	420924.7
AM3	Inactive	Cavity	2351477	420818.7
AM4	Active	Cavity	2351522	420728.9
AM5	Inactive	Cavity	2350060	420533.7
AM6	Inactive	Start	2350649	419328.6
FM0	Active	Start	2356872	407281.8
FM4	Inactive	Advanced start	2351548	416529.5
FM5	Active	Start	2357296	407201.4
FM6	Inactive	Start	2357616	407437.7
FM7	Inactive	Advanced start	2358012	407495.8

Table 1. (cont'd)

Tree Number	Activity Status	Stage of Completion	State Plane Grid System	
			X coordinate	Y coordinate
FM8	Inactive	Start	2359179	408019.5
FM9	Inactive	Start	2351997	411223.1
118C-4	Active	Cavity	2356877	407181.7
118C-3	Active	Cavity	2356797	407129.1
118C-2	Possibly active	Cavity	2356779	407068.8
118C-1	Active	Cavity	2356779	407068.8
118C-5	Possibly active	Start	2356762	407022.9
118C-6	Active	Cavity	2356812	406973.2
114 E - 1	Inactive	Cavity	2351979	411181.3
114 E - 2	Inactive	Start	2351924	411300
114 E - 4	Active	Cavity	2351900	411344.1
114 E - 5	Active	Cavity	2351912	411365.1
114 E - 6	Possibly active	Cavity	2351936	411021.2
114 E - 7	Inactive	DEAD TREE		
114 E - 3	Active	Cavity	2351853	410955
118 B - 6	Active	Cavity	2358888	408088.3
118 B - 3	Inactive	Cavity	2358930	408114.6
118 B - 4	Active	Cavity	2359121	408212.8
118 B - 5	Inactive	Start	2359166	408048.6
112 A - 2	Active	Cavity	2357586	413251.4
112 A - 1	Active	Cavity	2357657	413298.5
112 A - 8	Active	Cavity	2357667	413335.5
112 A - 3	Active	Cavity	2357647	413360.4
112 A - 6	Active	Cavity	2357315	413385.7
112 A - 7	Active	Start	2357183	413081.3
112 A - 4	Active	Cavity	2357555	413294.2
112 A - 5	Active	Cavity	2357570	413452.3
112 B - 7	Inactive	Start	2355656	412680.6
112 B - 8	Possibly active	Cavity	2356035	412631.9
112 B - 2	Active	Cavity	2356339	412577.5
112 B - 1	Active	Cavity	2356382	412539.3
112 B - 4	Possibly active	Cavity	2356431	412475.5
112 B - 3	Active	Cavity	2356425	412461.4
112 B - 5	Active	Resin wells only	2356417	412466.7

Table 1. (cont'd)

Tree Number	Activity	Stage of	State Plane Grid System	
	Status	Completion	X coordinate	Y coordinate
112 B - 6	Active	Start	2356003	412247.5
112 C - 8	Inactive	Cavity	2359706	414128.6
112 C - 9	Active	Cavity	2359743	414219.8
112 C - 6	Inactive	Cavity	2359832	414257.9
112 C - 5	Active	Cavity	2359847	414158.6
112 C - 2	Active	Cavity	2359968	414358.9
112 C - 1	Active	Cavity	2360133	414231.5
112 C - 7	Active	Cavity	2360172	414228.6
112 C - 3	Active	Cavity	2360308	414225.1
114 G - 3	Active	Cavity	2355761	409043.3
114 G-FM11	Possibly active	Start	2355778	409083.9
114 G-FM10	Active	Cavity	2355967	409391.4
114 G - 1	Active	Cavity	2356338	409077.0
114 G - 2	Active	Start	2356548	409821.2
114 B - 2	Inactive	Cavity	2354364	408488.8
114 B - 5	Inactive	Start	2354286	408529.4
114 B - 6	Inactive	Start	2354236	408572.6
114 B - 1	Active	Cavity	2354298	408588.6
114 B - 3	Inactive	Cavity	2354382	408687.7
114 A - 8	Active	Start	2363038	413302.6
114 A - 7	Active	Cavity	2362981	413340.5
114 A - 6	Active	Cavity	2362863	413402.8
114 A - 4	Active	Cavity	2363009	413116.9
118 A - 5	Active	Cavity	2362899	411461.2
118 A - 4	Possibly Active	Cavity	2362797	411230.3
118 A - 2	Inactive	Start	2362863	411011.0
118 A - 6	Inactive	Start	2362789	410974.4
118 A - 1	Active	Cavity	2362773	411007.2
118 A - 3	Active	Start	2362714	410999.4
113 A - 3	Active	Cavity	2356610	419103.1
113 A - 4	Inactive	Cavity	2356678	419428.8
114 D - 3	Inactive	Cavity	2361107	409071.8
114 D - 6	Active	Cavity	2361015	409214.7
114 D - 1	Active	Cavity	2361127	409214.8

Table 1. (cont'd)

Tree Number	Activity	Stage of	State Plane Grid System	
	Status	Completion	X coordinate	Y coordinate
112 B - 6	Active	Start	2356003	412247.5
112 C - 8	Inactive	Cavity	2359706	414128.6
112 C - 9	Active	Cavity	2359743	414219.8
112 C - 6	Inactive	Cavity	2359832	414257.9
112 C - 5	Active	Cavity	2359847	414158.6
112 C - 2	Active	Cavity	2359968	414358.9
112 C - 1	Active	Cavity	2360133	414231.5
112 C - 7	Active	Cavity	2360172	414228.6
112 C - 3	Active	Cavity	2360308	414225.1
114 G - 3	Active	Cavity	2355761	409043.3
114 G-FM11	Possibly active	Start	2355778	409083.9
114 G-FM10	Active	Cavity	2355967	409391.4
114 G - 1	Active	Cavity	2356338	409077.0
114 G - 2	Active	Start	2356548	409821.2
114 B - 2	Inactive	Cavity	2354364	408488.8
114 B - 5	Inactive	Start	2354286	408529.4
114 B - 6	Inactive	Start	2354236	408572.6
114 B - 1	Active	Cavity	2354298	408588.6
114 B - 3	Inactive	Cavity	2354382	408687.7
114 A - 8	Active	Start	2363038	413302.6
114 A - 7	Active	Cavity	2362981	413340.5
114 A - 6	Active	Cavity	2362863	413402.8
114 A - 4	Active	Cavity	2363009	413116.9
118 A - 5	Active	Cavity	2362899	411461.2
118 A - 4	Possibly Active	Cavity	2362797	411230.3
118 A - 2	Inactive	Start	2362863	411011.0
118 A - 6	Inactive	Start	2362789	410974.4
118 A - 1	Active	Cavity	2362773	411007.2
118 A - 3	Active	Start	2362714	410999.4
113 A - 3	Active	Cavity	2356610	419103.1
113 A - 4	Inactive	Cavity	2356678	419428.8
114 D - 3	Inactive	Cavity	2361107	409071.8
114 D - 6	Active	Cavity	2361015	409214.7
114 D - 1	Active	Cavity	2361127	409214.8

Table 1. (cont'd)

Tree Number	Activity	Stage of	State Plane Grid System	
	Status	Completion	X coordinate	Y coordinate
114 D - 4	Active	Start	2361110	409182.4
114 D - 5	Inactive	Start	2361158	409277.3
114 D - 2	Dead	Cavity	2361218	409313.3
113C-1	Active	Start	2351555	417363.7
113C-2	Active	Cavity	2351566	417388.8
113C-3	Inactive	Start	2351589	4174570
113C-4	Inactive	DEAD		
113C-5	Active	Cavity	2351640	417282.8
113C-6	Active	Start	2351663	417760.4
113C-7	Active	Start	2351578	417186.3
113C-8	Inactive	Start	2351785	417756.3

swales between the upland ridges. These swales were dominated by a sparse to moderate canopy of pond pine with a dense understory of evergreen shrubs dominated by fetterbush (*Lyonia lucida*). Most of Cainhoy Plantation is intensively managed for quail, turkey, and whitetail deer. The average diameter of the longleaf was in the range of approximately 10-12 inches. Stands were also essentially even-aged with the majority of the trees between 60 and 80 years of age. Stands appeared to have been burned regularly resulting in a very open understory with pine regeneration kept in a very low stage. Most understory vegetation was herbaceous, dominated by bracken fern (*Pteridium aquilinum*) and broomstraw (*Andropogon* spp.). The 84 trees on Cainhoy Plantation are associated with 11 clusters centered on the Plantation (1-11) and a twelfth (145) with its center in Francis Marion National Forest (Figure 3).

Six trees were located on Amoco Chemical Corporation, including an inactive RCW cavity start that was previously unknown (Table 1). However, the center of the cluster to which these trees belong (14) is located approximately 0.56 miles from the proposed corridor impact. The Amoco property was also severely impacted by Hurricane Hugo and lost much potential RCW foraging and nesting habitat (Ernie Nelson, pers. comm.). Prescribed burning has also been limited due to the proximity of SC Road 98 and the potential impacts of smoke on visibility conditions. The habitat on the Amoco that is incorporated in clusters 13 and 14 consists of a mixture of bottomland hardwoods, hardwood-pine uplands, and forested uplands dominated by longleaf pine. The longleaf stands also have a small amount of loblolly pine in the canopy and understory.

Twelve clusters were identified on Francis Marion National Forest with centers within 0.75 miles of at least one of the alternative rail segments (Figures 1 and 4). These clusters are

comprised of 73 trees on Francis Marion property, 9 of which were previously unknown. Two other trees located on Cainhoy Plantation are also associated with cluster 145 (Francis Marion cluster 114B). Although the habitat included within the clusters on the Francis Marion was highly variable, including gum pond, cypress domes, bottomland hardwood wetlands, and pocosin, almost all RCW cavity trees were located in forested uplands with an overstory of longleaf pine. Understory was of varying composition and densities, ranging from relatively open stands with few shrubs and a well developed herbaceous flora, to areas with moderately dense shrub layers of *Symplocos tinctoria* or inkberry (*Ilex glabra*).

Very little potential RCW habitat was found on the remainder of Cainhoy Peninsula, Thomas Island, and Daniel Island to the south. The majority of undeveloped land in those areas consisted of hardwood-pine (>50% hardwood) uplands, mixed hardwood uplands dominated by live oak (*Quercus virginiana*) and water oak (*Quercus nigra*), bottomland hardwoods, and agricultural fields. The few areas with marginal RCW habitat were walked with negative results.

#### **RCW Foraging Analyses**

Results of the partitioning of habitat among clusters and foraging analyses based on those partitions is presented in Table 2 and Figure 1. The results of foraging analyses on clusters after accounting for the impacts of the various alternative rail segments is presented in Table 3.

Table 2. Red-cockaded woodpecker clusters located on the Cainhoy Peninsula in the vicinity of alternative rail segments to serve the proposed South Carolina State Ports Authority's Daniel Island Marine Cargo Terminal, Berkeley County, South Carolina.

CLUSTER NUMBER	FRANCIS MARION NUMBER	PRE-PROJECT		TOTAL ACRES <sup>3</sup>	RAIL SEGMENTS AFFECTING FORAGING HABITAT
		BASAL AREA <sup>1</sup>	PINE STEMS <sup>2</sup>		
1 <sup>a</sup>	N/A	6696	7750	156.9	3-6, 5F, 6B
2 <sup>a</sup>	N/A	7739	8689	159.6	3-6, 6B, 6C-1
3 <sup>a</sup>	N/A	4911	5925	103.4	none
4 <sup>a</sup>	N/A	5400	6124	144.6	3-5B
5 <sup>a</sup>	N/A	3379	3923	94.9	none
6 <sup>a</sup>	N/A	4731	5344	120.4	8
7 <sup>a</sup>	N/A	5478	5856	174.3	6C-1
8 <sup>a</sup>	N/A	10808	12633	281.1	6C-1
9 <sup>a</sup>	N/A	11582	14142	321.5	8
10 <sup>a</sup>	N/A	7467	8277	172.7	5G
11 <sup>a</sup>	N/A	8054	9061	187.4	3-4, 3D, 3E, 4-3, 4-5, 4A, 4B, 4C, 5-4, 5G, 5H
12 <sup>b</sup>	114E	699	316	19.4	none
13 <sup>b</sup>	113C	1244	876	28.3	5I, 6C-2
14 <sup>a</sup>	N/A	7727	5486	177.2	none
113 <sup>b</sup>	114A	24075	10848	393.4	none
119 <sup>b</sup>	114C	3217	416	58.5	none
120 <sup>b</sup>	112A	2040	1353	35.4	3E
122 <sup>b</sup>	113A	5448	2507	127.6	4D, 5I
123 <sup>b</sup>	118B	7486	1952	165.1	none
124 <sup>b</sup>	114D	6825	1997	149.8	none
143 <sup>b</sup>	118C	10147	3819	145.1	3E
145 <sup>b</sup>	114B	6220	1472	100.8	4-5, 4C, 4D, 5-4, 5H, 5I
147 <sup>b</sup>	112B	3791	1021	28.9	4D
178 <sup>b</sup>	112C	7362	5599	126.4	none
182 <sup>b</sup>	114G	8754	1071	147.2	3E, 4D
187 <sup>b</sup>	115A	9174	3012	150.4	none

<sup>1</sup>Total basal area expressed in square feet.

<sup>2</sup>Total number of pine stems  $\geq 10''$  dbh.

<sup>3</sup>Total acreage of RCW foraging habitat

<sup>a</sup>Foraging habitat calculated within 0.5 miles of cluster geometric center

<sup>b</sup>Foraging habitat calculated within 0.75 miles of cluster geometric center but confined to within boundaries of Francis Marion National Forest.

Table 3. Pre- and post-project RCW foraging analyses for alternative railroad routes to serve the proposed South Carolina State Ports Authority's Daniel Island Marine Cargo Terminal, Berkeley County, South Carolina.

ALTERNATE RAIL SEGMENT	RCW CLUSTER AFFECTED	PRE-PROJECT		POST-PROJECT			
		BA <sup>1</sup>	STEMS <sup>2</sup>	100 FEET		500 FEET	
				BA (LOSS)	STEMS (LOSS)	BA (LOSS)	STEMS (LOSS)
3A	none						
3B	none						
3C	none						
3-4	11 <sup>b</sup>	8054	9061 <sup>a</sup>	8054 (0)	9061 <sup>a</sup> (0)	8052 (-2)	9059 <sup>a</sup> (-2)
3-5A	none						
3-5B	4	5400	6124	5400 (-0)	6124 (-0)	5240 (-160)	5931 (-193)
3-6	1	6696	7750 <sup>a</sup>	6482 (-214)	7493 <sup>a</sup> (-257)	5603 (-1093)	6443 <sup>a</sup> (-1307)
	2	7739	8689 <sup>a</sup>	7735 (-4)	8685 <sup>a</sup> (-4)	7650 (-89)	8591 <sup>a</sup> (-98)
3C-1	none						
3C-2	none						
3D	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7933 (-121)	8930 <sup>a</sup> (-131)	7454 (-600)	8407 <sup>a</sup> (-654)
3E	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7973 (-81)	8973 <sup>a</sup> (-88)	7651 (-403)	8622 <sup>a</sup> (-439)
	120	2040	1353	1860 (-180)	1251 (-102)	1389 (-651)	934 (-419)
	143	10147 <sup>a</sup>	3819	9800 <sup>a</sup> (-347)	3727 (-92)	8448 (-1699)	3351 (-468)
	182	8754 <sup>a</sup>	1071	8503 <sup>a</sup> (-251)	1043 (-28)	7549 (-1205)	936 (-132)
4-3	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7922 (-132)	8919 <sup>a</sup> (-142)	7399 (-655)	8354 <sup>a</sup> (-707)
4-5	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7858 (-196)	8835 <sup>a</sup> (-226)	6991 (-1063)	7835 <sup>a</sup> (-1226)
	145 <sup>b</sup>	7336	3813	7180 (-156)	3630 (-183)	6682 (-654)	3045 (-768)
4A	11 <sup>b</sup>	8054	9061 <sup>a</sup>	8054 (-0)	9061 <sup>a</sup> (-0)	8044 (-10)	9051 <sup>a</sup> (-10)
4B	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7976 (-78)	8980 <sup>a</sup> (-81)	7662 (-392)	8653 <sup>a</sup> (-408)

<sup>1</sup>Total basal area expressed in square feet.

<sup>2</sup>Total number of pine stems ≥10" dbh.

<sup>a</sup>Meets RCW foraging habitat requirements for projects with federal nexus (USFWS 1989).

<sup>b</sup>Based on 0.5-mile foraging circle and property both on and off of Francis Marion National Forest.

<sup>c</sup>Based on 0.75-mile foraging circle and property entirely within Francis Marion National Forest.

Table 3. (cont'd)

ALTERNATE RAIL SEGMENT	RCW CLUSTER AFFECTED	PRE-PROJECT		POST-PROJECT							
		BA <sup>1</sup>	STEMS <sup>2</sup>	100 FEET				500 FEET			
				BA (LOSS)		STEMS (LOSS)		BA (LOSS)		STEMS (LOSS)	
4C	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7860	(-194)	8838 <sup>a</sup>	(-223)	7027	(-1027)	7877 <sup>a</sup>	(-1184)
	145 <sup>b</sup>	7336	3813	7287	(-49)	3756	(-57)	7021	(-315)	3443	(-370)
4D	122	5448	2507	5448	(0)	2507	(0)	5336	(-112)	2457	(-50)
	145 <sup>b</sup>	7336	3813	7174	(-162)	3773	(-40)	6529	(-807)	3613	(-200)
	145 <sup>c</sup>	6220	1472	6009	(-211)	1424	(-48)	5167	(-1053)	1230	(-242)
	147	3791	1021	3417	(-374)	962	(-59)	2012	(-1779)	744	(-277)
	182	8754 <sup>a</sup>	1071	8669 <sup>a</sup>	(-85)	1060	(-11)	8334	(-420)	1018	(-53)
5-3	None										
5-4	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7932	(-122)	8818 <sup>a</sup>	(-243)	7492	(-562)	8401 <sup>a</sup>	(-660)
	145 <sup>b</sup>	7336	3813	7224	(-112)	3682	(-131)	6797	(-539)	3181	(-632)
5A	None										
5B	None										
5C	None										
5D	None										
5E	None										
5F	1	6696	7750 <sup>a</sup>	6652	(-44)	7691 <sup>a</sup>	(-59)	6427	(-269)	7391 <sup>a</sup>	(-359)
5G	10	7467	8277 <sup>a</sup>	7297	(-170)	8099 <sup>a</sup>	(-178)	6614	(-853)	7378 <sup>a</sup>	(-899)
	11 <sup>b</sup>	8054	9061 <sup>a</sup>	8023	(-31)	9025 <sup>a</sup>	(-36)	7896	(-158)	8876 <sup>a</sup>	(-185)
5H	11 <sup>b</sup>	8054	9061 <sup>a</sup>	7960	(-94)	8950 <sup>a</sup>	(-111)	7568	(-486)	8490 <sup>a</sup>	(-571)
	145 <sup>b</sup>	7336	3813	7247	(-89)	3709	(-104)	7012	(-324)	3432	(-381)

<sup>1</sup>Total basal area expressed in square feet.

<sup>2</sup>Total number of pine stems ≥10" dbh.

<sup>a</sup>Meets RCW foraging habitat requirements for projects with federal nexus (USFWS 1989).

<sup>b</sup>Based on 0.5-mile foraging circle and property both on and off of Francis Marion National Forest.

<sup>c</sup>Based on 0.75-mile foraging circle and property entirely within Francis Marion National Forest.

Table 3. (cont'd)

ALTERNATE RAIL SEGMENT	RCW CLUSTER AFFECTED	PRE-PROJECT		POST-PROJECT							
		BA <sup>1</sup>	STEMS <sup>2</sup>	100 FEET				500 FEET			
				BA (LOSS)	STEMS (LOSS)	BA (LOSS)	STEMS (LOSS)				
5J	13 <sup>b</sup>	9621 <sup>a</sup>	6175	9459 <sup>a</sup>	(-162)	6061	(-114)	8725 <sup>a</sup>	(-896)	5559	(-616)
	13 <sup>c</sup>	1244	876	1082	(-162)	763	(-113)	555	(-689)	391	(-485)
	145 <sup>b</sup>	7336	3813	7336	(0)	3813	(0)	7289	(-47)	3802	(-11)
	145 <sup>c</sup>	6220	1472	6191	(-29)	1457	(-15)	6072	(-148)	1410	(-62)
5J	122	5448	2507	5422	(-26)	2496	(-11)	4957	(-491)	2289	(-218)
5K	122	5448	2507	5448	(0)	2507	(0)	5425	(-23)	2497	(-10)
6A	none										
6B	1	6696	7750 <sup>a</sup>	6661	(-35)	7711 <sup>a</sup>	(-39)	6422	(-274)	7447 <sup>a</sup>	(-303)
	2	7739	8689 <sup>a</sup>	7723	(-16)	8672 <sup>a</sup>	(-17)	7645	(-94)	8586 <sup>a</sup>	(-103)
6C-1	2	7739	8689 <sup>a</sup>	7548	(-191)	8485 <sup>a</sup>	(-231)	6789	(-950)	7668 <sup>a</sup>	(-1021)
	7	5478	5856	5358	(-120)	5721	(-135)	4806	(-672)	5108	(-748)
	8	10808 <sup>a</sup>	12633 <sup>a</sup>	10558 <sup>a</sup>	(-250)	12330 <sup>a</sup>	(-303)	9391 <sup>a</sup>	(-1417)	10941 <sup>a</sup>	(-1692)
6C-2	13 <sup>b</sup>	9621 <sup>a</sup>	6175	9213 <sup>a</sup>	(-408)	5918	(-257)	7734	(-1887)	4976	(-1199)
	13 <sup>c</sup>	1244	876	1143	(-101)	805	(-71)	852	(-392)	601	(-275)
8	6	4731	5344	4555	(-176)	5146	(-198)	3890	(-841)	4397	(-947)
	9	11582 <sup>a</sup>	14142 <sup>a</sup>	11275 <sup>a</sup>	(-307)	13784 <sup>a</sup>	(-358)	10118 <sup>a</sup>	(-1464)	12429 <sup>a</sup>	(-1713)

<sup>1</sup>Total basal area expressed in square feet.

<sup>2</sup>Total number of pine stems ≥10" dbh.

<sup>a</sup>Meets RCW foraging habitat requirements for projects with federal nexus (USFWS 1989).

<sup>b</sup>Based on 0.5-mile foraging circle and property both on and off of Francis Marion National Forest.

<sup>c</sup>Based on 0.75-mile foraging circle and property entirely within Francis Marion National Forest.

#### IV. DISCUSSION

As currently aligned, alternative rail segments would directly impact the cavity trees and/or the foraging habitat of 16 active clusters (Table 3)(Figure 2). Of these clusters, only clusters 8 and 9 on Cainhoy Plantation, cluster 13, which is shared by Francis Marion National Forest and Amoco Chemical Corporation, and clusters 182 and 143 on the Francis Marion currently (pre-project) contain sufficient basal area to meet the requirements for adequate RCW foraging habitat for lands with a federal nexus (i.e., federal funding, federal permits, etc.). The requirements for such lands consists of a minimum of 8,490 ft<sup>2</sup> of pine BA and 6,350 pine stems  $\geq 10''$  dbh in stands of pine or pine-hardwood (>50% pine) within 0.5 miles of the geometric center of the cluster, contiguous with the cluster, and  $\geq 30$  years of age (USFWS 1989). Taking into account the more restrictive foraging habitat guidelines for RCW clusters with geometric centers on Forest Service property, cluster 13 lacks sufficient foraging basal area solely within the boundaries of the Francis Marion and within 0.75 miles of the cluster's geometric center. Of those clusters with sufficient basal area, only clusters 8 and 9 also have a sufficient stem count, pre-project. All other clusters which would be impacted are already deficient in adequate RCW foraging habitat. Any additional removal of foraging habitat within these clusters would likely adversely affect the species, according to federal guidelines.

Of the RCW clusters which have sufficient pre-project, 0.5-mile foraging basal area (clusters 8, 9, 13, and 182), clusters 13, 182, and 143 are deficient in pine stems  $\geq 10''$  dbh. Although federal guidelines permit the removal of pine stems  $< 10''$  dbh if basal area is adequate, the construction of a railroad right-of-way would require the removal of all pine stems. It

therefore seems likely that construction of alternative rail segments 6C-2 or 3E would likewise adversely affect the species through the loss of additional pine stems  $\geq 10$ " dbh.

Only clusters 8 and 9 appear to have sufficient RCW foraging habitat to withstand the impacts of proposed alternative rail segments (6C-1 and 8, respectively). However, construction of these segments would also impact clusters 2 and 7 (segment 6C-1) and cluster 6 (segment 8), all of which have insufficient pre-project RCW foraging habitat. It therefore appears that construction of the alternative rail segments that would impact RCW clusters cannot be carried out as currently designed without potentially adversely affecting the RCW.

Negative impacts to RCWs may possibly be reduced by utilizing a combination of alternative rail segments 3C-1, 8, and 6C-2. Impact could be further reduced by turning 6C-2 toward the east just north of the junction of segments 8 and 6C, passing between the foraging circles of clusters 12 and 13, and joining with segment 5J just before 5J intersects the foraging circle of cluster 113A. A further adjustment to segment 8 could allow that segment to avoid directly impacting cavity trees in cluster 6, and subsequently pass between the foraging circles of clusters 8 and 9 without affecting foraging habitat of either of those two groups. It may be possible that by utilizing such a route, mitigation requirements for RCWs could be held to 1 group (group 6).

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