Supplemental Environmental Assessment for the Transfer of Grant Encumbrance between the Pero Property (f/k/a McMurrian Property) and Harmony Ranch Property

Palm Beach and Martin Counties, Florida

For Further Information, Contact:
Project Leader: Ray Palmer
South Florida Water Management District
3301 Gun Club Road West Palm Beach 33406

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CHAPTER 1. Purpose and Need

1.1 Background

On February 28, 2018, the U.S. Fish and Wildlife Service (USFWS) completed Step 3 of the Everglades Grant Land Disposition Protocol outlined in a letter provided to the South Florida Water Management District (District) on March 11, 2016 by the U.S. Department of Interior (DOI). The review focused on the removal of specific grant funded restrictions on a property owned by the District known as the Pero Property (i.e., the McMurrian Property) in exchange for the placement of specific grant funded restrictions on a second property owned by the District known as the Harmony Ranch Property.

The Pero Property is a 570.77-acre property that is located within the former East Coast Buffer project area within Palm Beach County. The property was acquired using federal grant funding and later slated for surplus or exchange during the project review process as it was determined that the project was not part of the restoration strategy. Two impoundments have been constructed along the refuge: The Site 1 Impoundment area located 8 miles south of the Pero property and the Acme Basin located 12 miles north of the Pero.

Palm Beach County has agreed to purchase the District's property interest in the Pero property to conserve the property as part of the Palm Beach Agricultural Reserve, which is a component of the County's Agricultural Reserve Master Plan as well as the County's Comprehensive Plan. The surrounding properties to the east, north and south are developed for agriculture. The water conservation area is located to the west.

The Harmony Ranch Property lies within the Comprehensive Everglades Restoration Plan (CERP) Indian River Lagoon-South project area within the C-44 Basin project component. This property consists of an estimated 1,533 acres and is a key addition within the Palmar Natural Storage / Water Quality Area which is planned for hydrologic restoration and nutrient reduction within the basin.

Benefits of this exchange include:

- USFWS and the SFWMD are both removed from ownership of a highly intense agricultural property that provides no measurable ecological benefit, water quality or flood control. There are no documented plans that include these lands as part of a restoration strategy.

- USFWS gains conservation lands within Indian River Lagoon-South Project Area that will enhance hydrologic restoration and nutrient reduction within the basin and will provide ecological and wildlife benefits.

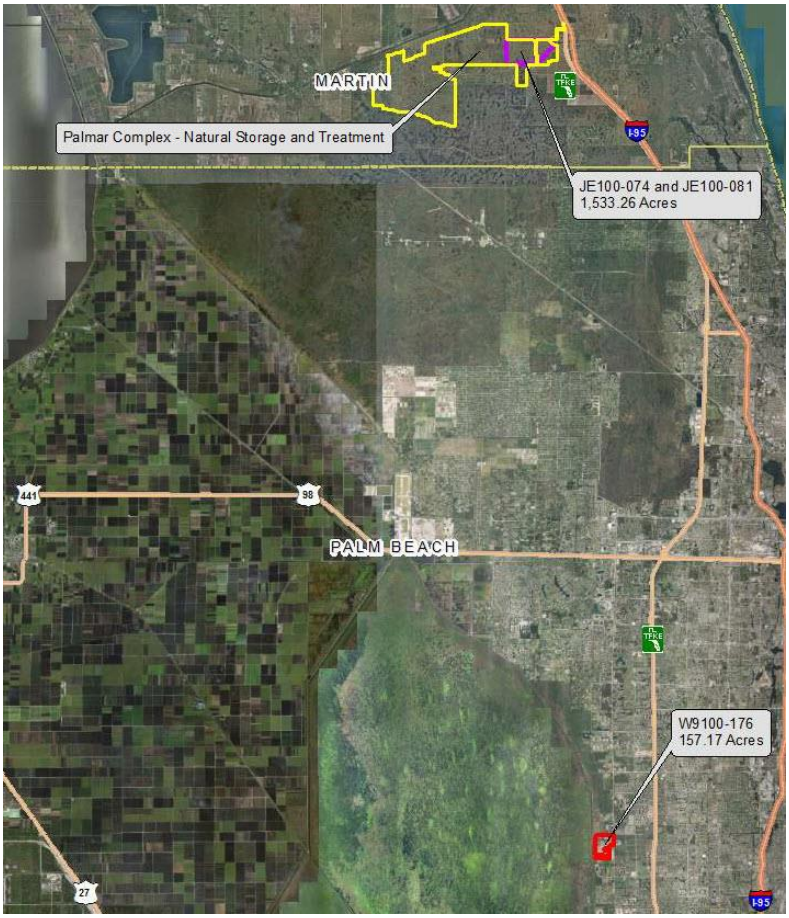
- Palm Beach County gains property interest in the Pero Property, which is part of the County's effort to conserve property within the area designated as the Palm Beach Agricultural Reserve and to limit residential encroachment on farm lands.

Appraisals revealed that the Pero Property is worth $15.4 million, and the Harmony Ranch Property is worth $15.33 million, resulting in a $70,000 difference in value between the two properties. The difference in value is less than ½ of 1 percent, indicating that the properties have equal value and the monetary difference is de-minimis.

Table 1. Locations and values of tracts identified for restriction release as part of exchange.

Property Name:	Pero Property	Harmony Ranch Property
Tract ID:	W9100-176	JE100-081, JE 100-074
County:	Palm Beach	Martin
Acreage:	570.77	1,533.26
Acquisition date:	8/29/2002	6/1/20152
Appraised value:	$15,400,000	$15,330,000
Federal share:	$7,700,000	---

Land Exchange overview map, showing the Indian River Lagoon-South Area, Harmony Ranch Property, and the Pero Property.



1.2 East Coast Buffer

The East Coast Buffer project area was part of the earliest Everglades restoration planning, which recognized the need for acquiring undeveloped lands east of the protective levees to better manage water in the Everglades without affecting the communities to the east (SFWMD 2013). The area was planned as a string of impoundments and restored wetlands that would act as a buffer between the Everglades and urban areas and would be managed to benefit both.

Land and Water Conservation Funds (LWCF-1) provided federal funds to the SFWMD to match state funds for the acquisition of land within the East Coast Buffer region in Palm Beach, Broward and Martin County. This “buffer” is located immediately east of the present Everglades ecosystem (Water Conservation Areas 1, 2 and 3 as well as Everglades National Park) and includes areas that were contemplated to become part of future authorized U.S. Army Corps of Engineers Everglades restoration projects. The East Coast Buffer is subdivided into multiple units, one of which would be influenced by

the land exchange as proposed. The Pero Property lies within the former “Palm Beach Ag Reserve” while the Harmony Ranch property is located within the Indian River Lagoon-South Restoration area (figure1).

1.3 Indian River Lagoon-South

The Indian River Lagoon-South project is part of the Everglades restoration planning component designed to reverse the negative effects of the discharge of large volumes of water between Lake Okeechobee and the Indian River Lagoon. The discharge of water in this manner has introduced more freshwater and suspended sediment into the natural areas, thereby disrupting the natural balance necessary to maintain the biodiverse estuary system of the lagoon.

The purpose of the project is to restore a more natural volume and location of freshwater deliveries, to store more water on land, to reduce excessive nutrient loads contributing to muck formation, plankton blooms and fish kills, to restore natural water storage functions to terrestrial wetlands in the watershed, and to restore water quality and more natural estuarine bottom communities. The Harmony Ranch Property lies within the Indian River Lagoon-South Project Area.

1.4 Department of the Interior and Related Agencies Appropriation Act of 1999, Public Law 105-277 (Land and Water Conservation Funds Grant Agreement -1) (LWCF-1)

LWCF-1 recognized that the properties acquired might not be used for an Everglades restoration project. In such circumstances, Farm Bill-1 allowed that the SFWMD may:

1. Retain and use the property for other Everglades restoration purposes
2. Acquire replacement property for Everglades restoration. Such replacement property shall be of at least equal fair market value.

Through this proposed exchange, SFWMD is reviewing option two. The SFWMD would therefore provide replacement property to DOI for fair market value of their share of the Pero property. The SFWMD proposes that the DOI share of the value would be applied to the Harmony Ranch Exchange lands.

1.5 Scope of Analysis

This supplemental environmental assessment evaluates the removal of federal grant funding from the Pero Property purchased pursuant to federal grant agreement LWCF-1 (Table 1). SFWMD proposed to compensate DOI for the removal of this restriction by applying the proceeds to Harmony Ranch Property to equalize the transaction. The effects of changed ownership at both the Pero Property and Harmony Ranch Property are evaluated in this limited Environmental Assessment.

CHAPTER 2. Alternatives

2.1 Revised Alternative A: No Action - Current Land Ownership

Under Alternative A, no land exchange would occur, and the current land ownership and management would continue with Pero Property co-owned by SFWMD / Palm Beach County and Harmony Ranch Property owned by the SFWMD. Restrictions on the Pero Property would remain; however, the value remaining in the property would now benefit Palm Beach County's Agricultural Comprehensive Plan needs and not those of Everglades restoration projects such as the Indian River Lagoon-South project.

2.2 Alternative B: New Proposed Action - Removal of Federal Interest in Pero Property for Harmony Ranch Property

The new proposed action would equalize the values of both properties. SFWMD would convey all real property interest in the 570.77-acre Pero Property parcel to Palm Beach County and remove the encumbrance and federal nexus from the Pero Property, which was partially acquired with LWCF-1 funds. In exchange, the SFWMD would transfer the Federal interest encumbrance to the Harmony Ranch Property.

2.3 Alternative C: New Proposed Action - Removal of Federal Interest in Pero Property for newly identified property

The new proposed action would require, if available, the acquisition of properties within an acceptable area having an appraised value of at least $15.4 million. Once acquired, SFWMD would convey all real property interest in the 570.77-acre Pero Property parcel to Palm Beach County and remove the encumbrance and federal nexus from the Pero Property, acquired with Federal Agriculture Improvement and Reform Act of 1996 funds. In exchange**,** the SFWMD would transfer the Federal interest encumbrance to the newly acquired property. This alternative is problematic, however, due to property availability, budgetary and time constraints.

CHAPTER 3. Affected Environment

The following sections provide a review for the Pero farm site and the Harmony Ranch properties

3.1 Pero Farms

Location

The Pero Farm Tract # W9100-176 is located between US Highway 441 and the Loxahatchee Wildlife Refuge in Palm Beach County, Florida, within Section 12, Township 46 South, Range 41 East. The property is located within the boundaries of the Palm Beach County Agricultural Reserve (figure 2).

Property Use

The property is currently operated under a 10-year lease for vegetable crop cultivation, primarily winter vegetables and bell peppers (figure 3). The farm utilizes a highly automated irrigation and fertilizer system for the vegetable cultivation. Agricultural chemicals are commonly applied by boom and sprayed at the plant base or through agrochemical drip type irrigation system. Agrochemical applications include fungicides, insecticides and herbicides (URS, 2009). The property has historically been used as agricultural farmland since the early 1940's. This includes vegetable farming (eggplant, cucumbers, peppers, string beans, and corn) as well as packing, equipment staging, and construction of drainage/irrigation canal.

Topography

The site is estimated to be 15 feet above mean sea level "University Park Quadrangle US Geologic Survey" on the eastern boundary of the property (figure 4). Elevation data are referenced to the (National Geodetic Vertical Datum of 1929 (NGVD)). The property slopes to the west with a change in elevation of an estimated 1-2 feet. The western portion of the property is located within a Special Flood Hazard Area (SFHAs) zone, indicating that the site has a higher potential for flooding. While the site slopes to the west the actual planting fields are relatively level due to site grading and improvements from the row cropping operations. There are an estimated 12 depression areas located outside of the crop area (figure 5). The SFWMD conducted an ecological assessment of the property in June 2014 (appendix 1). Based on the ecological site assessment it was determined that depressional wetland areas were disturbed but some areas retain remnants of historic native communities such as cypress and hardwood swamps. The current configuration of wetlands reflects the historic soils and hydrology in this vicinity which was the transition from the eastern flatwoods to the Everglades (SFWMD, 2014).

Hydrology

The site consists of internal canals and field ditches with riser culverts and flashboards to control shallow ground water. Five farm surface water pumps are located on the western perimeter of the property and at one of the northeast corner of the site which are used to artificially control water elevation and the shallow water table (URS, 2009). Surface water from the farm ditches is directed to a larger header canal which directs water to the Lake Worth Drainage District pump station on the north side of the property. During the growing season, the water table is typical maintained at an elevation of 1-2 feet below grade. The elevation of the water table will vary seasonally, with winter typically being the dry period of the year in this region. A portion of the property would experience saturation and inundation during a typical rainy season if the site is not adequately maintained with pumps (figure 6).

Contaminants

Based on the results of the pre-acquisition Phase I/II ecological site assessment, residual pesticides were identified within the former cultivated fields. The assessment identifies the presence of DDE, Toxaphene and copper in the surficial soils. It was determined that the concentrations of the Chemical of Concerns (COCs) were sufficient to be toxic to

some species of invertebrates and that corrective action would be required prior to converting this site from agricultural to a wetland or reservoir (appendix 1).

Soil Survey

Based on the United States Department of Agricultural Soil Conservation Service soil survey map for Palm Beach County, soils include Oldsmar sands, Okeelanta muck, Myakka sand and Bassinger/Myakka sands (ECT , 2000) (figure 7).

3.2 Harmony Ranch Property

Location

The Harmony Ranch parcel is located within the CERP Indian River Lagoon-South project, Indian River Lagoon – Palmar Complex Natural Storage and Water Quality area. The subject property is in the southern portions of Sections 31, 32 and 33, Township 39 South, Range 41 East (figure 8).

Property Use

The property consists primarily of improved pasture, with the remaining acreage being wooded depressional wetlands. The site is currently leased for cattle grazing with a low-density stocking rate of one animal unit per 8 acres. Based on historic aerial photographs during the 1950s up until the 1970s, approximately 720 acres of the site was used for agricultural purposes, specifically row crops. The subject property has reportedly been utilized primarily for livestock grazing since at least 1995. The application of agrochemicals and fertilizer are restricted to only those agrochemicals necessary to maintain site conditions by controlling invasive vegetation and sustaining current pasture lands (figure 9).

Topography

The United States Geological Survey (USGS) map titled 7.5 Minute Topographic Quadrangle Indiantown SE, dated 1953 and photo revised 1983, depicts the subject property as nearly level with several small depressional areas. The average elevation on the site is approximately 22 feet above mean sea level (figure 10). Elevation data are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Based on the site reconnaissance and a review of the topographic map, the subject property is flat containing surface depression areas. Networks of drainage ditches ranging from 2-4 feet below land surface are present throughout the subject property (SFWMD, 2017).

Hydrology

Martin County is in the coastal lowlands unit of the Atlantic Coastal Plain physiographic province on the southeastern coast of peninsular Florida. Martin County extends from the Atlantic Ocean on the east side to Lake Okeechobee on the west. The County is divided into three physiographic subdivisions, which include the coastal ridge, the broad sandy flatlands and a narrow extension of the Everglades marsh along the shore of Lake Okeechobee. The Harmony Ranch Property is located within the broad sandy flatland area or flatwoods (figure 11).

The shallow sandy soils of the flatwoods are underlain by calcareous to clayey quartz sand, fossiliferous to sandy limestone, shell beds and coquina limestone of the Anastasia and Caloosahatchee Formations. The combined thickness of these formations is approximately 150 feet and represents the surficial aquifer in this area. The Hawthorn Group of Miocene age consisting of sandy to calcareous and phosphatic clays, clayey sands and sandy to phosphatic carbonates underlies these formations. Locally, the approximate thickness of the Hawthorn Group is 700 feet. The Hawthorn Group represents a major confining unit between the overlying surficial aquifer and the underlying Floridan aquifer system. The top of the Floridan aquifer is composed of cavernous, hydraulically connected carbonates consisting of the Suwannee Limestone, the Ocala Limestone, and the Avon Park Formation. Beneath much of Southern Florida, the Floridan aquifer contains water under artesian pressure; however, the water generally is corrosive and high in dissolved mineral content (Florida Geological Survey RI #20, 1959).

Regional groundwater flow is typically a subdued reflection of the topography and is locally influenced by soil permeability and nearby water bodies such as ponds, drainage ditches and canals. The network of drainage canals influences the general direction of groundwater flow in the subject property.

Contaminants

As part of the Phase II ESA investigation soil, sediment, and groundwater sampling events were performed to evaluate the presence or absence of contamination from hazardous substances and waste due to historical or current agricultural land use. The ESA identified an estimated 90-acre area in the northwest portion of the project area that potentially poses an environmental risk if the site was inundated as part of the natural hydrologic flow appendix. Included within the 90 acres are an estimated 46 acres of soils impacted with DDE above the Sediment Quality Assessment Guidelines (SQAG) probable effect concentrations (PEC). Prior to implementing restoration design, the SFWMD will need to develop a corrective action plan and receive concurrence from the USFWS and FDEP. The identified contaminants do not pose an unacceptable risk while the property remains in use as a cattle pasture (URS, 2008).

Soil Survey

The United States Department of Agriculture (USDA), Soil Conservation Service Soil Survey of Martin County Area, Florida indicates that the surficial soils at the subject property are the Pineda & Riviera fine sand, and the Wabasso sand (URS, 2008) (figure 12).

3.3 Biological Environment - Pero Property

Vegetation

The Pero property is categorized as improved agricultural lands with some pockets of Freshwater Forest / Shrub Wetlands according to the U.S. Fish and Wildlife Service National Wetland Inventory maps (figure 13). A review of aerial photographs of the property and the surrounding area dated 1940, 1984, 1897, 1995, 2004 and 2013, was conducted. It appears that in 1940 approximately the western 50 percent of the site was

natural wetlands that were part of the northeastern extent of the Everglades system and the remaining 50 percent (located in the eastern portion of the site) was agricultural fields. By 1984, most of the western portion of the site had also been converted to agricultural fields but with some natural areas preserved, essentially in the configuration that exists currently (SFWMD, 2014).

Based on the District site observation during, 2014 no naturally-occurring native upland plant communities exist on the property. The site consists primarily of intense agriculture operation and isolated depressional areas that are covered with Australian pine (Casuarina spp.) and Brazilian pepper (Schinus terebinthifolius) (SFWMD, 2014)

Wildlife

The Pero site is bound to the east by US highway 441 and the Loxahatchee Wildlife Refuge to the West. The majority of the site features highly managed vegetable row crops. A general inspection of the property was conducted to identify wildlife presence, particularly species listed as endangered, threatened or species of special concern by the Florida Fish and Wildlife Conservation Commission (FWC) or the USFWS.

Wildlife species observed included one Everglades snail kite (Rostrhamus sociabilis plumbeus) (listed as Endangered according to USFWS and FWC) that flew into Wetland K, limpkins (*Aramus guarauna*) (a species of special concern according to FWC) foraging in the ditches and fields, white ibis (Eudocimus albus) (a species of special concern according to FWC), glossy ibis (Plegadis falcinellus), boat tail grackles (Quiscalus major), common grackles (Quiscalus quiscula), great blue heron (Ardea herodias), killdeer (Charadrius vociferus), anhingas (Anhinga anhinga), mottled ducks (Anas fulvigula) in the ditches, flocks of Quaker parakeets (Myiopsitta monachus), and a raccoon (Procyon lotor) (SFWMD, 2014).

No nesting or denning sites of the native species were observed. According to the FWC, the nearest bald eagle nest is approximately 5 miles to the southwest of the property (SFWMD, 2014). Based on the highly managed agricultural site operation, the site provides minimal wildlife habitat opportunity.

3.4 Biological Environment – Harmony Ranch

Vegetation

The Harmony Ranch site is a relatively disturbed expanse of improved pasture that includes some remaining natural communities, including marsh, prairie, swamp, pine flatwoods, and hammock communities. Eight natural communities and one ruderal community have been identified on the property. Actual community condition across the site varies widely, depending on previous and current land use, hydrologic alteration, exotic infestation, and current management activities (SFWMD, 2017).

Wildlife

Auditory and visual wildlife inventory surveys conducted on the site documented 54 animal species within the Harmony Ranch. Wildlife species observed while utilizing the property include 21 species of birds, one mammal, one reptile, eight amphibians and two

fish. Additionally, 18 species of invertebrates have been documented within the Hobe Sound Ranch property. Six species of birds that are considered rare, endangered, threatened or of special concern have been noted. Future surveys for mammals, amphibians, reptiles, and fishes will be performed throughout the year since many animals may only utilize the property for short segments of the year. These surveys will be used to augment the current species list with new wildlife observations (SFWMD, 2017)

3.5 Socio-economic Environment

Demographics

The Pero property is located within the Palm Beach County Agricultural Reserve, which protects against the loss of agricultural lands for non-agricultural development. The Harmony Ranch is in western Martin county. This property is currently used for cattle pasture and is not proposed for future development.

Recreation Use

Pero Farm

The Pero site has been in State ownership with Federal restrictions as described previously since purchase. The site has been used for intense farming with site restriction and access due to the use of heavy equipment and agrichemical application. Based on the current use for farming, no developed or proposed public use facilities are located or planned for the site.

Harmony Ranch

The SFWMD has developed an interim land management plan for the site that envisioned a variety of compatible public use activities that may be allowed on the property including, but not limited to, the establishment of hiking, biking, and horseback riding trails, fishing, birding, environmental education, and nature appreciation (SFWMD, 2017). Trailhead parking and pedestrian public access will be evaluated and may be initially allowed via walk-thru gates located off Pratt Whitney Road (CR 711). Additional recreational opportunities will be re-evaluated and proposed after the restoration is completed or if additional properties are acquired (SFWMD, 2017)

3.6 Cultural and Historic Resources

The Pero Farm site was once part of the larger Everglades system dominated primarily by sawgrass prairies, sloughs, and scattered tree islands. Beginning in the late 19th century, construction of a network of canals, levees, and roads substantially altered the area's hydrology leading to a shortened hydroperiod and lowered ground water levels. The introduction of invasive exotic species, as well as the network of farm ditches and pumps to support the vegetable row crop operations has modified the natural ecological system. There are no structures on either the Pero Farm or Harmony Ranch properties.

Janus Research, on behalf of the SFWMD, conducted a cultural resources desktop analysis of both the Pero Farm property and the Harmony Ranch site. The purpose of this analysis was to identify any previously recorded resources within the two sites that may have been determined as eligible for the National Register of Historic Places and as well as any resources with documented or suspected human remains. The analysis also assessed the site for the potential of archaeological sites within the project areas. The desktop analysis reviewed the most current Florida Master Site File (FMSF) data as well as a review of the associated FMSF forms and survey reports to assess the accuracy of the locational data and any evaluation of National Register-eligibility. An analysis of available historic aerials, historic General Land Office (GLO) plat maps and associated surveyor's notes, United States Geological Survey (USGS) quadrangle maps, and pertinent environmental features was also conducted to help identify areas of high probability of the presence of cultural resources.

The FMSF data identified no previously recorded archaeological sites, historic resources, or previous surveys of the Pero Farm property. The desktop analysis identified no known human remains or areas with suspected human remains. The analysis of environmental features indicated that the majority of the property consists of freshwater fresh water marshes and low pine flatwoods with low archaeological site potential. An area of high archaeological site potential was identified in the northeastern portion of the study area where an "old Indian Camp" was identified on a nineteenth century General Land Office map. A 150- meter buffer around the area of high probability associated with the camp is considered to have a moderate archaeological potential. Area containing coco plum islands identified on the GLO maps were also considered to have a moderate potential.

The Harmony Ranch property was included within the boundaries of a previous survey: The Cultural Resource Assessment Survey: Harmony Ranch, Martin County, Florida which was conducted in 2004 by Archaeological Resources, Inc. An archaeological pedestrian survey and subsurface testing was conducted as well as a historic resources survey. No human remains, archaeological sites or historic resources were identified within the boundaries of the current Harmony Ranch project area and no further work was recommended. In a letter dated June 25, 2004, the Florida Division of Historical Resources and State Historic Preservation Office concurred with the findings of the cultural resource assessment survey.

CHAPTER 4. Environmental Consequences

This chapter describes the foreseeable environmental consequences of removing restrictions on the Pero land. These parcels have been included in the land exchange between the USFWS and the SFWMD to achieve equitable value in the exchange. When detailed information is available, a scientific and analytic comparison between alternatives and their anticipated consequences is presented, which is described as "impacts" or "effects." When detailed information is not available, those comparisons are based on the professional judgment and experience of District Staff and concurrence form the USFWS.

4.1 Physical Consequences

Pero Farm

The restrictions that currently exist on the Pero property in question require the properties to be used for Everglades restoration. Based on a more updated evaluation, the SFWMD has determined that the parcel is no longer needed for that purpose. The parcel is located with the Palm Beach County Agricultural reserve. The Agricultural Reserve has a long history of supporting the cultivation of winter vegetable crops and is considered highly valuable farm land (PBC, 2000)

Any future changes to the use of the properties by the SFWMD or any other owner would require separate assessments and reviews as required by law and based on the specific details of the proposed changes. The USFWS, the public and other entities would provide comment on any specific plans for the parcels at that time (*no impacts anticipated*).

Harmony Ranch

The Interim use of the Harmony Ranch site will continue to be used as a cattle pasture. The long-term objective of this property is to restore the site to a more natural hydrological pattern to facilitate storage of fresh water, to enhance natural ecological systems and to reduce excessive nutrient loads to downstream water bodies (*no impacts anticipated*).

4.2 Impacts to Physical Environment

Pero Farm

The proposed grant funding transfer from the Pero Farm tracts does not inherently cause a change in the physical environment of this property. Thus, Alternative B would have no impacts on the physical environment, including hydrology, water quality, and air quality.

Harmony Ranch

The proposed grant funding transfer to the Harmony Ranch site would allow for the restoration of and re-hydration of the site, improving natural hydrologic patterns, water quality and ecological systems within the Indian River lagoon-south project area.

4.3 Impacts to Refuge Facilities

Pero Farm / Harmony Ranch

The Loxahatchee Wildlife Refuge is located west of the Pero Farm. The property is hydrologically isolated by a canal and levee. Based on the canal and physical barrier (i.e., the levee) the Pero farm site does not impact the Refuge or federal facilities. The Harmony Ranch site is not located near a Wildlife Refuge or other federal facility. Therefore, the proposed grant funding transfer does not impact either Wildlife Refuge or any other federal facilities (*no impacts anticipated*).

4.4 Biological Consequences

Pero farm

There are no immediate or anticipated biological consequences to the Pero Farm tracts associated with the proposed federal grant funding transfer. The site is currently an intensely managed vegetable farm with minimal natural areas onsite. The subject tract is located within the Palm Beach County Agricultural Reserve; therefore, the property will continue to be zoned for agricultural use. The adjacent properties north, south and east of the subject tract are developed for vegetable row crop cultivation. The Loxahatchee Wildlife Refuge is located to the west of the subject site.

Harmony Ranch

The Harmony Ranch site is proposed for additional restoration activities. Therefore, the proposed grant funding would provide positive biological benefits to the Harmony Ranch site.

4.5 Impacts to Vegetation and Habitat

Pero farm

The proposed federal grant funding transfer on the Pero Property does not cause a change to vegetation within this property or necessitate a change in use of the land. Based on the local county ordinance, the site is within the Palm Beach County Agricultural Reserve and it is anticipated the property will stay in vegetable crop cultivation. Thus, Alternative B would have minimal impacts on localized vegetation, soil, water, or wildlife habitat.

The SFWMD assessments of the Pero Farm have documented that most of the site is developed for high intensity row crop cultivation. The site has an estimated 12 depressional wetland areas on site. However, these sites have minimal native plant communities (SFWMD, 2014). The proposed transfer is not anticipated to have any changes to vegetation or habitat on site

Harmony

The proposed federal grant funding transfer for the Harmony Ranch tract will result in a better wildlife habitat for USFWS trust species based upon the lower intensity (low density beef cattle pasture) of the interim agricultural use. Additionally, the SFWMD has developed an Interim Land Management Plan for the site that will improve ecological benefits (SFWMD, 2017). Therefore, it is anticipated that the proposed grant fund transfer will improve native vegetation coverage and habitat.

4.6 Impacts to Wildlife

Pero Farm

The proposed Federal grant funding transfer with the Pero Farm tracts does not change the potential for wildlife to occur onsite. The property is currently an intensive row crop farm and will continue to be operated as such within the Palm Beach County Agricultural Reserve. The wildlife habitat on this site is not anticipated to experience any wildlife impacts.

Harmony Ranch

The Harmony Ranch site offers a more productive ecological system. The proposed re-hydration to improve the natural hydrologic patterns will improve ecological system as this restoration work is implemented. The proposed Federal grant funding transfer would provide wildlife benefits.

4.7 Impacts to Threatened and Endangered Species

Pero Farm

The proposed Federal grant funding transfer with the Pero Farm tracts does not negatively impact threatened and Endanger Species. The property is currently an intensive row crop farm and will continue to be operated as such within the Palm Beach County Agricultural Reserve. The wildlife habitat on this site is minimal and no changes are planned. Removing restrictions does not inherently induce a change to wildlife or wildlife habitat in general or to threatened and endangered species on the tracts proposed for inclusion in the exchange.

Harmony Ranch

The Harmony Ranch site offers a more productive ecological system. The proposed re-hydration to improve the natural hydrologic patterns will continue to improve the ecological system and habitat for USFWS trustee species.

4.8 Socioeconomic Consequences

Pero farm /Harmony Ranch

The proposed federal grant transfer would not have an adverse effect on either of the properties. The Pero farm site will remain in its current use as part of the Palm Beach County Agricultural Reserve. The Harmony Ranch will in remain the interim as a low-density cattle lease as the property is restored to a natural area to improve water quality, flow, ecological habitat and public access. The proposed grant funding transfer (Alternative B) will not cause negative socioeconomic consequences.

4.9 Impacts on Environmental Justice

Pero Farm / Harmony Ranch

President Bill Clinton signed Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” on February 11, 1994, to focus Federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment and to provide minority and low-income communities with access to public information and participation in matters relating to human health or the environment.

This assessment has not identified any adverse or beneficial effects as part of the proposed Federal grant funding transfer. Therefore, no impacts are anticipated with the grant funding transfer to minority or low-income populations in the affected area. The proposed grant funding transfer (Alternative B) will not disproportionately place any adverse environmental economic, social, or health impacts on minority or low-income populations.

4.10 Impacts on Public Health and Safety

Pero Farm / Harmony Ranch

The proposed Federal grant funding transfer on the Pero funding to the Harmony Ranch site will not negatively change any activity or infrastructure that serves public health and safety. Therefore, Alternative B is not anticipated to have any impact on human health and safety.

4.11 Impacts on Recreation

Pero Farm

No recreational opportunities are currently available on the Pero property because of the high intensity agricultural operation. The proposed Federal grant funding transfer will not negatively affect recreation opportunity on this site.

Harmony Ranch

According to the Interim Land Management Plan public use for the Harmony Ranch site may include hiking, biking, and horseback riding trails, fishing, birding, environmental education, and nature appreciation (SFWMD, 2017). The proposed Federal grant funding transfer will provide additional recreational opportunity for the public on the Harmony Ranch site.

4.12 Cultural Resource Consequences

The Pero site, which is included in Alternatives B, has no known archaeological or historic resources and removing restrictions from these parcels does not inherently cause disturbance or disruption of the physical conditions of the properties. Considering that all three parties USFWS, SFWMD and Palm Beach County are public agencies and are required to protect cultural resources; thus, if any cultural resources were discovered on either property, they would continue to be protected in the public's trust. The State of Florida historic preservation responsibilities are delineated in Chapter 267.061 of the Florida Statutes and the Division of Historical Resources' 2014 Management Procedures and Guidelines for Archaeological and Historical Sites and Properties on State-owned or Controlled Lands. In addition, Chapter 872 of the Florida Statutes provides supplementary assurances that sites would be protected.

4.13 Cumulative Impacts Analysis

The analysis reviewed the cumulative impacts to the environment resulting from incremental effects of a proposed action when these are added to other past, present, and reasonably foreseeable future actions.

The USFWS is currently l assessing the cumulative impacts through a Section 7 Intra-service Biological Evaluation related to this proposal. That decision will be included upon receipt as an addendum to the Final Environmental Assessment for this proposed action. While cumulative effects may result from individually minor actions, they may become substantial over time. Based on the current land use a conversion between high intense row crop cultivation (Pero Farm) to a low-density beef cattle operation (Harmony Ranch), it is anticipated that the USFWS Section 7 Biological Evaluation will report a no impacts, positive or negative, to listed or proposed resources.

As stated in Chapter 2, the new proposed grant funding transfer (Alternative B) would transfer funding from the Pero Farm property to the Harmony

Ranch site. No future land change is anticipated with the Pero farm site as it is currently located within the Palm Beach County Agricultural reserve and will remain in County Ownership. The Harmony Ranch site is proposed for future restoration to improve degraded natural land and is within a designated restoration area.

In the proposed land exchange (Alternative B), the proposed federal grant funding may be transferred to more suitable properties (Harmony Ranch). It is the District staff’s opinion that the proposed fund transfer would provide an equitable value and would enhance the physical, biological, socioeconomic, and cultural and historic characteristics of the current environment after the proposed transfer to the State. As such, there are no expected cumulative impacts of this action.

CHAPTER 5. Consultation and Coordination with Others

The SFWMD and DOI have worked together over the past year to identify and assess properties that could be included in the proposed Federal Land grant transfer that would result in an equitable exchange and would provide benefits to the mission and goals of both entities. The transfer of the land grant funding from the Pero Farm site to the Harmony Ranch site would include other federal, state, and tribal agencies as well as the affected, and interested public will have an opportunity to review and comment on this proposal. Notification of the opportunity to comment and where to get copies of the Environmental Assessment will be announced to provide the public a chance to review and comment.

References

ECT. (2000). Environmental Site Assessment and Ecological Risk Assessment. Fort Lauderdale: ECT.

PBC. (2000). Palm Beach County Agricultural Reserve Master Plan. PBC.

SFWMD. (2014). Ecological Assessment of Surplus Tract No W9100-176. West Palm Beach: SFWMD.

SFWMD. (2017). Hobe Sound Ranch Interim Land Management. West Palm Beach.

URS. (2008). Phase I/II Environmental Site Assessment Report and Screening Level Ecological Risk Assessment. Boca Raton.

URS. (2009). Pero Farm BMP inspection. Boca Raton: URS.

Figure 1

Harmony Ranch

Pero Farms

Martin County

Palm Beach County

WCA 1

WELLINGTON

NORTH PALM BEACH

HYPOLUXO

Atlantic Ocean

Gulf of Mexico

Map Location

STA-1W

STA-1E

ENR DISTRIBUTION CANAL

ENR SUPPLY CANAL

ENR DISCHARGE COLLECTION CANAL 2 CANAL

L-7

L-8

L-12

L-13

L-40

C-18

C-17

C-51

C-16

C-15

FL TPKE

710

95

1

80

98

441

N

S

E

W

0 1.25 2.5 5 Miles

0 2 4 8 Kilometers

80°20'0"W

80°10'0"W

80°0'0"W

27°0'0"N

26°50'0"N

26°40'0"N

26°30'0"N

Legend

- Pero Farms
- Harmony Ranch
- Fee Interest
- External Partner - Fee
- Easement Interest

BASE CREDITS:
Base map from South Florida Water Mgmt. District,
State plane projection, Florida east zone, NAD 83-HARN, US feet.
2011 Palm Beach County Half-Foot Natural Color Aerial Photography

South Florida Water Management District
3301 Gun Club Rd, West Palm Beach, FL 33406
561-686-8800 - FL WATS 1-800-432-2045
P.O. Box 24680 - West Palm Beach, FL 33416-4680

sfwmd.gov

Pero Farms, and Harmony Ranch
Aerial Mapping
Palm Beach and Martin County, Florida

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Map Date: March 2018

IT GEOSPATIAL SERVICES

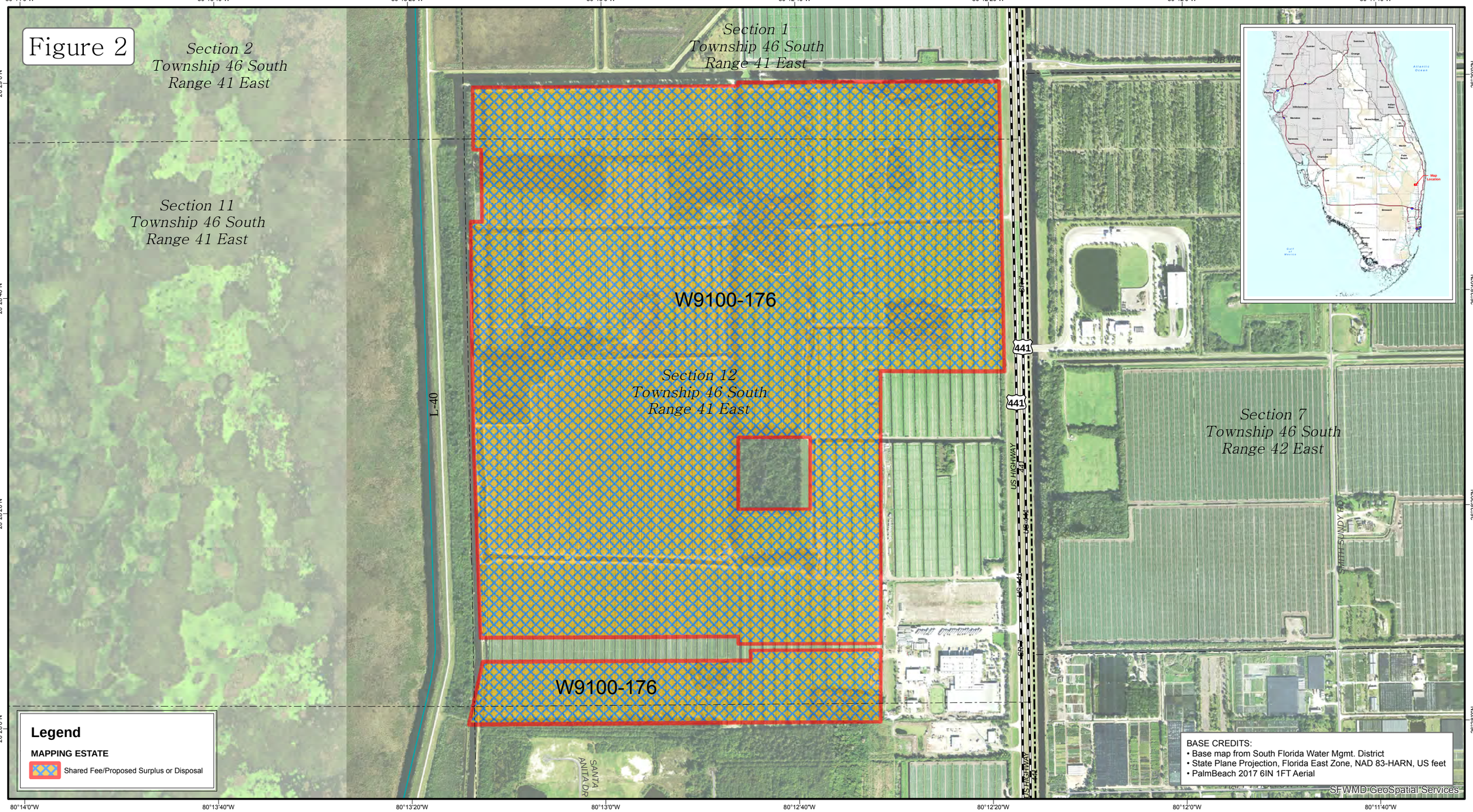
User Name: rschaff

Remedy: 69466

Map Produced on Date: 3/16/2018 8:08:13 AM

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Harmony\am\overall.mxd

Figure 2



South Florida Water Management District
3301 Gun Club Rd, West Palm Beach, FL 33406
(561) 686-8800; www.sfwmd.gov

0 1,000 2,000 Feet
0 250 500 Meters

Pero Farms
Aerial Mapping
Palm Beach County, Florida

N W E S

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Map Date: March 2018

GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/15/2018

\\ad.sfwmd.gov\dfsroot\data\arc_data\maps\Leasing\am\Pero Farm.mxd

Figure 3

Section 2
Township 46 South
Range 41 East

Section 1
Township 46 South
Range 41 East

Section 11
Township 46 South
Range 41 East

W9100-176

Section 12
Township 46 South
Range 41 East

Section 7
Township 46 South
Range 42 East

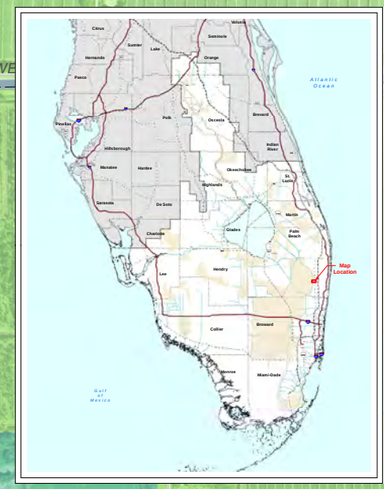
L-40

US HIGHWAY 441

SMITH SUNDY RD

SANTA ANITA DR

W9100-176



Legend

- W9100-176
- Low-Density Res.
- Medium-Density Res.
- High-Density Res.
- Commercial
- Industrial
- Institutional
- Extractive
- Recreational
- Open Urban
- Agriculture
- Rangeland
- Upland Forests
- Water
- Wetlands
- Barren Land
- Trans., Commun., Util.

Notes:

This data set serves as documentation of land cover and land use (LCLU) within the South Florida Water Management District as it existed in 2014-15. Land Cover Land Use data was updated from 2008-09 LCLU by photo-interpretation from 2014-15 aerial photography and classified using the SFWMD modified FLUCCS classification system. Features were interpreted from the county-based aerial photography (4 in - 2 ft pixel) and updated on screen from the 2008-09 vector data. Horizontal accuracy of the data corresponds to the positional accuracy of the county aerial photography. The minimum mapping unit for classification was 0.5 acres for wetlands and 5 acres for uplands. This portion included the Priority Areas of the Upper and Lower Kissimmee Basins and was completed on 08/31/2016 (version 1.0).

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- PalmBeach 2017 6IN 1FT Aerial

SFWMD GeoSpatial Services

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0 1,000 2,000 Feet
0 250 500 Meters

Pero Farms
Land Use
Aerial Mapping
Palm Beach County, Florida

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Map Date: March 2018

IT GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/16/2018

\\ad.sfwmd.gov\dfsroot\data\arc_data\maps\Leasing\am\Pero Farms Land Use.mxd

Figure 4

Section 2
Township 46 South
Range 41 East

Section 11
Township 46 South
Range 41 East

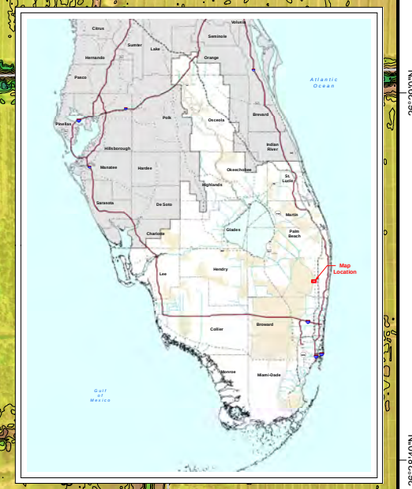
Section 1
Township 46 South
Range 41 East

Section 12
Township 46 South
Range 41 East

Section 6
Township 46 South
Range 42 East

W9100-176

W9100-176



Legend

W9100-176

contours

SFWMD_SF_MRG_2016_5FT elevation

Value

High : 25.2382

Low : 8.92712

Metadata;
South Florida Merged Topography, high-resolution DEM, 5-ft cell size, April 2016. This is a raster dataset representing a 5-ft digital elevation model (DEM) of best-available data for southern Florida. It was created in March-April 2016 by resampling the best-resolution DEMs for available topo data to 5-ft cell size and merging them to produce a best-available composite. More than 40 separate sources were used, including LiDAR datasets, photogrammetry, miscellaneous survey data, Everglades GPS obtained by helicopter, and older contours and spot elevations. This dataset includes the best data currently available, including several LiDAR datasets created in 2015. The extent includes the SFWMD and a 25000-ft buffer around it, with nearshore areas filled in with an arbitrary value of -2.0 ft.
X-Y coordinates are in the standard State plane, Florida east zone projection used by the SFWMD.
Elevation values are in feet, relative to NAVD 1988.

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- PalmBeach 2017 6IN 1FT Aerial

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0 1,000 2,000 Feet

0 250 500 Meters

Pero Farms
LiDAR Data
Aerial Mapping
Palm Beach County, Florida

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Map Date: March 2018

IT GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/15/2018

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Figure 5

Section 2
Township 46 South
Range 41 East

Section 1
Township 46 South
Range 41 East

Section 11
Township 46 South
Range 41 East

W9100-176

Section 12
Township 46 South
Range 41 East

Section 7
Township 46 South
Range 42 East

L-40

US HIGHWAY 441

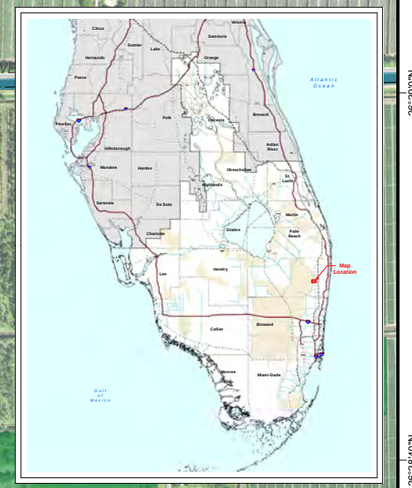
441

SANTA ANITA DR

SOUTH SHORE DR

80°14'0"W 80°13'40"W 80°13'20"W 80°13'0"W 80°12'40"W 80°12'20"W 80°12'0"W 80°11'40"W

26°29'0"N 26°28'40"N 26°28'20"N 26°28'0"N



Legend

W9100-176

FL Wetlands

WETLAND TYPE

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

The N.W.I. data shown hereon was downloaded from the U.S. Fish and Wildlife Services website at "https://www.fws.gov/wetlands/Data/Data-Download.html" on March 9, 2018, for the State of Florida.

Data Description Per Metadata

This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the United States and its Territories. These data delineate the areal extent of wetlands and surface waters as defined by Cowardin et al. (1979). The National Wetlands Inventory - Version 2, Surface Waters and Wetlands Inventory was derived by retaining the wetland and deepwater polygons that compose the NWI digital wetlands spatial data layer and reintroducing any linear wetland or surface water features that were orphaned from the original NWI hard copy maps by converting them to narrow polygonal features. Additionally, the data are supplemented with hydrography data, buffered to become polygonal features, as a secondary source for any single-line stream features not mapped by the NWI and to complete segmented connections. Wetland mapping conducted in WA, OR, CA, NV and ID after 2012 and most other projects mapped after 2015 were mapped to include all surface water features and are not derived data. The linear hydrography dataset used to derive Version 2 was the U.S. Geological Survey's National Hydrography Dataset (NHD). Specific information on the NHD version used to derive Version 2 and where Version 2 was mapped can be found in the 'comments' field of the Wetlands_Project_Metadata feature class. Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and near shore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery. By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition. Contact the Service's Regional Wetland Coordinator for additional information on what types of farmed wetlands are included on wetland maps. This dataset should be used in conjunction with the Wetlands_Project_Metadata layer, which contains project specific wetlands mapping procedures and information on dates, scales and emulsion of imagery used to map the wetlands within specific project boundaries.

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- PalmBeach 2017 6IN 1FT Aerial

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0 1,000 2,000 Feet
0 250 500 Meters

Pero Farms
National Wetlands Inventory
Aerial Mapping
Palm Beach County, Florida

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Map Date: March 2018

IT GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/28/2018

\\ad.sfwmd.gov\dfsroot\data\arc_data\maps\Leasing\am\Pero Farm (NWI).mxd

Hydrologic Soil Group

Aggregation Method: Dominant Condition
Tie-break Rule: Higher

Palm Beach County Area, Florida
Survey Area Version and Date: 13 - 10/06/2017

Map symbol	Map unit name	Rating	Map unit percent
2	Anclote fine sand	A/D	100
8	Basinger and Myakka sands, depressional	A/D	100
18	Immokalee fine sand, 0 to 2 percent slopes	B/D	90
21	Myakka fine sand, 0 to 2 percent slopes	A/D	98
24	Okeelanta muck, drained, frequently ponded, 0 to 1 percent slopes	A/D	100
25	Oldsmar sand, 0 to 2 percent slopes	A/D	94
99	Water		100

Hydrologic Soil Group

Rating Options

Attribute Name: Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value to represent the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. The components in the map unit name represent the major soils within a map unit delineation. Minor components make up the balance of the map unit. Great differences in soil properties can occur between map unit components and within short distances. Minor components may be very different from the major components. Such differences could significantly affect use and management of the map unit. Minor components may or may not be documented in the database. The results of aggregation do not reflect the presence or absence of limitations of the components which are not listed in the database. An on-site investigation is required to identify the location of individual map unit components.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be generated. Aggregation must be done because, on any soil map, map units are delineated but components are not.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Figure 6

Section 2
Township 46 South
Range 41 East

Section 1
Township 46 South
Range 41 East

Section 11
Township 46 South
Range 41 East

Section 12
Township 46 South
Range 41 East

Section 7
Township 46 South
Range 42 East

W9100-176

L-40

US HIGHWAY 441

SR 7

SOUTH SHORE BLVD

Notes:
Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Metadata;
2016, U.S. Department of Agriculture, Natural Resources Conservation Service
Publication Date: 20160914, Soil Survey Geographic (SSURGO)
database for Palm BeachCounty, Florida.
This data set is a digital soil survey and generally is the most
detailed level of soil geographic data developed by the National
Cooperative Soil Survey. The information was prepared by digitizing
maps, by compiling information onto a planimetric correct base
and digitizing, or by revising digitized maps using remotely
sensed and other information..
Data was downloaded on March 14, 2018 from the USDA website at
"https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx"
and mapped using the NRCS Soil Data Viewer Version Number 6.2

BASE CREDITS:
• Base map from South Florida Water Mgmt. District
• State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
• Martin 2016 6IN Aerial

BASE CREDITS:
• Base map from South Florida Water Mgmt. District
• State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
• PalmBeach 2017 6IN 1FT Aerial

SFWMD GeoSpatial Services

Legend
- W9100-176
- **Hydrologic_Soil_Group**
- {DCD, >}
- Not rated or not available
- A/D
- B/D

80°14'0"W · 80°13'40"W · 80°13'20"W · 80°13'0"W · 80°12'40"W · 80°12'20"W · 80°12'0"W · 80°11'40"W
26°29'0"N · 26°28'40"N · 26°28'20"N · 26°28'0"N

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0 · 1,000 · 2,000 Feet
0 · 250 · 500 Meters

Pero Farms
N.R.C.S. Hydrologic Soil Group
Aerial Mapping
Palm Beach County, Florida

N · W · E · S

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Map Date: March 2018

GEOSPATIAL SERVICES

User Name:rschaff · Remedy: 69466 · Map Produced on Date: 3/15/2018

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Pero Farms\Exhibits_Taylor\am\Pero Farm (Soils).mxd

Map Unit Description

Palm Beach County Area, Florida

[Minor map unit components are excluded from this report]

Map unit: 2 - Anclote fine sand

Component: Anclote (90%)

The Anclote component makes up 90 percent of the map unit. Slopes are 0 to 2 percent. This component is on drainageways on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 3 inches during June, July, August, September, October, November. Organic matter content in the surface horizon is about 6 percent. Nonirrigated land capability classification is 3w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 8 - Basinger and Myakka sands, depressional

Component: Basinger, depressional (47%)

The Basinger, depressional component makes up 47 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is very high. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during June, July, August, September, October, November. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Component: Myakka, depressional (47%)

The Myakka, depressional component makes up 47 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during June, July, August, September, October, November. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 7w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 18 - Immokalee fine sand, 0 to 2 percent slopes

Component: Immokalee (90%)

The Immokalee component makes up 90 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 4w. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 21 - Myakka fine sand, 0 to 2 percent slopes

Component: Myakka (85%)

The Myakka component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September. Organic matter content in the surface horizon is about 2

Map unit: 21 - Myakka fine sand, 0 to 2 percent slopes

Component: Myakka (85%)

percent. Nonirrigated land capability classification is 4w. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 24 - Okeelanta muck, drained, frequently ponded, 0 to 1 percent slopes

Component: Okeelanta, drained (90%)

The Okeelanta, drained component makes up 90 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of herbaceous organic material over sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 75 percent. Nonirrigated land capability classification is 3w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 25 - Oldsmar sand, 0 to 2 percent slopes

Component: Oldsmar (85%)

The Oldsmar component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September, October, November. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 4w. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 99 - Water

Component: Water (100%)

Generated brief soil descriptions are created for major soil components. The Water is a miscellaneous area.

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

The Map Unit Description (Brief, Generated) report displays a generated description of the major soils that occur in a map unit. Descriptions of non-soil (miscellaneous areas) and minor map unit components are not included. This description is generated from the underlying soil attribute data.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

Figure 7

Section 2
Township 46 South
Range 41 East

Section 1
Township 46 South
Range 41 East

Section 11
Township 46 South
Range 41 East

Section 12
Township 46 South
Range 41 East

Section 7
Township 46 South
Range 42 East

W9100-176

W9100-176

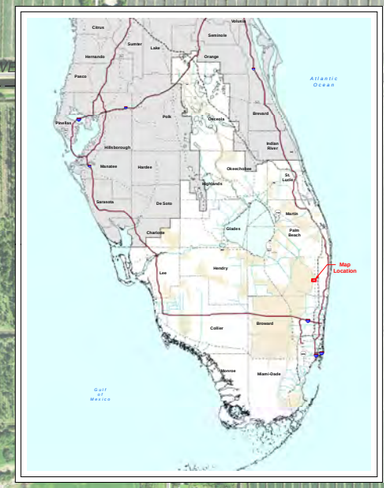
L-40

US HIGHWAY 441

SMITH SUNDY RD

80°14'0"W 80°13'40"W 80°13'20"W 80°13'0"W 80°12'40"W 80°12'20"W 80°12'0"W 80°11'40"W

26°29'0"N 26°28'40"N 26°28'20"N 26°28'0"N



Legend

W9100-176

Map Unit Name

{NAN, <}

- Anclote fine sand
- Basinger and Myakka sands, depressional
- Immokalee fine sand, 0 to 2 percent slopes
- Myakka fine sand, 0 to 2 percent slopes
- Okeelanta muck, drained, frequently ponded, 0 to 1 percent slopes
- Oldsmar sand, 0 to 2 percent slopes
- Water

Metadata;
2016, U.S. Department of Agriculture, Natural Resources Conservation Service
Publication Date: 20160914, Soil Survey Geographic (SSURGO)
database for Palm BeachCounty, Florida.
This data set is a digital soil survey and generally is the most
detailed level of soil geographic data developed by the National
Cooperative Soil Survey. The information was prepared by digitizing
maps, by compiling information onto a planimetric correct base
and digitizing, or by revising digitized maps using remotely
sensed and other information..
Data was downloaded on March 14, 2018 from the USDA website at
"https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx"
and mapped using the NRCS Soil Data Viewer Version Number 6.2

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- PalmBeach 2017 6IN 1FT Aerial

SFWMD GeoSpatial Services

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0 1,000 2,000 Feet
0 250 500 Meters

Pero Farms
N.R.C.S. Soils Survey
Aerial Mapping
Palm Beach County, Florida

N W E S

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Map Date: March 2018

IT GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/15/2018

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Pero Farms\Exhibits_Taylor\am\Pero Farm (Soils).mxd

Figure 8

80°17'40"W 80°17'20"W 80°17'0"W 80°16'40"W 80°16'20"W 80°16'0"W 80°15'40"W 80°15'20"W 80°15'0"W 80°14'40"W 80°14'20"W

27°3'0"N 27°2'40"N 27°2'20"N 27°2'0"N 27°1'40"N

Range 40 East | Range 41 East

Section 25 Township 39 South Range 40 East

Section 30 Township 39 South Range 41 East

Section 29 Township 39 South Range 41 East

Section 28 Township 39 South Range 41 East

Section 36 Township 39 South Range 40 East

Section 31 Township 39 South Range 41 East

Section 32 Township 39 South Range 41 East

Section 33 Township 39 South Range 41 East

Township 39 South Township 40 South

Township 39 South Township 40 South

JE100-074

JE100-081

CR-708 SE BRIDGE RD

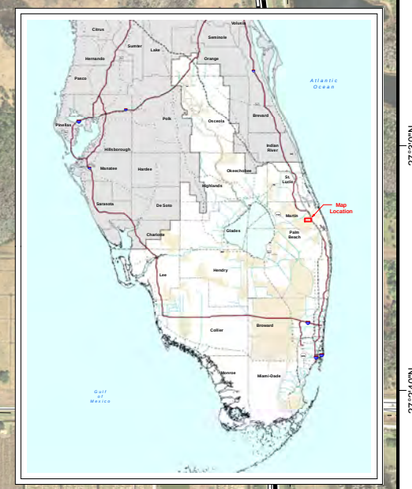
SW PRATT WHITNEY RD

CR-711

SW TRAILSIDE RUN

SW TRAILSIDE PATH

SW TRAILSIDE PATH



BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

Legend

MAPPING ESTATE

Acquired - Fee Acquisition

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0 1,500 3,000 Feet

0 400 800 Meters

Harmony Ranch
Aerial Mapping
Martin County, Florida

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Map Date: March 2018

GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/15/2018

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Harmony\am\Harmony Ranch.mxd

Figure 9

Range 41 East
Range 40 East

Section 25
Township 39 South
Range 40 East

Section 30
Township 39 South
Range 41 East

Section 29
Township 39 South
Range 41 East

Section 28
Township 39 South
Range 41 East

Section 36
Township 39 South
Range 40 East

Section 31
Township 39 South
Range 41 East

Section 32
Township 39 South
Range 41 East

Section 33
Township 39 South
Range 41 East

Township 39 South
Township 40 South

Township 39 South
Township 40 South

JE100-074

JE100-081

CR-708 SE BRIDGE RD

SW PRATT WHITNEY RD

CR-711

SW TRAILSIDE RUN

SW TRAILSIDE PATH

SW TRAILSIDE PATH

Map Location

Notes:

This data set serves as documentation of land cover and land use (LCLU) within the South Florida Water Management District as it existed in 2014-15. Land Cover Land Use data was updated from 2008-09 LCLU by photo-interpretation from 2014-15 aerial photography and classified using the SFWMD modified FLUCCS classification system. Features were interpreted from the county-based aerial photography (4 in - 2 ft pixel) and updated on screen from the 2008-09 vector data. Horizontal accuracy of the data corresponds to the positional accuracy of the county aerial photography. The minimum mapping unit for classification was 0.5 acres for wetlands and 5 acres for uplands. This portion included the Priority Areas of the Upper and Lower Kissimmee Basins and was completed on 08/31/2016 (version 1.0).

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

Legend

Current and Future Land Acquisitions

General Land Cover - '14-'15

LCCODE_2014

- Unmapped
- Urban
- Agriculture
- Upland nonforested
- Forest
- Water
- Wetland
- Barren land
- Transportation, Communication, Utilities

80°17'40"W 80°17'20"W 80°17'0"W 80°16'40"W 80°16'20"W 80°16'0"W 80°15'40"W 80°15'20"W 80°15'0"W 80°14'40"W 80°14'20"W

27°3'0"N 27°2'40"N 27°2'20"N 27°2'0"N 27°1'40"N

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0 1,500 3,000 Feet
0 400 800 Meters

Harmony Ranch
Land Use
Aerial Mapping
Martin County, Florida

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Map Date: March 2018

GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/28/2018

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Harmony\am\Harmony Ranch Land Use.mxd

Figure 10

Range 41 East
Range 40 East

Section 23
Township 39 South
Range 40 East

Section 30
Township 39 South
Range 41 East

Section 29
Township 39 South
Range 41 East

Section 28
Township 39 South
Range 41 East

Section 36
Township 39 South
Range 40 East

Section 31
Township 39 South
Range 41 East

Section 32
Township 39 South
Range 41 East

Section 33
Township 39 South
Range 41 East

Township 39 South
Range 40 East

Township 40 South

Township 39 South
Township 40 South

SW PRATT WHITNEY RD

SE BRIDGE RD

SW TRAILSIDE RUN

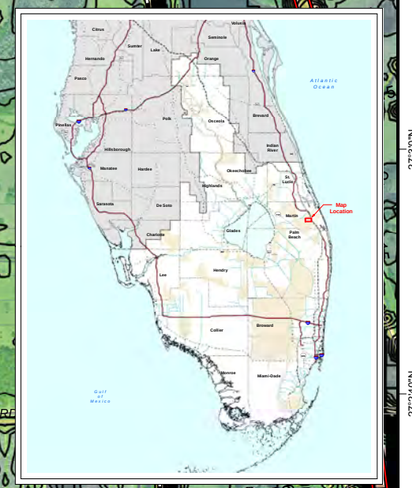
GR-41

JE100-074

JE100-081

80°17'40"W 80°17'20"W 80°17'0"W 80°16'40"W 80°16'20"W 80°16'0"W 80°15'40"W 80°15'20"W 80°15'0"W 80°14'40"W 80°14'20"W

27°3'0"N
27°2'40"N
27°2'20"N
27°1'40"N



Metadata;
South Florida Merged Topography, high-resolution DEM, 5-ft cell size, April 2016. This is a raster dataset representing a 5-ft digital elevation model (DEM) of best-available data for southern Florida. It was created in March-April 2016 by resampling the best-resolution DEMs for available topo data to 5-ft cell size and merging them to produce a best-available composite. More than 40 separate sources were used, including LiDAR datasets, photogrammetry, miscellaneous survey data, Everglades GPS obtained by helicopter, and older contours and spot elevations. This dataset includes the best data currently available, including several LiDAR datasets created in 2015. The extent includes the SFWMD and a 25000-ft buffer around it, with nearshore areas filled in with an arbitrary value of -2.0 ft.
X-Y coordinates are in the standard State plane, Florida east zone projection used by the SFWMD.
Elevation values are in feet, relative to NAVD 1988.

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

Legend

Current and Future Land Acquisitions

contours

SFWMD_SF_MRG_2016_5FT elevation

Value

High : 43.0233

Low : 10.8815

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0 1,500 3,000 Feet
0 400 800 Meters

Harmony Ranch
LiDAR Data
Aerial Mapping
Martin County, Florida

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Map Date: March 2018

IT GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/15/2018

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Hydrologic Soil Group

Aggregation Method: Dominant Condition
Tie-break Rule: Higher

Martin County, Florida
Survey Area Version and Date: 16 - 10/05/2017

Map symbol	Map unit name	Rating	Map unit percent
17	Wabasso sand, 0 to 2 percent slopes	C/D	89
21	Pineda and Riviera fine sands	C/D	88
38	Floridana fine sand, frequently ponded, 0 to 1 percent slopes	C/D	88
47	Pinellas fine sand	B/D	80
49	Riviera fine sand, frequently ponded, 0 to 1 percent slopes	A/D	93

Hydrologic Soil Group

Rating Options

Attribute Name: Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value to represent the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. The components in the map unit name represent the major soils within a map unit delineation. Minor components make up the balance of the map unit. Great differences in soil properties can occur between map unit components and within short distances. Minor components may be very different from the major components. Such differences could significantly affect use and management of the map unit. Minor components may or may not be documented in the database. The results of aggregation do not reflect the presence or absence of limitations of the components which are not listed in the database. An on-site investigation is required to identify the location of individual map unit components.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be generated. Aggregation must be done because, on any soil map, map units are delineated but components are not.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Figure 11

Range 40 East | Range 41 East

Section 25 Township 39 South Range 40 East

Section 30 Township 39 South Range 41 East

Section 29 Township 39 South Range 41 East

Section 28 Township 39 South Range 41 East

Section 36 Township 39 South Range 40 East

Section 31 Township 39 South Range 41 East

Section 32 Township 39 South Range 41 East

Section 33 Township 39 South Range 41 East

Township 39 South Township 40 South

Township 39 South T...

JE100-081

JE100-074

CR-708

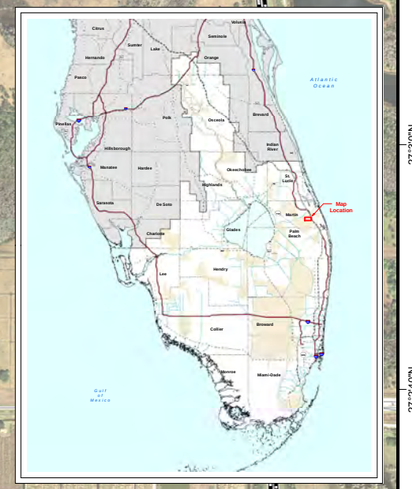
SW PRATT WHITNEY RD

CR-711

SE BRIDGE RD

SW TRAIL SIDE RUN

SW TRAIL SIDE PATH



Metadata;
2016, U.S. Department of Agriculture, Natural Resources Conservation Service
Publication Date: 20160914, Soil Survey Geographic (SSURGO) database for Martin County, Florida.
This data set is a digital soil survey and generally is the most
detailed level of soil geographic data developed by the National
Cooperative Soil Survey. The information was prepared by digitizing
maps, by compiling information onto a planimetric correct base
and digitizing, or by revising digitized maps using remotely
sensed and other information..
Data was downloaded on March 14, 2018 from the USDA website at
"https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx"
and mapped using the NRCS Soil Data Viewer Version Number 6.2

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

Legend

Current and Future Land Acquisitions

Hydrologic Soil Group

SdvOutpu_1

- A/D
- B/D
- C/D

Notes:
Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

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0 1,500 3,000 Feet
0 400 800 Meters

Harmony Ranch
N.R.C.S. Hydrologic Soil Group
Aerial Mapping
Martin County, Florida

N W E S

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Map Date: March 2018

GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/15/2018

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Harmony\am\Hydrologic Soil Group.mxd

Map Unit Description

Martin County, Florida

[Minor map unit components are excluded from this report]

Map unit: 17 - Wabasso sand, 0 to 2 percent slopes

Component: Wabasso (85%)

The Wabasso component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer, strongly contrasting textural stratification, is 9 to 50 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3w. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 21 - Pineda and Riviera fine sands

Component: Pineda (45%)

The Pineda component makes up 45 percent of the map unit. Slopes are 0 to 2 percent. This component is on drainageways on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 6 inches during June, July, August, September, October. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Component: Riviera (40%)

The Riviera component makes up 40 percent of the map unit. Slopes are 0 to 2 percent. This component is on drainageways on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 6 inches during June, July, August, September, October. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 38 - Floridana fine sand, frequently ponded, 0 to 1 percent slopes

Component: Floridana (85%)

The Floridana component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 6 percent. Nonirrigated land capability classification is 7w. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 1 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 47 - Pinellas fine sand

Component: Pinellas (80%)

The Pinellas component makes up 80 percent of the map unit. Slopes are 0 to 2 percent. This component is on flats on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September. Organic matter content in the surface horizon is about 3

Map unit: 47 - Pinellas fine sand

Component: Pinellas (80%)

percent. Nonirrigated land capability classification is 3w. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 15 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: 49 - Riviera fine sand, frequently ponded, 0 to 1 percent slopes

Component: Riviera (85%)

The Riviera component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 7w. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

The Map Unit Description (Brief, Generated) report displays a generated description of the major soils that occur in a map unit. Descriptions of non-soil (miscellaneous areas) and minor map unit components are not included. This description is generated from the underlying soil attribute data.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

Figure 12

Range 41 East
Range 40 East

Section 25
Township 39 South
Range 40 East

Section 30
Township 39 South
Range 41 East

Section 29
Township 39 South
Range 41 East

Section 28
Township 39 South
Range 41 East

Section 36
Township 39 South
Range 40 East

Section 31
Township 39 South
Range 41 East

Section 32
Township 39 South
Range 41 East

Section 33
Township 39 South
Range 41 East

Township 39 South
Township 40 South

Township 39 South
Township 40 South

JE100-074

JE100-081

CR-708 SE BRIDGE RD

SW PRATT WHITNEY RD

CR-711

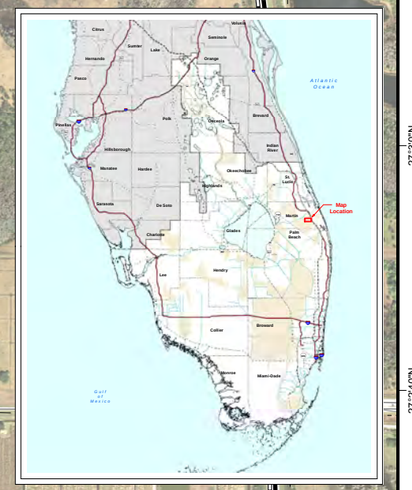
SW TRAILSIDE RUN

SW TRAILSIDE PATH

SW TRAILSIDE PATH

80°17'40"W 80°17'20"W 80°17'0"W 80°16'40"W 80°16'20"W 80°16'0"W 80°15'40"W 80°15'20"W 80°15'0"W 80°14'40"W 80°14'20"W

27°3'0"N 27°2'40"N 27°2'20"N 27°2'0"N 27°1'40"N



Metadata;
2016, U.S. Department of Agriculture, Natural Resources Conservation Service
Publication Date: 20160914, Soil Survey Geographic (SSURGO) database for Martin County, Florida.
This data set is a digital soil survey and generally is the most
detailed level of soil geographic data developed by the National
Cooperative Soil Survey. The information was prepared by digitizing
maps, by compiling information onto a planimetric correct base
and digitizing, or by revising digitized maps using remotely
sensed and other information..
Data was downloaded on March 14, 2018 from the USDA website at
"https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx"
and mapped using the NRCS Soil Data Viewer Version Number 6.2

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

Legend

Current and Future Land Acquisitions

Map Unit Name

MUName

- Floridana fine sand, frequently ponded, 0 to 1 percent slopes
- Pineda and Riviera fine sands
- Pinellas fine sand
- Riviera fine sand, frequently ponded, 0 to 1 percent slopes
- Wabasso sand, 0 to 2 percent slopes

South Florida Water Management District
3301 Gun Club Rd, West Palm Beach, FL 33406
(561) 686-8800; www.sfwmd.gov

0 1,500 3,000 Feet
0 400 800 Meters

Harmony Ranch
N.R.C.S. Soils Syrvey
Aerial Mapping
Martin County, Florida

N W E S

IMPORTANT DISCLAIMER:
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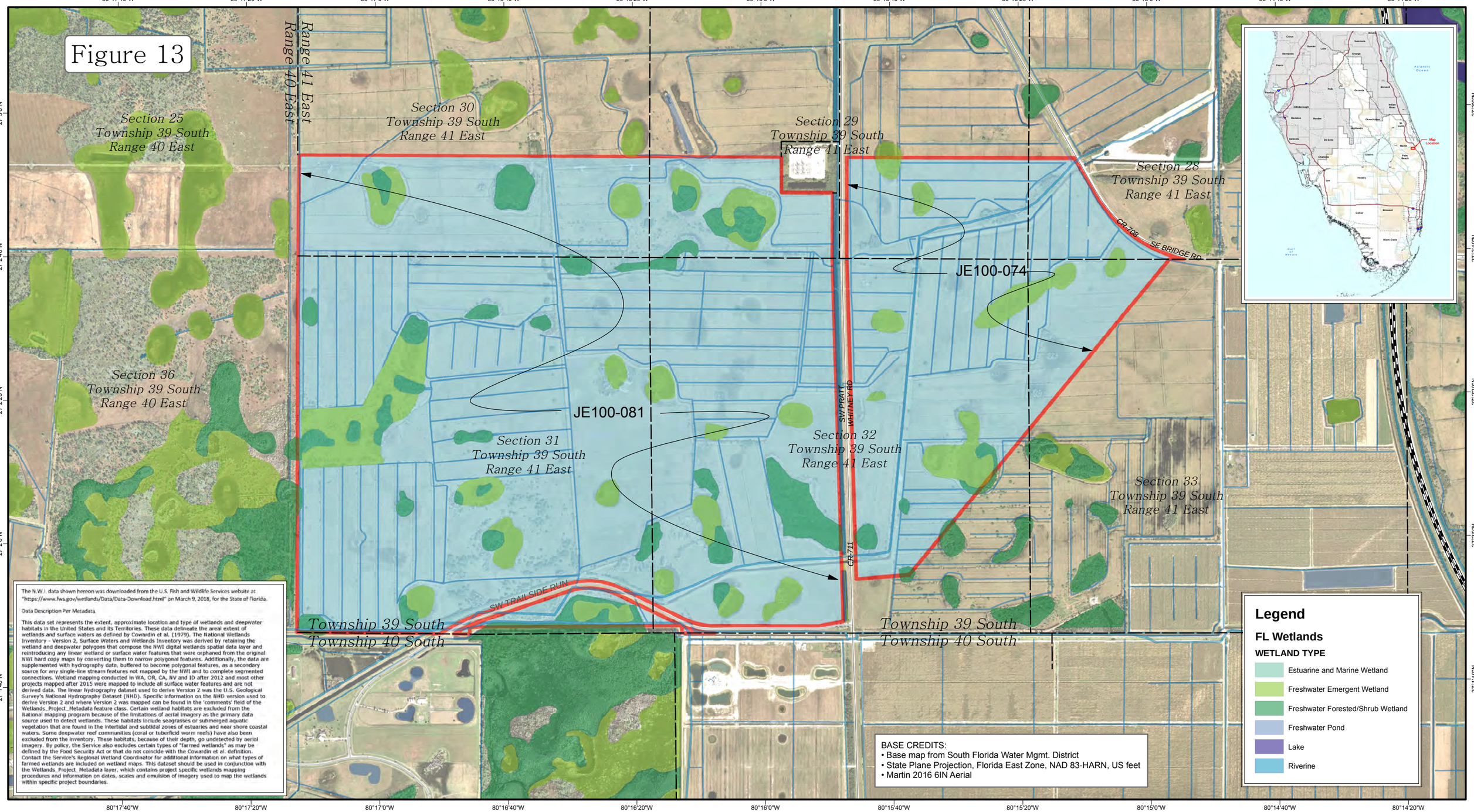
Map Date: March 2018

GEOSPATIAL SERVICES

User Name:rschaff Remedy: 69466 Map Produced on Date: 3/28/2018

\\ad.sfwmd.gov\dfsroot\data\cad\GIS\acad_data2\proj\Harmony\am\Harmony Ranch (Soils).mxd

Figure 13



The N.W.I. data shown hereon was downloaded from the U.S. Fish and Wildlife Services website at "https://www.fws.gov/wetlands/Data/Data-Download.html" on March 9, 2018, for the State of Florida.

Data Description Per Metadata

This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the United States and its Territories. These data delineate the areal extent of wetlands and surface waters as defined by Cowardin et al. (1979). The National Wetlands Inventory - Version 2, Surface Waters and Wetlands Inventory was derived by retaining the wetland and deepwater polygons that compose the NWI digital wetlands spatial data layer and reintroducing any linear wetland or surface water features that were orphaned from the original NWI hard copy maps by converting them to narrow polygonal features. Additionally, the data are supplemented with hydrography data, buffered to become polygonal features, as a secondary source for any single-line stream features not mapped by the NWI and to complete segmented connections. Wetland mapping conducted in WA, OR, CA, NV and ID after 2012 and most other projects mapped after 2015 were mapped to include all surface water features and are not derived data. The linear hydrography dataset used to derive Version 2 was the U.S. Geological Survey's National Hydrography Dataset (NHD). Specific information on the NHD version used to derive Version 2 and where Version 2 was mapped can be found in the 'comments' field of the Wetlands_Project_Metadata feature class. Certain wetland habitats are excluded from the national mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and near shore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery. By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition. Contact the Service's Regional Wetland Coordinator for additional information on what types of farmed wetlands are included on wetland maps. This dataset should be used in conjunction with the Wetlands_Project_Metadata layer, which contains project specific wetlands mapping procedures and information on dates, scales and emulsion of imagery used to map the wetlands within specific project boundaries.

Legend

FL Wetlands

WETLAND TYPE

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

BASE CREDITS:
- Base map from South Florida Water Mgmt. District
- State Plane Projection, Florida East Zone, NAD 83-HARN, US feet
- Martin 2016 6IN Aerial

South Florida Water Management District
3301 Gun Club Rd, West Palm Beach, FL 33406
(561) 686-8800; www.sfwmd.gov

0 1,500 3,000 Feet
0 400 800 Meters

Harmony Ranch
National Wetlands Inventory
Aerial Mapping
Martin County, Florida

N W E S

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Map Date: March 2018

IT GEOSPATIAL SERVICES

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
ECOLOGICAL ASSESSMENT OF SURPLUS TRACT NO. W9100-176
June 16, 2014

INTRODUCTION

This report is the result of a brief ecological assessment of Surplus Tract No. W9100-176. The subject property is being considered for surplus and disposition by the Governing Board of the South Florida Water Management District. Prior to a disposition of the property, the Governing Board will use this assessment as a factual foundation and aid in making a determination with respect to whether this tract of property is no longer needed for its original purpose or for conservation purposes.

BACKGROUND

The 570.77-acre property is located in the East Coast Buffer area of southern Palm Beach County, between State Road 7 and Water Conservation Area 1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge-LNWR), approximately 1.2 mile north of West Atlantic Avenue, in western Delray Beach. Please refer to Figures 1 and 2 on page 6, which depict the location of property.

The tract comprises a 516.07 acre northern parcel and a 54.70-acre southern parcel separated by two narrow parcels under different ownership. Collectively they are bordered on the west and north by Lake Worth Drainage District canals E-1WN and L-30W and Water Conservation Area 1/LNWR, on the east in part by State Road 7, agricultural fields and related buildings and parking areas owned by Pero Land Co., and on the south by District Surplus Tract W9100-178 (West Delray Regional Park), District Surplus Tract W9100-170, and undeveloped Florida Power and Light land (FPL). FPL powerlines run north/south through the eastern portion of the site.

A review of aerial photographs of the property and surrounding area dated 1940, 1984, 1897, 1995, 2004 and 2013, was conducted. It appears that in 1940 approximately 50 percent of the site was natural wetlands that were part of the northeastern extent of the Everglades system, and 50 percent (located in the eastern portion of the site) was agricultural fields. By 1984, most of the western portion of the site had also been converted to agricultural fields but with some natural areas preserved, essentially in the configuration that exists currently.

METHODOLOGY

A District biologist first conducted a desktop analysis of aerial photography, SFWMD geographic information (RegGSS), Google Earth EC, and soil surveys to obtain initial information about Tract No. W9100-176, and the potential vegetative habitats at the property. A brief field survey of the property was then performed on May 28, 2014 to identify the current vegetative habitats and ecological conditions at the property, and the relative ecological importance of the property. Specifically, the property was evaluated for: 1) the potential presence and approximate locations of state jurisdictional wetlands and other surface waters; 2) dominant vegetation communities; 3) wildlife presence and potential usage (including state or federally-listed species); and 4) overall land conservation significance. All field observations of dominant plant species and vegetation community types (FNAI 2010), reptiles, amphibians, birds, and mammals or their sign (e.g. tracks, nests, burrows, scat, etc.) were noted.

Many of the wetland areas were inaccessible due to perimeter ditching and difficulty maneuvering the vehicle through farm fields, so observations of some of the wetlands were conducted using binoculars and photographs were taken using the zoom feature. Therefore, only the visually dominant canopy species are noted, and shrub and groundcover species that may be present are not noted for all areas.

Estimates of sizes of potential state jurisdictional wetlands and other surface waters were obtained using SFWMD geographic information (Reg GSS), Google Earth EC, historic soil data, current hydrology as it appears, and observations of current vegetation. It is important to note that the boundaries of wetlands shown on Figure 3 were not subject to a thorough field verification using the methods in Chapter 62-340, so the boundaries may be subject to reinterpretation if a more thorough analysis based on a more extensive field investigation is conducted in the future.

RESULTS

The 570.77-acre property consists primarily of agricultural fields and a system of ditches and dirt roads, but with isolated areas of historic East Everglades wetlands disturbed as a result of land alterations associated with the agricultural activities, drainage, access roads and infestation by exotic vegetation. Twelve separate wetland areas are identified as areas A-M (not C, which is upland) in Figure 3 on Page 7. A parcel in the central part of the site is a separate property, Surplus Tract W9100-177 (identified by the red "**X**" on Figure 3). Additional information regarding the wetlands is included in the 'Wetlands and Other Surface Waters' section below.

Soils (see Figure 4, on Pages 8 and 9)

Based on a review of the U.S. Department of Agriculture Web Soil Survey web site, soils on the property consist of:

- Anclote fine sand that is a sandy soil which naturally occurs on flats of mesic or hydric lowlands;
- Basinger and Myakka sands (depressional) that is a sandy soil which naturally occurs on stream terraces, flood plains, or in depressions;
- Immokalee Fine Sand and Myakka fine sand that are sandy soils which naturally occur in flats of mesic or hydric lowlands;
- Myakka fine sand that are sandy soils which naturally occur in flats of mesic or hydric lowlands;
- Okeelanta muck that is an organic soil which naturally occurs in depressions and on flood plains;
- Oldsmar sand (0 to 2 percent slopes) that is a sandy soil which naturally occurs on flats of mesic or hydric lowlands; and
- Udorthents that are unconsolidated geologic material excavated during the construction of canals and placed as levees

Upland Ecological Communities

No naturally-occurring native upland plant communities exist on the property. One small area identified as area C on Figure 3 contains discarded farm materials and is dominated by dense Australian pine (*Casuarina* sp.) and castor bean (*Ricinus communis*). The northeast corner of the site

is uplands dominated by Australian pine (*Casuarina* sp.) and Brazilian pepper (*Schinus terebinthifolius*).

Wetlands and Other Surface Waters

The site contains both state jurisdictional wetlands and other surface waters within the property boundaries.

The surface waters on the property consist of the numerous ditches which have not been quantified for this report, and a 1.2-acre pond located on the south side of Wetland Area J. The ditches are characterized by steep slopes with weedy cover and either open water, or surface cover by water lettuce.

There are twelve (12) wetland areas identified as areas A-M on Figure 3:

- A, B in the eastern half of the southern parcel
- D-M in the northern parcel
- C is upland
- Photographs of most of the wetlands are on Pages 10-13

All the wetland areas on the site are disturbed, but some retain features indicative of the historic native communities such as cypress and hardwood swamps. The current configuration of wetlands reflects the historic soils and hydrology in this vicinity which was the transition from the eastern flatwoods to the Everglades. Wetlands A (3.21 acres), B (1.60 acre), F (3.2 acre), G (1.77 acre), H (0.97 acre), and I (4.24 acre) occur in soils mapped as depressional and represent individual wetlands, or portion of a wetland, that were historically isolated from the surrounding flatwoods (Figure 4, soils map). Wetland A extends offsite to the south and only the onsite portion is depicted. Wetlands D (2.95 acre), E (3.72 acre), J (3.18 acre) (total area of these 3 wetlands is 9.85 acres) are close together and separated from each other only by a narrow berm road and ditches, and together with (but separated by farm fields) Wetland K (8.12 acre) comprise a 17.97-acre remnant of a linear wetland that extended from the Everglades system to the west. Wetlands L (1.94 acre) and M (10.05 acre) (11.99 acre total area of these 2 wetlands) are in a configuration similar to, and just south of, that above. All of these wetlands occur in muck soils (depressional, organic).

Wetlands A, B, D, E, and I contain a canopy of cypress (*Taxodium* spp.) and strangler fig (*Ficus aurea*) with a ground cover of swamp fern with an outer zone of dense Brazilian pepper and/or Australian pine. A dense area of tall grass occurs on the north side of Wetland B.

Wetland F, bisected by a north/south farm road is heavily disturbed and contains dense Brazilian pepper, Melaleuca (*Melaleuca quinquenervia*), Carolina willow (*Salix caroliniana*), and tall grass.

Wetlands G and H occur on the edge of exotic-infested uplands, and contain Melaleuca, pond apple (*Annona glabra*) and a few cypress trees.

Wetlands J, K and M are heavily infested with dense Brazilian pepper and Melaleuca, but also contain natives such as red maple (*Acer rubrum*), strangler fig, and shoestring fern (*Vittaria lineata*).

Wetland L is heavily impacted by ground disturbance and use as a compost site. Vegetation is Brazilian pepper, Melaleuca and strangler fig. A strong foul odor is associated with the compost area and is noticeable a good distance from it. However, wading birds such as glossy ibis and white ibis were observed foraging in it.

The wetlands and other surface waters on the site may be considered federal jurisdictional by the U.S. Army Corps of Engineers.

Wildlife

A general inspection of the property was conducted to identify wildlife presence, particularly species listed as endangered, threatened or species of special concern by the Florida Fish and Wildlife Conservation Commission (FWC) or the US Fish and Wildlife Service (USFWS). Wildlife species observed included an Everglades snail kite (*Rostrhamus sociabilis plumbeus*) (listed as Endangered according to USFWS and FWC) that flew into Wetland K, limpkins (*Aramus guarauna*) (a species of special concern according to FWC) foraging in the ditches and fields, white ibis (*Eudocimus albus*) (a species of special concern according to FWC), glossy ibis (*Plegadis falcinellus*), boat tail grackles (*Quiscalus major*), common grackles (*Quiscalus quiscula*), great blue heron (*Ardea herodias*), killdeer (*Charadrius vociferus*), anhingas (*Anhinga anhinga*), mottled ducks (*Anas fulvigula*) in the ditches, flocks of Quaker parakeets (*Myiopsitta monachus*), and a raccoon (*Procyon lotor*).

No nesting or denning sites of the native species were observed. According to the FWC, the nearest bald eagle nest is approximately 5 miles to the southwest of the property.

SUMMARY

The site contains wetlands that have been heavily disturbed by the surrounding land use, and other surface waters created for agricultural purposes. However, the property is located directly east of the regionally significant Eastern Everglades system, and the wetlands and other surface waters on the site are used by listed wildlife species associated with the Everglades ecosystem. Additionally, several of the wetland fragments that remain are larger than 3 acres and/or contiguous with each other or other offsite wetlands, except for separation by ditching and berms, providing connectivity to facilitate wildlife use. Despite heavy cover by exotic vegetation, several of the wetlands, such as A, D, E and J, and I, also contain sizable native habitats and the associated benefits of forage, cover, roosting, and nesting opportunities.

CONTACT

Caroline Hanes
Environmental Analyst 3
Environmental Resource Permitting Bureau
South Florida Water Management District
(561) 682-6856
chanes@sfwmd.gov

REFERENCES

FWC, 2011. Eagle nest mapping: https://public.myfwc.com/FWRI/EagleNests/nestlocator.aspx

FWC, 2011. Florida Wildlife Conservation Guide: http://myfwc.com/conservation/value/fwcg/

FNAI,2010. Natural Communities Guide: http://www.fnai.org/naturalcommguide.cfm

Google Earth EC 6.1.0.5001

USDA, 2011. Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Figure 1: Location of Tract No. W9100-176 (depicted by the yellow boundary- excluding area in red boundary).

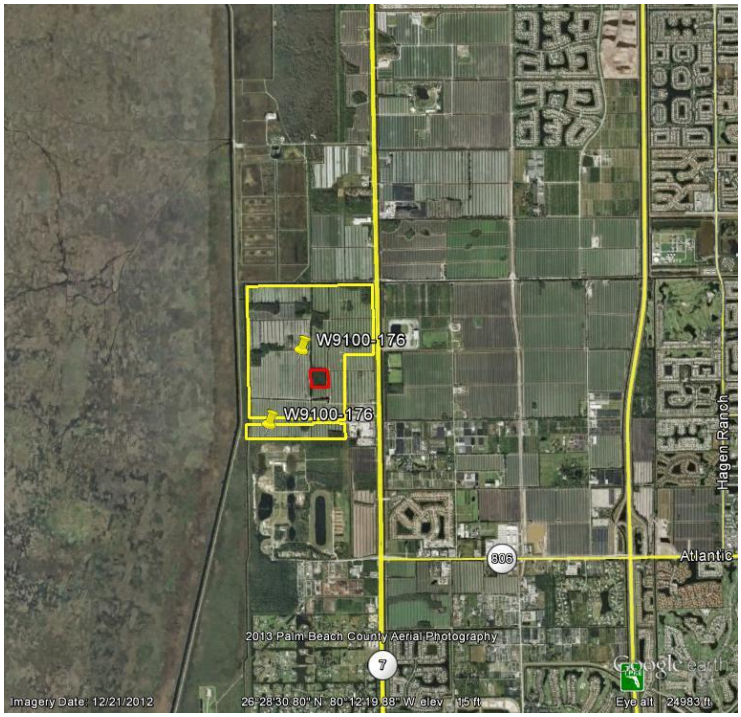


Figure 2: Location of Tract No. W9100-177 (yellow boundary- excluding area in red boundary).



Figure 3: Location of on-site state jurisdictional wetlands and other surface waters.

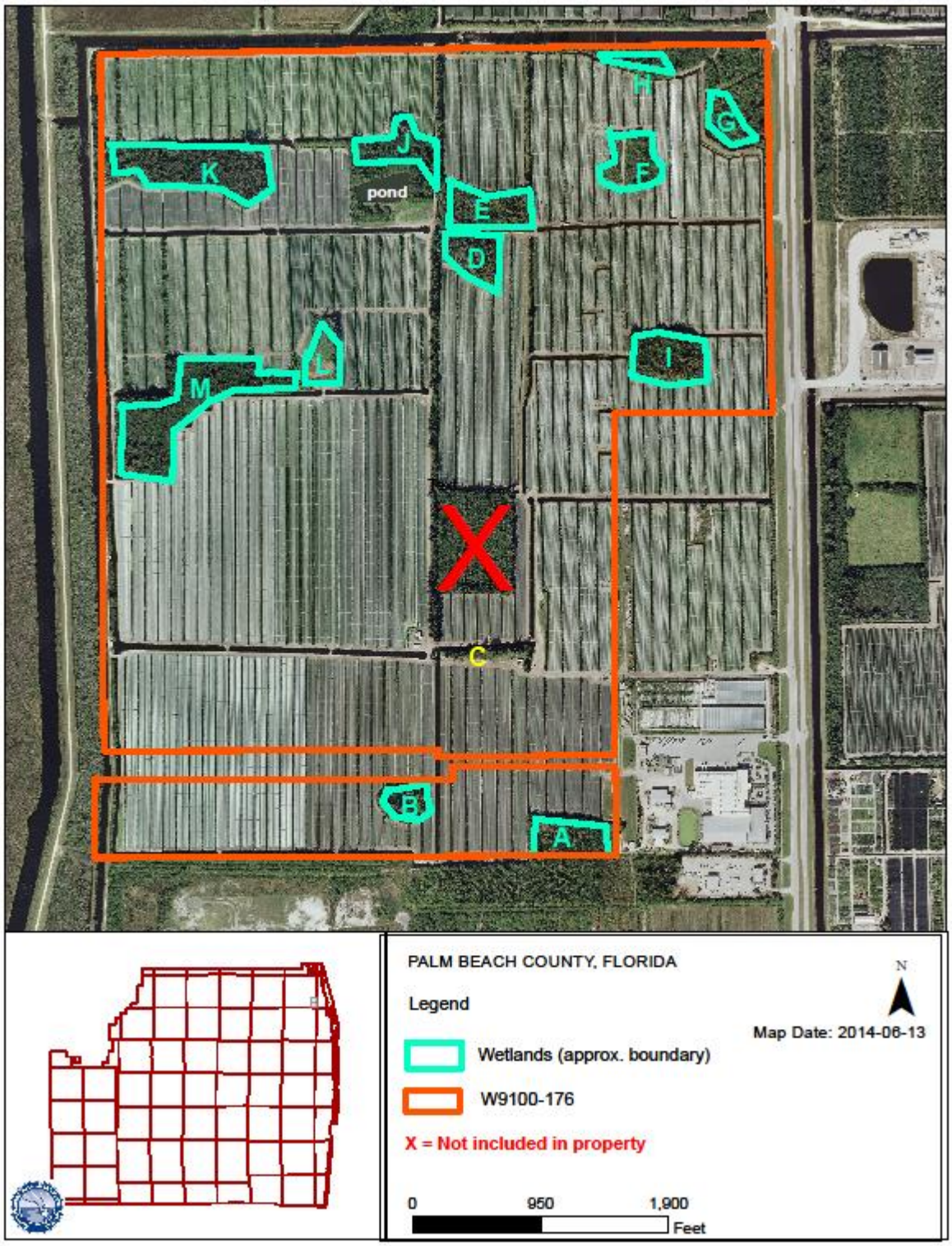


Figure 4. Soils Map



Figure 4. cont'd

Map Unit Legend

Palm Beach County Area, Florida (FL611)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2	Anclote fine sand	6.4	0.5%
8	Basinger and Myakka sands, depressional	52.5	4.4%
18	Immokalee fine sand, 0 to 2 percent slopes	189.9	15.8%
21	Myakka fine sand, 0 to 2 percent slopes	590.6	49.3%
24	Okeelanta muck	99.5	8.3%
25	Oldsmar sand, 0 to 2 percent slopes	218.7	18.3%
47	Udorthents, 2 to 35 percent slopes	20.7	1.7%
99	Water	18.1	1.5%
Subtotals for Soil Survey Area		**1,196.3**	**99.9%**
Totals for Area of Interest		**1,198.1**	**100.0%**

Water Conservation Area, Florida (FL615)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
8	Terra Ceia muck	1.7	0.1%
Subtotals for Soil Survey Area		**1.7**	**0.1%**
Totals for Area of Interest		**1,198.1**	**100.0%**

Photograph 1: Wetland A, view SSW



Photograph 2: Wetland B, viewing W



Photograph 3: Wetland D. Wetland E not shown but similar.



Photograph 4: Wetland F in distance



Photograph 5: Wetland G, view North



Photograph 6: Wetland H



Photograph 7: Wetland J, NE corner



Photograph 8: Wetland K, view SW. Wetland M is similar, not shown.



COPY

ENVIRONMENTAL SITE ASSESSMENT
AND
ECOLOGICAL RISK ASSESSMENT
FOR
MCMURRAIN FARMS
STATE ROAD 7 & ATLANTIC AVENUE
PALM BEACH COUNTY, FLORIDA
TRACT # 100-085

Prepared for:

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
3932 RCA BOULEVARD, SUITE 3210
PALM BEACH GARDENS, FLORIDA 33410

Prepared by:

ECT
Environmental Consulting & Technology, Inc.

6300 NE First Avenue, Suite 100
Fort Lauderdale, Florida 33334
(954) 771-0444

ECT. No. 00-0388-0100

AUGUST 2000

ENVIRONMENTAL SITE ASSESSMENT
AND
ECOLOGICAL RISK ASSESSMENT

Conducted on

McMurrain Farms

State Road 7 & Atlantic Avenue

Palm Beach County, Florida

Tract # 100-085

00-0388-100

for

South Florida Water Management District

3932 RCA Boulevard, Suite 3210

Palm Beach Gardens, Florida 33410

Issue Date: August 2000

Crystal Robbins _____ _____
Associate Engineer Signature

Marc A. Lefebvre, P.E. _____ _____
Principal Engineer Signature

Prepared by:

Environmental Consulting & Technology, Inc.

6300 NE First Avenue, Suite 100

Fort Lauderdale, FL 33334

(954) 771-0444 (954) 771-8118
Phone Fax

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EXECUTIVE SUMMARY

During the period of March through August 2000, Environmental Consulting & Technology, Inc. (ECT) conducted a phase I and phase II environmental site assessment (ESA), as well as an ecological risk assessment, of the McMurrain Farms Property (Tract # 100-085) located to the west of US Highway 441 and to the east of the Loxahatchee Wildlife Refuge, in Palm Beach County, Florida. The property encompasses an area of approximately 640 acres and is located in Section 12, Township 46 South, Range 41 East. The phase II assessment was recommended based upon the South Florida Water Management District's and ECT's inspection of the property, performed on April 8, 1999, identifying various environmental concerns on the subject parcels.

The Pero Family has leased the property for the past 16 years and has cultivated portions of the property in eggplant, cucumbers and peppers. Mr. McMurrain indicated that the property was acquired in the early 1940's and was originally cultivated in string beans and later corn. The Pero family owns and operates a packing house located to the southeast of the proposed acquisition area.

The purpose of the phase II assessment was to investigate potential soil, sediment and groundwater impacts at the McMurrain Farms property. Additionally, the objective of the phase II was to develop sufficient information to calculate remediation costs to restore these areas to cleanup criteria, consistent with future land use requirements as a regional water attenuation reservoir.

Based upon discussions with FDEP, in the absence of sediment quality cleanup criteria, the most conservative soil cleanup criteria from Florida Administrative Codes (FAC) 62-777, (FAC) 62-785, or (FAC) 62-770 were applied when reviewing the phase II assessment data. When sediment quality was available, the toxic effect level (TEL) values from the 1994 FDEP document Volume 1- Development and Evaluation of Sediment Quality Assessment Guidelines were applied to the soil data. One notable

exception to this is arsenic, which has a standard of 7.24 ppm in sediments versus the residential soil cleanup criteria of 0.8 ppm. The assumption validating this approach is that the soils would become sediments after redevelopment of the properties to a reservoir. Groundwater cleanup target levels stipulated in FAC 62-770, have been applied for the dissolved groundwater petroleum impacts, as suggested by FDEP. This is also due to the uncertainty of impacts to surface water from present groundwater impacts.

Specifically, the following concerns noted in the phase I assessment were investigated at the McMurrain Farms facility during this phase II investigation:

1. The vicinity of five (5) diesel powered pump stations numbered MP-2 through MP-7, located along the west side of the property boundary;
2. The area marked by the central fertilizer tank;
3. The area of six (6) trailers, located north of the aforementioned AST;
4. The area adjacent to the main 'north to south' canal near the center of the property, called the "large equipment graveyard";
5. The "small equipment graveyard"/burning area, located proximal to the large equipment graveyard;
6. The area adjacent to the small pesticide storage shed;
7. The area adjacent to the new mobile home installation as a background sample;
8. The area proximal to the vegetable disposal area, located in the northwest quadrant of the site;
9. The area adjacent to the currently active borrow pit, located in the north central area of the site;
10. Four (4) background samples;
11. Four (4) canal sediment locations; and
12. Former underground storage tank area.

Based upon these concerns, ECT prepared a phase II proposal dated March 10, 2000. The proposal delineated soil, sediment and groundwater sampling for the property.

The results of the phase II indicated the presence of DDE and copper in background locations and toxaphene at two (2) point source locations. An additional subsequent expanded sampling program was conducted on the property to evaluate the extent of these impacts. This expanded program indicated that copper and toxaphene impacts were widespread across the property. A 95% upper confidence statistical analysis was then applied to the constituents to calculate average concentration values for copper, toxaphene, and DDE impacts.

These average concentrations exceeded published sediment quality assessment guidelines (SQAGs) for toxaphene and copper. No Florida toxaphene SQAG exists, however. In an effort to remedy this situation, tests were conducted on soil and surface water samples from the site to develop site specific SQAGs and hazard quotients (HQs) for copper and toxaphene using an ecological risk assessment model (model) targeting specific species. In addition, endosulfan, chlordane, propoxur, and cadmium were identified at point source locations and were considered chemicals of potential ecological concern (COPECs). These constituents were also evaluated in the model. The tests that were conducted included the following: 3, 7, 14, and 21-day elutriate tests for toxaphene and copper; 7-Day larval fathead minnow (*Pimephales promelas*) growth and survival; *Hyalella azteca* (amphipod) sediment toxicity test (10 days); *Chironomous tentans* (midge) sediment toxicity test (10 days); 7-Day larval fathead minnow (*Pimephales promelas*) growth and survival; fathead minnow 96-hour water column toxicity test; bioaccumulation test of catfish from McMurrain property; and bioaccumulation test in fish (28-30 days) for fathead minnow and *Lumbriculus Variegatus*.

An ecological risk assessment (ERA) was performed for the McMurrain Farms Property. This ERA was performed "prospectively" assuming that the property will become a water retention reservoir with an associated reservoir ecology.

A total of six (6) assessment endpoints were developed for the ERA in the context of the expected ecosystem at risk. These assessment endpoints (attributes important to the stability, diversity, and functioning of the expected ecosystem) included evaluations of:

- the expected plants (wetland plants and algae growing on the sediment),
- sediment dwelling invertebrates,
- herbivorous mammals and insects,
- omnivorous birds and fish, and
- carnivorous birds and fish.

The following summarizes the findings:

- Copper may be significantly elevated such that benthic invertebrates are probably at risk, and sensitive mammalian herbivores may be at risk.
- None of the pesticides appear to be sufficiently elevated such that risks will be present for the relevant ecological receptors.

These findings are not believed to preclude the conversion of the McMurrain Farms property into a water retention reservoir. The risks associated with copper appear to be isolated to the benthic macroinvertebrate community and do not appear to pose any persuasive risks to any other ecological resources.

Based upon the information that has been derived from the ecological risk assessment, the property appears to be suitable as a regional attenuation reservoir. Target species that have been discussed with the United States Fish & Wildlife Services, such as the wood stork and white pelican, do not appear to be at risk from toxaphene, copper and other chemicals of potential ecological concern in the soils. A summary of the SQAGs and HQs for the Clapper Rail, Wood Stork, and White Pelican are presented below:

Table 1. Target Species SQAG and HQ Summary

Constituent	Target Species		
	Clapper Rail	**Wood Stork**	**White Pelican**
Toxaphene			
HQ_{NOAEL}	1.69E-01	2.40E-02	2.70E-02
HQ_{LOAEL}	1.17E-01	1.70E-02	1.90E-02
SQAG-NOAEL (mg/kg)	9.74	89.2	86.3
C_{max} (mg/kg)	1.5	1.5	1.5
DDE			
HQ_{NOAEL}	1.56E-03	2.94E-03	8.50E-04
HQ_{LOAEL}	3.23E-04	2.94E-04	8.50E-05
SQAG-NOAEL (mg/kg)	15.4	7.84	30.2
C_{max} (mg/kg)	0.024	0.024	0.024
Clordane			
HQ_{NOAEL}	1.46E-04	5.85E-05	8.75E-06
HQ_{LOAEL}	4.09E-05	1.64E-05	2.45E-06
SQAG-NOAEL (mg/kg)	29.8	469	722
C_{max} (mg/kg)	0.0042	0.0042	0.0042
Endosulfan			
HQ_{NOAEL}	1.19E-03	1.60E-04	1.72E-.04
HQ_{LOAEL}	1.19E-04	1.60E-05	1.72E-05
SQAG-NOAEL (mg/kg)	33.2	328	332
C_{max} (mg/kg)	0.036	0.036	0.036

Legend:

HQ = Hazard quotient based on minimum detected concentration observed in McMurrain Farms soil
SQAG = Sediment quality assessment guideline where hazard quotient would equal one
NOAEL = No observed adverse effect level
LOAEL = Lowest observed adverse effect level
C_{max} = Maximum detected concentration onsite

Based upon the environmental site assessment and ecological risk assessment, no further assessment or remediation is proposed for any areas on the property with the exception of pump station MP-3 and the vegetable disposal area. The phase II ESA indicated the presence of petroleum constituents proximal to pump station 2 and pump station 3. During the period of July 17 to July 21, 2000, ECT conducted oversight of soil excavation activities performed by CRB. Approximately 5 truckloads (110 tons) of petroleum contaminated soil was excavated from the areas around pump stations 2 and 3. After excavation and backfill activities were completed, one (1) temporary monitoring well was installed in each excavation area. A groundwater sample was collected from each area and submitted for laboratory analysis by EPA methods 8270 and FL PRO. Based on laboratory analysis, groundwater cleanup target levels were exceeded at pump station MP-3; however the detected concentrations are well within natural attenuation levels. As such, ECT recommends natural attenuation monitoring for pump station MP-3. No further action is recommended for pump station MP-2. ECT performed these services under contract with Palm Beach County. Any monitoring program that may be approved will be implemented under contract with Palm Beach County.

On June 29, 2000, a comment letter was prepared by the University of Florida regarding the Interim Report conducted on the subject facility. The comment letter was addressed to Ligia Mora-Applegate, Bureau of Waste Cleanup, Florida Department of Environmental Protection. A response letter to these comments was prepared by URS and ECT and is included in Attachment A.

1.0 PHASE I ESA

1.1 INTRODUCTION

In March of 2000, ECT was retained by the South Florida Water Management District to conduct a limited phase I and phase II investigation of the McMurrain Farms property in Palm Beach County, Florida. The subject site consists of a parcel of land totaling approximately 640 acres. The property is located west of US Highway 441 and to the east of the Loxahatchee Wildlife refuge. The property is located to the south and adjacent to Cell 3 of the East Coast Buffer Project area. The property is located in Section 12, Township 46 South, Range 41 East. A copy of the legal description of the property, furnished by the SFWMD, is included in Appendix A. Figure 1 illustrates the site vicinity map of the subject parcel and Figure 2 is a site map (Attachment B). The subsequent phase II investigation was designed to address concerns noted in the site inspection, which included potential petroleum, pesticide, chemical mixing and storage issues at the property.

1.2 BACKGROUND

Pursuant to the request of Pete Schneider, an inspection of the McMurrain Farms Ltd. Property, Tract No. 100-085, was conducted on April 8, 1999. The attendees were as follows:

George McMurrain, property owner

Knox McKee and Robert Kukleski, General Services Division.

Marc Lefebvre and Michael Duvall, Environmental Consulting and Technology Inc. (ECT): representing the District

The subject parcel is proposed for District acquisition (in fee title) as part of the expanded East Coast Buffer Project. The purpose of the assessment was to provide a preliminary evaluation of the presence of on-site environmental concerns as well as potential off-site contaminant sources that could adversely impact the subject parcel. Based upon initial observations, recommendations were included for additional Phase I Evaluation/Phase II Sampling Assessment and required corrective actions.

The subject parcel encompasses approximately 640 acres located in Sections 12 and 13, Township 46 South, Range 41 East, Palm Beach County. The proposed acquisition area is located to the west of U.S. Highway 441/State Road 7 and to the east of the Loxahatchee National Wildlife Refuge. The subject property is located to the south, and adjacent to Cell 3 (in the District's numbering scheme) of the East Coast Buffer Project area.

Mr. McMurrain indicated that the property had been acquired in the early 1940's and has been used for agricultural purposes since that timeframe. The property was initially cultivated in string beans and, then later, corn. The Pero family has leased the property for the past 16 years and had grown eggplant, cucumbers and peppers. The Pero family owns and operates the packing house, located to the southeast of the proposed acquisition area. The current land use remains consistent with the Pero family's previous use of the property.

Infrastructure associated with the agricultural operation includes six (6) pump stations, which are used to control water level in the cultivated areas. Five (5) of the pump stations are situated on the levee road, which forms the western boundary of the parcel and consists of a pump motor and an aboveground diesel storage tank approximately 500 gallons in capacity. The tanks are staged in secondary containment structures equipped with a roof. These structures appear to be relatively new in construction. There is some evidence of soil staining in proximity to the pump motors. It is undetermined what the configuration of the pump stations consisted of prior to the installation of the secondary containment structures. The remaining pump station is electrically powered and is located in the northeast corner of the subject property.

ECT was unable to obtain any information from Mr. George McMurrain or Peter Pero regarding current or historical use of agricultural chemicals on the property.

A staging area for possible fertilizer application was noted in the south central portion of the subject property. A well and ancillary piping were identified in proximity to a fertilizer tank. Soil staining and distressed vegetation were noted at this location. Several tractor-trailers were also staged at this location. Bags of agricultural chemicals were discarded underneath the trailers. Some of the trailers appeared to be used to store pump motors and portable fuel tanks. The remaining trailers were locked with the contents unknown. Several large propane tanks (greater than 500 gallons in capacity) were also staged at this location. Discarded culverts, scrap metal, farm equipment, etc, appeared to be discarded in an area overgrown with vegetation proximal to the fertilizer tank.

Two (2) additional staging areas were noted to the east of the above-described location. Both of these staging areas appeared to be discarded farm equipment "graveyards". Various types of agricultural implements: i.e., tires, tanks, scrap metal, dumpsters, etc. were noted at these locations. A tank that appeared to be used as a burn receptacle was also identified. Petroleum and pesticide odors were detected at both of these locations.

A relatively small (approximately 15'x15') building was noted in the southeast portion of the proposed acquisition area. It appeared that this structure was used to store pesticides, herbicides and other chemicals. A full inventory of the contents of the building was not possible, as the structure was locked at the time of inspection. A mobile home was in the process of being installed on an elevated mound of soil in this portion of the property as well.

A vegetative disposal area was noted in the interior of the parcel. Large stockpiles of rotting vegetables were noted at this location. An active borrow pit was also noted. Beehives were observed to be staged at a remote location of the subject property.

The majority of the remaining subject area consists of cultivated farm fields. Approximately 10-15% of the proposed acquisition area is undeveloped and in natural vegetation. There is also a 10-acre exclusion area located in the interior of the proposed acquisition area that is owned by the Archdiocese of Palm Beach.

A preliminary evaluation of potential off-site contaminant sources identified the Pero Packing House and ancillary functions operated by the Pero Family to the southeast of the proposed acquisition area. This facility was examined at a distance, as Mr. McMurrain indicated we did not have right of entry to this portion of the property and should not attempt to access for purposes of inspection. It appears that there are fuel storage facilities and maintenance activities conducted at this location. There is also evidence of recent construction of a 10-acre pond (approximate). It is undetermined at this juncture, as to the function of this pond.

Following is a summary of potential environmental concerns associated with the McMurrain Farms Ltd. Property, as well as recommendations for additional Phase I Evaluation/ Phase II Sampling Assessment and corrective actions.

- Multiple potential point sources of contamination associated with the agricultural operation were identified. These site conditions, as well as the uncertainty associated with historical and current agricultural chemical application, warranted Phase II sampling to evaluate the presence (or absence) of soil and /or groundwater contamination resulting from site operations. The Phase II portion of this investigation focused upon the pump stations, the staging areas, borrow pit, pesticide storage building and any historical mixing/loading areas identified in a review of previous aerial photography, as well as an additional query of property owner/lessee. Soil and groundwater samples were collected from these locations and analyzed for appropriate pesticide, herbicide and petroleum parameters. Sampling points also included locations within the cultivated areas to establish site-specific background conditions and evaluate the residual concentrations resulting from typical long-term application practices. Sampling results were compared with applicable regulatory criteria to determine the necessity of any required corrective actions. Any required corrective actions include an estimate of probable costs. In addition to the review of historical aerial photography, additional Phase I activities also recommended included regulatory inquiry of possible enforcement conditions associated with on-site or off-site activities and interview of the current operators of the property.

- The agricultural equipment, i.e., vehicles, scrap metal, construction debris and miscellaneous trash noted on the property, particularly at the staging areas, would constitute a solid waste disposal concern if allowed to remain on the property after acquisition. It is recommended that the property owner retain responsibility for removal of all such material.

- It would be necessary to consider the necessity of the pump stations to any future or interim use of the property. If the pump stations are deemed unnecessary for the future use of the property, it is recommended that the property owner retain responsibility for the dismantling and removal of the pump motors, tanks and structures prior to vacating, including all applicable regulatory closure requirements. However, if it is determined necessary to maintain the pump stations in an operational capacity for any future or interim use of the property (by lease agreement), it will be necessary to maintain compliance with all applicable operating requirements to prevent any future releases of petroleum products. This includes the necessity of the eventual closure assessment.

1.3 HISTORICAL DOCUMENTATION

ECT conducted a review of agency records, and environmental documents pertaining to the subject site. The following sections describe this review.

1.4 AERIAL PHOTOGRAPHS

Aerial photographs were selected from all available aerials catalogued by the Palm Beach County Engineering Department. These photographs document significant changes which have occurred onsite and at adjacent sites.

1968 – Review of the earliest available aerial photograph indicates the subject site was dedicated to row crop agricultural operations. Large drainage canals bordered the property on its northern and western boundaries. Small areas remained in their natural vegetative state. The property known as the "Catholic Archdiocese Property" was cultivated at this time.

1973 – During the intervening years, very little change appears to have occurred. Most of the ploughed areas remained cultivated, with the notable exception of the Catholic Archdiocese outparcel, which appears to be reverting back to natural conditions. No large mixing areas were discernible in this photograph.

1984 – Review of this aerial photograph indicates that the area identified as the "central fertilizer tank" area appears to be a centralized staging area, marked by a lack of vegetation and covered with dirt. The Catholic Archdiocese property continues to be covered with natural and maturing vegetation. Farming activities throughout the remainder of the property continue unchanged.

1994 – In the intervening years, specific areas of activity appear to have occurred. The centralized staging area, the borrow pit area to the north of the property, the large equipment graveyard, and the vegetable disposal area are all apparent at this time. Row crop farming remains the land use activity at the site.

1997 – Review of the most recent aerial photograph reflects current site conditions. The property is delineated by major canals on the north and west boundary, and by SR 7 (Highway 441) to the east.

1.5 FEDERAL AND STATE REGULATORY AGENCIES

ECT investigated the following federal and State of Florida regulatory databases through Environmental Data Resources (EDR) electronic search capabilities, to evaluate whether the subject property or adjacent sites within an approximate 0.5-mile radius were listed. The complete report is provided in Appendix B.

1.5.1 LISTING OF AGENCIES

- **Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) List**--The CERCLIS list is a database of sites that have been or are scheduled to be investigated by EPA to determine if an existing or threatened release of hazardous substances is present. *No sites were found on the CERCLIS list within the area of study.*

- **Facility Index System (FINDS) List**--The FINDS list identifies sites subject to regulation under certain EPA programs. The appearance of a site on this list does not necessarily indicate environmental problems on the site, but rather that the site conducts operations that may have a potential to cause environmental degradation if hazardous compounds are released in an uncontrolled manner. *No sites were found on the FINDS list within the area of study.*

- **National Priorities List (NPL)**--The NPL lists sites where environmental contamination has been confirmed. The NPL was devised as a method for EPA to prioritize these sites for the purpose of taking remedial action under the SARA program, which was initially established under the Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and reinstated under SARA. *No sites were found on the NPL list.*

- **Resource Conservation and Recovery Act Index System (RCRIS) List**- The RCRIS list identifies those facilities or locations that have notified EPA of their activities relative to the handling of hazardous wastes. The appearance of a site on this list does not necessarily indicate environmental problems on the site, but rather that the site is (or was) engaged in hazardous wastes handling activities and, therefore, may have the potential to cause environmental degradation if hazardous wastes are mishandled or otherwise released in an uncontrolled manner. *No sites were found on the RCRIS list within the area of study.*

- **Toxic Release Inventory (TRIS) List**--Facilities subject to this reporting requirement are required to complete a toxic chemical release form (Form R) for specified chemicals. The form must be submitted to EPA and those state officials designated by the governor on or before July 1, 1989, and annually thereafter on July 1. These reports reflect releases during the preceding calendar year. *No sites were found on the TRIS list within the area of study.*

- **State Landfill List**—This list identifies facilities permitted by FDEP to conduct solid waste disposal activities. The list includes active and inactive sites (class I and II landfills are allowed to accept non-hazardous waste from domestic, municipal, commercial, and industrial sources). *No sites were found on the State Landfill list within the area of study.*

- **UST and AST Database(s)**--These lists identify those facilities or locations that have registered ASTs and USTs pursuant to notification requirements under Chapters 62-761 and 62-762, F.A.C. The appearance of a site on these lists does not necessarily indicate environmental problems at the site, but rather that the potential for environmental degradation to occur on the site or

on adjacent sites is present if there has been a release from the storage tanks or appurtenances. *Three (3) USTs and two (2) ASTs were found in the area of study. Additional information can be found at the end of this section.*

- **Leaking Underground Storage Tanks (LUST)**--This report identifies facilities and/or locations that have notified FDEP of a possible release of contaminants from petroleum storage systems. This list also includes those sites that have been accepted into the State of Florida Early Detection Incentive Program, which provides for state cleanup funds or reimbursement for cleanup costs associated with sites contaminated as a result of leaking storage tanks. The appearance of a site on this list is an indication that a release has occurred on the site and may pose a potential for environmental degradation of the site and surrounding properties. *Four LUST sites were found within the area of study. Additional information can be found at the end of this section.*

- **Florida Sites (SITES) List**--This list contains sites identified by FDEP as having suspected environmental (groundwater) contamination (excluding petroleum contaminated sites). *No sites were found on the SITES list within the area of study.*

The following facilities were identified on the regulatory database with USTs and/or ASTs in the vicinity of the site: Rangeline Farm Supply, Inc. 12601 SR 7; Pero Family Farms 14095 SR7; Atlantic Growers Nursery on Smith Sundry Road; and Happy Hollow Nursery 9827 Happy Hollow Road. A number of these facilities have also documented releases. However, these facilities are either closed, have had the UST removed, or have had the discharge addressed. As such, none of the referenced facilities are considered to be a concern to the subject site. Pero Family Farms, the abutting packing facility to the south, has three (3) ASTs [two (2) 3,000 gallon and one (1) 2,000 gallon]. These ASTs were installed to replace two (2) 3,000 gallon ASTs removed in 1991. These tanks are located in secondary containment. No concerns were indicated.

As a result of the phase I assessment, the following areas of concern were identified at the McMurrain property and subject to investigation during the phase II ESA:

1. The vicinity of five (5) diesel powered pump stations numbered MP-2 through MP-7, located along the west side of the property boundary;
2. The area marked by the central fertilizer tank;
3. The area of six (6) trailers, located north of the aforementioned AST;
4. The area adjacent to the main 'north to south' canal near the center of the property, called the "large equipment graveyard";
5. The "small equipment graveyard"/burning area, located proximal to the large equipment graveyard;
6. The area adjacent to the small pesticide storage shed;
7. The area adjacent to the new mobile home installation as a background sample;
8. The area proximal to the vegetable disposal area, located in the northwest quadrant of the site;
9. The area adjacent to the currently active borrow pit, located in the north central area of the site;
10. Four (4) background samples;
11. Four (4) canal sediment locations; and
12. Former underground storage tank area.

The phase II investigation was designed to address concerns noted during the phase I site inspection, conducted on April 8, 1999 and March 10, 2000, which indicated potential issues associated with equipment storage, solid waste dumping and historical agricultural uses.

2.0 PHASE II ESA

2.1 OBJECTIVES

ECT, under contract with the South Florida Water Management District, has completed a phase II site assessment in accordance with the ECT proposal dated March 10, 2000 for the McMurrain Farms parcel. The field investigations were performed between the period of March 20 through March 23, 2000. Our evaluation of data and interpretation were completed after the field investigations and receipt of laboratory data.

The focus of the investigation was to identify point sources of contamination associated with agricultural operations and use, and storage of petroleum products and agricultural chemicals. The objectives of this Environmental Site Assessment were to: (1) further evaluate areas of environmental concern through the collection and evaluation of field data (2) identify and delineate potential exclusion areas, if appropriate, and (3) develop a remedial strategy, where appropriate, and associated cost estimates to implement corrective actions at identified areas. The areas subject to review during the phase II investigation are as follows.

1. The vicinity of five (5) diesel powered pump stations numbered MP-2 through MP-7, located along the west side of the property boundary;
2. The area marked by the central fertilizer tank;
3. The area of six (6) trailers, located north of the aforementioned AST;
4. The area adjacent to the main 'north to south' canal near the center of the property, called the "large equipment graveyard";
5. The "small equipment graveyard"/burning area, located proximal to the large equipment graveyard;
6. The area adjacent to the small pesticide storage shed;
7. The area adjacent to the new mobile home installation as a background sample;
8. The area proximal to the vegetable disposal area, located in the northwest quadrant of the site;
9. The area adjacent to the currently active borrow pit, located in the north central area of the site;
10. Four (4) background samples;
11. Four (4) canal sediment locations; and
12. Former underground storage tank area.

3.0 APPLICABLE REGULATORY STANDARDS

3.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Applicable or relevant and appropriate requirements (ARARs) include those provisions of the Florida Administrative Code (FAC) which are relevant to the assessment and remediation of environmental concerns identified during this site investigation. This includes provisions for the proper handling and disposal of solid and hazardous waste, proper management and storage of petroleum in underground and aboveground tanks, and procedures for proper assessment and remediation of petroleum and non-petroleum contaminants. A summary of various, applicable chapters and sections of Florida Administration Code are provided below.

3.1.1 SOLID WASTE MANAGEMENT FACILITIES-CHAPTER 62-701, FAC

The intent of this chapter is to establish standards for the construction, operation, and closure of solid waste management facilities to minimize their threat to public health and the environment; to provide for the safe handing, storage, transportation, disposal or beneficial use of ash residue from the combustion of solid waste to regulate the production and use of compost made from solid waste; to establish a comprehensive program for the proper management and recycling of used oil; to regulate waste tire storage, collection, transport, processing, recycling, reuse and disposal; to establish procedures for disbursement of recycling and education grants, small county grants, waste tire grants, litter control and prevention grants, and small county landfill closure grants to local governments for recycling and solid waste education to provide a uniform procedure by which certain persons in this state who handle, purchase, receive, recover, sell or are end users of recovered materials shall be certified by and report to the Department and register with and report to certain local governments; and to implement the provisions of the Florida Solid Waste Management.

Solid Waste-Unless authorized by the Department permit or site certification in effect on January 5, 1993, no solid waste shall be stored or disposed of by being placed:

1) In an area where geological formations or other subsurface features will not provide support for the solid waste;
2) In any area where the absence of geological formations or subsurface features would allow for the unimpeded discharge of waste or leachate to ground or surface water;
3) Within 500 feet of an existing or approved potable water well unless disposal takes place at the facility for which a complete permit application was filed or which was originally permitted before the potable water well was in existence;
4) In a dewatered pit unless the pit is lined and permanent leachate containment and special design techniques are used to ensure the integrity of the liner;
5) In an area subject to frequent and periodic flooding unless flood protection measures are in place;
6) In any natural or artificial body of water including groundwater; or
7) Within 200 feet of any natural or artificial body of water, including wetlands within the jurisdiction of the Department, except bodies of water contained completely within the property boundaries of the disposal site, which do not discharge from the site to surface waters. Note: These provisions represent the pertinent sections of Chapter 62-701, FAC, and it is not intended to be a complete summary of the regulation.

3.1.2 ABOVEGROUND STORAGE TANK SYSTEMS-CHAPTER 62-762, FAC

Five (5) aboveground storage tanks of approximately 500-gallon capacity each were observed at the pump stations. Based upon their size, these tanks are not required to be registered with the State.

3.1.3 PETROLEUM CONTAMINATED SITE-CHAPTER 62-770, FAC

The clean-up criteria contained in Chapter 62-770, FAC, apply to cleanup of a site contaminated with petroleum or petroleum products. The cleanup criteria does not apply to: (1) petroleum or petroleum products contaminated with significant quantities of other substances; (2) any refined derivatives or by-products of crude oil, natural gas, or other

naturally occurring hydrocarbons, except those defined as petroleum product in Section 376.301, FS; or (3) any discharge of petroleum or petroleum products of less than 25 gallons onto a pervious surface, as long as the discharge is removed and properly treated or properly disposed, or otherwise remediated, so that no contamination from the discharge remains on site.

Cleanup target levels for petroleum products' chemical of concern found in groundwater shall be the applicable State water quality standards, except where site-specific, alternative cleanup target levels have been established. In addition, where groundwater contaminated with petroleum or petroleum products' chemicals of concern is discharging into surface water or when available information indicates that it may discharge in the future, the cleanup target levels are also based on the surface water standards. Cleanup target levels for petroleum products' chemicals of concern found in soil, or alternative cleanup target levels are enforceable under this chapter and apply only in the rehabilitation of a site contaminated with petroleum or petroleum products.

3.1.4 GROUNDWATER PERMITTING AND MONITORING REQUIREMENTS-CHAPTER 62-522, FAC

The criteria outlined in Chapter 62-522, FAC apply to direct and indirect discharges into groundwater which causes a violation in the water quality standards and criteria for receiving groundwater as established in Chapter 62-520, FAC, except with a zone of discharge established by rule or permit pursuant to this Chapter. Dimensions for zones of discharges for Class G-11 groundwater, permit and monitoring requirements and exceptions and groundwater corrective action criteria are described in Chapters 62-522.500 through 62-522.700, FAC.

3.1.5 CLEANUP CRITERIA-CHAPTERS 62-785 AND 62-777, FAC

These chapters are established for the purpose of protecting the public health and the environment under actual circumstances of exposure and for determining, on a site-specific basis, the rehabilitation program tasks that comprise a site rehabilitation program and the levels at which a rehabilitation program task and site rehabilitation program may be deemed

completed. Risk based corrective action principles are incorporated, to the maximum extent feasible, to achieve protection of human health and safety and the environment in a cost-effective manner. These chapters provide both default cleanup target levels and a process for the derivation of site-specific alternative cleanup target levels that are protective of human health and safety and the environment.

3.1.6 APPLICABLE CRITERIA

Applicable State of Florida water quality standards for surface water pursuant to Chapter 62-302, FAC and groundwater pursuant to Chapters 62-520 and 62-550, FAC were utilized as cleanup target levels for each contaminant found in groundwater except where alternative cleanup target levels have been established. Where contaminated groundwater was observed or reported to discharge to surface water or when available information indicates that it may discharge to the surface water in the future, the cleanup target levels for the contaminant were based on the surface water standards and criteria. State water quality standards were applied as follows:

- Cleanup target levels for each contaminant found in groundwater shall be the applicable state water quality standards. Where such standards do not exist the cleanup target levels for department shall consider the following, as appropriate, in establishing the applicable minimum criteria: calculations using a lifetime cancer risk level of 1.0E-6 a hazard index of 1 or less; the best achievable detection limit; the naturally occurring background concentration; or nuisance, organoleptic and aesthetic considerations.

- Where surface waters are exposed to contaminated groundwater, the cleanup target levels for the contaminants shall be based on the lower of the groundwater or surface water standards as established by department rule. The point of measuring compliance with the surface water standards shall be in the groundwater immediately adjacent to the surface water body.

- The department may set alternative cleanup target levels based upon the person responsible for site rehabilitation demonstrating, using site-specific modeling and risk assessment studies, that human health, public safety, and the environment are protected to the same degree as provided above. Where a state water quality standard is applicable, a deviation may not result in the application of cleanup target levels more stringent than the standard. In determining whether it is appropriate to establish alternative cleanup target levels at a site, the department must consider the effectiveness of source removal that has been completed at the site, and the practical likelihood of the use of low yield or poor quality groundwater, the use of groundwater near marine surface water bodies, the current and projected use of the affected groundwater in the vicinity of the site, or the use of groundwater in the immediate vicinity of the contaminated area, where it has been demonstrated that the groundwater contamination is not migrating away from such localized source, provided human health, public safety, and the environment are protected.

3.1.7 CLEAN SOIL/SEDIMENT CRITERIA

Based upon projected future land use, sediment quality criteria as stipulated in the FDEP document entitled Development and Evaluation of Sediment Quality Assessment Guidelines-Volume 1, dated November 1994, was applied. If sediment quality criteria was not available, the most conservative soil cleanup target levels (SCTLs) were applied. The FDEP lists two types of SCTLs; those based on Direct Exposure (human health) and those based on Leachability (protection of the groundwater). There are two sets of Direct Exposure SCTLs (columns 1 and 2), based on different land use assumptions. The first set (direct exposure I) includes values calculated for a residential scenario; the second set (direct exposure II) includes values calculated for an industrial scenario. For this assessment the values were applied to all agricultural operations. There are four sets of SCTLs: (1) based on leachability [based on groundwater cleanup target levels (GCTLs)] (2) levels of GCTLs and freshwater surface criteria, (3) surface water criteria for resource protection/recovery, and (4) groundwater of low yield/poor quality, which are derived (back-calculated) from the

groundwater cleanup target levels (based on one of the previously mentioned four water quality criteria). This means that soil with concentrations at or below the appropriate leachability based concentration should not leach at concentrations exceeding the corresponding groundwater standards (based on one of the previously mentioned four water criteria). Except as described below, to qualify for an NFA without conditions, the Chemicals of Concern (COCs) detected in soil samples from the vadose zone must meet both the Direct Exposure cleanup levels for a residential scenario and the leachability cleanup levels based on the default groundwater cleanup levels. In most cases, sediment quality criteria, if available, was applied.

4.0 ENVIRONMENTAL SETTING

4.1 EVERGLADES PROGRAM

Florida's Everglades Forever Act (Chapter 94-115, Laws of Florida; now contained in Section 373.4592 Florida Statutes) outlined a comprehensive plan to restore portions of the remaining Everglades ecosystems. The general goal of the Everglades Forever Act is to improve water quality, water quantity and to prevent the spread of exotic flora and fauna species. The overall restoration and cleanup effort is referred to as the Everglades Program. The Act outlines a comprehensive program to ensure that all state water quality standards are met by December 31, 2006 and that no water entering the Everglades Protection Area Water Conservation Areas (WCAs 1, 2A and 3A) causes an imbalance in the natural populations of aquatic flora and fauna. For areas that are already impacted, the Act requires a net improvement be provided (SFWMD, 1992).

The area identified for restoration is referred to as the Everglades Protection Area which extends from Water Conservation Area 1 and the Arthur R. Marshall Loxahatchee National Wildlife Refuge in western Palm Beach County generally south to the Everglades National Park. The Everglades Protection Area is situated west of the McMurrain Farms property, occupying the area between Lake Okeechobee and the water conservation areas. Figure 3 (Attachment B) illustrates the location of the Everglades Agricultural Area (EAA) and the water conservation areas.

4.1.1 SURFACE WATER HYDROLOGY

The Everglades Agricultural Area (EAA) was founded in the 1920's when approximately 700,00 acres of marsh land associated with the Everglades were drained to evaluate the agricultural potential of the organic rich peat or mulch soil deposits. Prior to the construction of the canal systems, there was relatively unrestricted surface water flow from Lake Okeechobee across the Upper Glades, south through the Everglades to Florida Bay.

Presently, both the shallow groundwater and the surface water are regulated through a network of canals, pump stations and control structures. The surface water management basins of the EAA were first delineated in the 1950's by the Army Corps of Engineers (Corps). Based on the hydrology of these basins, the Corps designed and constructed a complex system of canals, levees, and water control structures to provide flood protection for southern and central Florida. Six major canals, the West Palm Beach, Hillsboro, Miami, North New River, Cross and Bolles canals, represent the primary drainage canals for the EAA. These canals have four functions: (a) to provide flood protection and drainage, (b) to supply irrigation water to the EAA and for municipal water supply for the city of West Palm Beach, (c) to make regulatory releases from Lake Okeechobee, and (d) to transfer water from storage in Lake Okeechobee to storage in the Water Conservation Areas. The EAA is comprised of seven water management basins named primarily after the major pump station, which drains each basin. These basins include the S-2, S-3, S-5A, S-6, S-7, S-8 and L-8 basins. (SFWMD, 1992)

4.1.2 SURFACE WATER RUNOFF

Farmers remove runoff water from their lands by pumping to the six canals serving the EAA. Growers in general are allowed a maximum removal rate that is determined by a runoff formula and is almost always in excess of the basin wide design rate of three-quarters of an inch of runoff per day. This amount was based on three considerations: (1) that not all land in the basin would be in agricultural production at one time, (2) that some of the land would be planted to water tolerant crops, and (3) that the canals in the basin have some storage capacity. Although the capacity of the canal system was not designed large enough to handle all the water discharged into from the EAA at one time, it was assumed that not all of the growers pump stations would be pumping or pumping to capacity at any given time (SFWMD, 1992).

4.2 SURFACE WATER CHARACTERISTICS

4.2.1 SITE TOPOGRAPHY/PHYSIOGRAPHY

Palm Beach County is divided into three physiographic subdivisions: the coastal ridge, the sandy flatlands, and the Everglades. The coastal ridge parallels the coast and extends

inland 2 to 3 miles from the ocean. The Everglades occupies much of the west and southwest two-thirds of the county. The sandy flatlands lie between the coastal ridge and the Everglades. The elevation of the coastal ridge ranges from 25 to 40 ft National Geodetic Vertical Datum (NGVD) and extends as much as 30 ft above the adjacent sandy flatlands. The sandy flatlands range in natural elevation from 10 to 15 ft NGVD adjacent to the coastal ridge. The highest elevation in the sandy flatlands area is about 25 ft NGVD at the northern boundary of the county where the area slopes to the east and south. Elevations are least immediately west of the coastal ridge and at the Broward County line. The Everglades is virtually flat and ranges only from 16 ft in the north to 18 ft NGVD at the Broward County boundary (Land, 1973). The elevation for the site is approximately 15 ft NGVD [University Park Quadrangle, U.S. Geological Survey (USGS), 1983]. Figure 4 is a topographic map of the site vicinity (Attachment B).

4.2.2 SURFACE WATER BODIES

Based on visual observations and the 7.5-Minute USGS Quadrangle Maps for the site vicinity, the major surface water bodies are the series of major and minor canals constructed by the Army Corps of Engineers for Flood Control between Lake Okeechobee and South Florida. In addition, review of the University Park Quadrangle, Palm Beach County, indicates the major surface water bodies in the vicinity of the subject site include the various irrigation and drainage canals associated with the various farms in the vicinity of the site. The L-40 canal is west of the site.

4.2.3 STORM WATER DRAINAGE AND DISCHARGES

The principal surficial drainage features at the subject site are the numerous lateral and longitudinal canals that criss-cross the site, used primarily for drainage. In addition, a prominent perimeter canal along the north and western property boundaries is also present. West of the dyke road is the L-40 canal, which abuts Conservation Area #1, the Loxahatchee National Wildlife Refuge. Drainage at the subject site is expected to occur by infiltration to the underlying aquifer.

4.3 SUBSURFACE GEOLOGICAL CHARACTERIZATION

4.3.1 GEOLOGY

The geologic formations in Palm Beach County are grouped into three hydrologic units: upper, middle, and lower. The upper is a shallow non-artesian aquifer, the lower unit is the deep artesian Floridan aquifer, and the middle unit is a confining bed separating the two aquifers. The shallow aquifer consists of Pamlico sand, Miami oolite, and the Anastasia and Fort Thompson formations of the Pleistocene age, and the Caloosahatchee marl of Pliocene age (Schroeder *et al.*, 1954). The geologic formations are identified in order of occurrence from the land surface downward, with information on each formation tabulated below.

4.3.2 AREA SOIL SURVEYS

Based upon review of the Palm Beach County, United States Department of Agriculture, Soil Conservation Service Soil classified for soils at the site. The site soils include Oldsmar sand and Okeelanta muck, Myakka sand, and Basinger/Myakka sands. A summary of soil descriptions follows.

Os - Oldsmar Sand - This is a nearly level, poorly drained, sandy soil that has a dark colored, weakly cemented layer below a depth of 30 inches over a loamy layer. It is in broad, flatwood areas. It has the pedon described as representative of the series. Under natural conditions, the water table is within 10 inches of the surface for 1 to 3 months during most years. It is within 10 to 40 inches for 6 or more months in most years and recedes to below 40 inches in extended dry periods. Included within this soil mapping unit are small areas of Immokalee, Myakka, Wabasso, Basinger, Holopaw, Riviera, and Tequesta soils; and soils that have a subsurface layer of brown and yellow.

On - Okeelanta Muck - This is a nearly level, very poorly drained, organic soil that has sandy mineral material within a depth of 40 inches. It is in large, fresh water marshes and small, isolated depressions. It has the pedon described as representative of the series. Under natural conditions, the soil is covered by water, or the water table is within 10 inches of the surface for 6 to 12 months in most years, except during extended dry periods. Included within this soil mapping unit are small areas of Pahokee, Lauderhill, Terra Ceia, Okeechobee, Sanibel, and Tequesta soils; and soils that have a slightly higher fiber content and are less well-decomposed.

Table 2. Geologic Formations and Characteristics in Palm Beach County

Age	Formation	Characteristics	Water Bearing Characteristics
Recent and Pleistocene	Soils Lake Flirt marl	Peat and muck; laterite. White to gray calcareous mud, rich with shells of *Helisoma* sp., a fresh-water gastropod. In some places casehardened to a dense limestone. Relatively impermeable.	
Pleistocene (Formations are Contemporaneous in part)	Pamlico sand	Quartz sand, white to black or red, depending upon nature of staining materials, very fine to coarse, average medium. Mantles large areas underlain by Miami oolite and Anastasia formation.	Small yields to domestic wells
	Anastasia formation	Coquina, sand, calcareous sandstone, sandy limestone, and shell marl. Probably composed of deposits equivalent in age to marine members of Fort Thompson formation. Fair to good aquifer.	Important shallow aquifer. Fair to good yields.
	Miami oolite	Limestone, oolitic, soft, white to yellowish, containing streaks or thin layers of calcite, massive to crossbedded and stratified; generally perforated with vertical solution holes. Fair to good aquifer.	Shallow aquifer. Good yields.
	Fort Thompson formation	Alternating marine, brackish-water and fresh-water marls, limestones, and sandstone. A major component of the highly permeable Biscayne aquifer of coastal Dade and Broward counties, which yields copious supplies of groundwater.	Shallow aquifer. Fair yields.
Pliocene	Caloosahatchee marl	Sandy marl, clay, silt, sand, and shell beds. Yields groundwater less abundantly than most other parts of the Biscayne aquifer.	Shallow aquifer. Fair yields.
Miocene	Tamiami formation	Cream, white, and greenish-gray clayey marl, silty and shelly sands, and shell marl, locally hardened to limestone. Upper part, where permeability is high, forms the lower part of the Biscayne aquifer. Lower and major part of formation is of low permeability and forms the upper beds of the aquiclude that confines water in the Floridan aquifer (Ocala and associated limestones) below.	Fair yields. Upper part of aquiclude.

Source: Appraisal of Water Resources of Palm Beach County (L. Land, *et al.*, 1973) (fr. Schroeder, *et al.*, 1954).

Mk - Myakka Sand- This is a nearly level, poorly drained, deep, sandy soil that has a dark colored layer, weakly cemented with organic matter, above a depth of 30 inches. It is in broad, flatwoods areas in the eastern part of the survey area. This soil has the pedon described as representative of the series. Under natural conditions, the water table is within 10 inches of the surface for 2 to 4 months in most years. It is within a depth of 10 to 40 inches for 6 months or more in most years and recedes to below 40 inches during extended dry periods. Included within this soil-mapping unit are small areas of soils that have a thick, dark colored surface layer and small areas of Immokalee, Pomello, Basinger, Wabasso, and Oldsmar soils.

BM - Basinger and Myakka sands, depressional - These are nearly level, very poorly drained, sandy soils in shallow depressions. The depressions are small to large isolated ponds or poorly defined narrow drainage ways that have many branches. Generally, Basinger soils make up about 45 percent of this complex. Both soils can occur separately or together. The water table is above the surface for 3 to 9 months or more in most years. Included within this soil-mapping unit are small areas of Pompano, Placid, Anclote, and Sanibel soils.

4.4 FLOOD POTENTIAL

According to the Federal Emergency Management Agency's ("FEMA") Flood Insurance Rate Map, the subject property has been designated as Zone B. These areas are between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (FEMA)

4.5 RADON POTENTIAL

The principal natural source of radon is soil gas. Radon is the product of the uranium decay chain. Existing information on radon soil gas and indoor radon studies strongly suggests that terrain overlying uranium occurrences has the highest probability of producing elevated radon levels (Makofske, 1987). In Florida, reclaimed phosphate mining areas and unmined phosphate lands have been recognized as areas for potential radon problems. The location of phosphate districts is restricted to southeast, central and north Florida (Figure 5 of Attachment B). The potential for elevated natural radon occurrence in Palm Beach County is low.

4.6 GROUNDWATER CHARACTERISTICS

4.6.1 HYDROLOGIC MAPS

According to the Palm Beach County Wellfield Protection Map, the subject site is located two miles west of the contour for the Palm Beach County System 3 municipal wellfield (located east of the Florida Turnpike). (Figure 6 of Attachment B)

4.6.2 AQUIFERS OF CONCERN

Two aquifer systems are present within Palm Beach County. These are the water-table or non-artesian aquifer and the Floridan aquifer. These aquifer systems are separated by the Hawthorn formation (Schroeder *et al.*, 1954). The non-artesian, water table aquifer is estimated to be at least 250 ft thick at the coast and tapers to less than 100 ft in the western part of the county. The non-artesian aquifer extends downward to the top of the confining beds which cover the Floridan aquifer. Groundwater from the shallow aquifer is the principal source of water for most uses in Palm Beach County. Water quality is variable and is related to formation permeability. The water quality is best along the Coastal Ridge and poorest west toward the Everglades. The sandy flatland area contains water of transitional quality. Virtually all of Palm Beach County's water supply for potable consumption, industry, and irrigation is withdrawn from wells in the shallow aquifer. The aquifer has been designated by the U.S. Environmental Protection Agency (EPA) as a "sole source" drinking water supply and is classified as G-II water by the Florida Department of Environmental Protection (FDEP).

4.6.3 DEPTHS TO GROUNDWATER

The water table in the area occurs in the sand and limestone beds of the hydraulic unit, which consists of the Pamlico sand, Miami Oolite, and Anastasia and Fort Thompson formations. Depth to groundwater varies seasonally, generally reflects the topography, which is flat, and ranges between 2 and 5 ft bls. Recharge to the surficial aquifer is predominantly by local rainfall and seepage from canals.

4.6.4 GROUNDWATER UTILIZATION

Virtually all of Palm Beach County's water supply for potable consumption, industry, and irrigation is withdrawn from wells in the shallow aquifer. The aquifer has been classified as G-II water by FDEP.

4.6.5 DIRECTIONAL FLOW CHARACTERISTICS OF GROUNDWATER

The regional groundwater flow direction is generally southeast to east, although flow directions in the water table are locally influenced by proximal water bodies/drainage canals, rainfall mounding, and the adjacent water conservation areas.

5.0 PHASE II ESA INVESTIGATIVE METHODOLOGY

To address concerns associated with petroleum and agricultural chemicals, ECT developed a proposal for the collection of soil, sediment, and groundwater at the McMurrain Farms property. The proposal included specific investigative methodologies for the collection and analysis of field data, proposed sample locations, a general schedule of field activities, and methods used to collect and analyze field samples. A discussion of constituents of concern, and general investigative methodologies and procedures is provided below:

5.1 CONSTITUENTS OF CONCERN (COCs)

There are three primary groups of COCs, which have the potential to impact soil, sediment, and groundwater at the McMurrain Farms site. These include: (1) agricultural chemicals; (2) petroleum hydrocarbons; and (3) metals.

5.1.1 AGRICULTURAL CHEMICALS

ECT's April 8, 1999 and March 10, 2000 site walkthrough identified areas where pesticides and herbicides may have impacted the soil and groundwater. These areas included pesticide storage and mix areas and equipment staging areas. To evaluate soil and groundwater in these areas for the presence of residual pesticides, a limited soil and groundwater investigation for these constituents was conducted. In those areas where pesticides were the suspected COCs, soil and groundwater samples were collected for laboratory analyses by EPA Methods 8081 (Chlorinated Pesticides), 8141 (Organophosphorus Pesticides and Triazine Herbicides), 632 (carbamate urea pesticides), 8150 (Chlorinated Pesticides) and 8 RCRA metals plus copper and lead. Specific pesticide analytical methods were selected based on historical use, environmental persistence, and hazardous characteristics.

5.1.2 PETROLEUM HYDROCARBONS

Several areas of concern were identified at those locations where aboveground petroleum storage tanks were present; as well as areas with suspected impacted soil and groundwater. ECT's preliminary field reconnaissance also identified areas with obvious petroleum staining of the surficial soils. To evaluate soil and groundwater for the presence of

petroleum hydrocarbons, field screening of soils with an Organic Vapor Analyzer (OVA) was conducted and three laboratory analytical methods were utilized, including EPA Method 8021 (volatile and semi-volatile aromatic hydrocarbons), 8270 (polynuclear aromatic hydrocarbons), and Florida Petroleum Range Organics (FL PRO).

5.1.3 METALS

During the course of ECT's assessment, areas of concern where metals may have impacted the soil and/or groundwater were identified. These areas of concern included pesticide mixing/loading areas and equipment staging areas. To evaluate the soil and groundwater in these areas of concern for elevated metals, a limited soil and groundwater investigation was completed which included initial testing for 10 metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, copper and zinc.

5.2 INVESTIGATIVE DESIGN

Investigative design considered collection of soil and/or groundwater samples at those areas or facilities across the property associated with the identified constituents of concern. These areas or facilities included: (1) pump stations; (2) equipment staging areas; (3) pesticide mixing and loading areas, and solid waste and farm machinery staging sites. The following is a summary of the investigative design for those recurring features and Figure 7 is a map illustrating the areas of investigation (Attachment B).

5.2.1 AGRICULTURAL PUMP STATIONS

Each agricultural pump station generally included one diesel powered canal pump fueled by an approximately 500 gallon capacity aboveground storage tank (AST) with secondary containment. The diesel pump engines were located on a concrete slab and roofed enclosure. None of the pump motors were within secondary containment. Surficial soil stained with petroleum was observed adjacent to these units at two locations. The secondary containment areas around the tanks were of recent construction. Past use of the tanks without the secondary containment may have resulted in petroleum discharges, which were investigated as part of this phase II ESA. Since these tanks are approximately 500-gallon capacity, they are exempt from registration (Chapter 62-762.300, FAC). One soil boring

and one monitoring well was installed at each pump station location to evaluate the presence of any petroleum impacts. The soil borings and well designation were as follows: MP2SB, MP3SB, MP4SB, MP5SB, and MP7SB for the soil borings and MP2MW, MP3MW, MP4MW, MP5MW, and MP7MW for the monitoring wells. Each sample of soil and groundwater was analyzed for FL PRO. Figure 8 illustrates the locations of the soil borings and monitoring wells (Attachment B).

5.2.2 CENTRAL FERTILIZER TANK

The central fertilizer tank area was targeted for assessment due to the storage and mixing of chemicals in this area. One (1) soil boring (CFTSB) and one (1) monitoring well (CFTMW) were installed in this area to evaluate the presence of pesticides, and herbicides in the soil and groundwater. The soil boring and monitoring well locations for the central fertilizer tank is depicted is Figure 9 (Attachment B). The groundwater sample was analyzed for the following methodologies: 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides) and 504.1 (EDB). The soil samples were analyzed for the same parameters plus copper and zinc.

5.2.3 AREA OF SIX TRAILERS

The six trailer area was targeted for assessment due to the storage and mixing of chemicals in this area, as well as for petroleum products due to the presence of petroleum storage tanks housed within the trailers. Two (2) soil borings (STSB-1 and STSB-2) and two (2) monitoring wells (STMW-1 and STMW-2) were installed in this area to evaluate the presence of pesticides, herbicides and petroleum products in the soil and groundwater. The soil boring and monitoring well locations are depicted in Figure 9 (Attachment B). The groundwater samples were analyzed for the following methodologies: 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides), 504.1 (EDB), and FL PRO. The soil samples were analyzed for the same parameters plus copper and zinc.

5.2.4 LARGE EQUIPMENT GRAVEYARD

The large equipment graveyard area was investigated due the presence of old machinery, spray equipment, tanks and miscellaneous debris. A total of six (6) soil samples were collected and submitted as two (2) composite samples (LEGSS-1 and LEGSS-2) and one monitoring well (LEGMW) was submitted for analysis to evaluate the presence of pesticides, herbicides and petroleum products in the soil and groundwater. The soil boring and monitoring well locations for the large equipment graveyard area are illustrated in Figure 10 (Attachment B). The groundwater samples were analyzed for the following methodologies: 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides), 504.1 (EDB), and FL PRO. The soil samples were analyzed for the same parameters plus copper and zinc.

5.2.5 SMALL EQUIPMENT GRAVEYARD

The small equipment graveyard area was investigated due the presence of old machinery, spray equipment, tanks and miscellaneous debris. A total of eight (8) soil samples were collected and submitted as two (2) composite samples (SEGSS-1 and SEGSS-2) and one (1) monitoring well (SEGMW) was submitted for analysis to evaluate the presence of pesticides, herbicides and petroleum products in the soil and groundwater. The soil boring and monitoring well locations for the small equipment graveyard area are illustrated in Figure 10 (Attachment B). The groundwater samples were analyzed for the following methodologies: Eight RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides), 504.1 (EDB), and FL PRO. The soil samples were analyzed for the same parameters plus copper and zinc.

5.2.6 SMALL PESTICIDE SHED

The small pesticide shed area was targeted for assessment due to the storage and mixing of chemicals in this area. One (1) soil boring (SPSSB) and one (1) monitoring well (SPSMW) was installed in this area to evaluate the presence of pesticides and herbicides

in the soil and groundwater. The soil boring and monitoring well location for the small pesticide shed is depicted in Figure 11 (Attachment B). The groundwater sample was analyzed for the following methodologies: 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides) and 504.1 (EDB). The soil sample was analyzed for the same parameters plus copper and zinc.

5.2.7 MOBILE HOME AREA

The unaffected background location was designated as the mobile home area. This area was selected due to its location as a non-cultivated area but representative unaffected background conditions. The soil boring and monitoring well was designated MHBGSB and MHBGMW, respectively. The groundwater sample for this well was analyzed by the following methodologies: 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides) and 504.1 (EDB). The soil sample was analyzed for the same methodologies as the water with the addition of total copper and zinc. Figure 11 illustrates the location of the soil boring and monitoring well in the mobile home area (Attachment B).

5.2.8 VEGETABLE DISPOSAL AREA

A vegetable disposal area for rejected and rotting vegetables was investigated as part of this assessment. This area was targeted to investigate possible impacts associated with pesticide and herbicide use. One (1) soil boring (VDASB) and one (1) monitoring well (VDAMW) were installed in this area. The well and soil boring locations are depicted on Figure 12 (Attachment B). The groundwater samples were analyzed for 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides) and 504.1 (EDB). The soil samples were analyzed for the same parameters plus copper and zinc.

5.2.9 BORROW PIT

A borrow pit used to provide fill material for the levee and road construction on the site was also investigated as part of this assessment. This area was targeted to investigate possible impacts associated with pesticide and herbicide use, as well as petroleum impacts. Two (2) soil borings and one (1) monitoring well were installed in this area. The borrow pit sample locations were designated BPSB-1, BPSB-2, and BPMW for soil and groundwater samples, respectively. The well and soil boring locations are depicted on Figure 13 (Attachment B). The groundwater samples were analyzed for 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides), 504.1 (EDB), and FL PRO. The soil samples were analyzed for the same parameters plus copper and zinc.

5.2.10 BACKGROUND LOCATIONS

Based upon historical use of the property as an agricultural facility cultivated in row crops, background samples were collected to evaluate the presence of any residual agricultural chemicals which could impair the property based upon it's intended future use as a regional attenuation reservoir.

The investigation required the installation of four (4) soil borings and (4) monitoring wells. The well and soil boring locations are depicted on Figure 14 (Attachment B). The following wells and soil borings were installed and sampled to evaluate the presence of any pesticides or herbicides at background locations: BGSB-1 through BGSB-4, and BGMW-1 through BGMW-4. Groundwater samples for these wells were analyzed by the following methodologies: 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides) and 504.1 (EDB). The soils were analyzed for the same methodologies as the water with the addition of total copper and zinc.

5.2.11 SEDIMENT SAMPLES

Four sediment samples were collected from surface water bodies at the facility. The sampling locations are depicted on Figure 15 (Attachment B). The samples were collected approximately 6 inches into the sediments with the use of a ponar sampler. These samples were collected in strategic locations to best target any historical pesticide or herbicide runoff issues from the cultivated and mix areas, which could have a tendency to accumulate in the sediments. The sediment samples were analyzed for 8 RCRA metals, 8141 (organophosphorus compounds), 8150 (chlorinated herbicides), 8080 (organochlorine pesticides), 632 (carbamate/urea pesticides), 8141 (triazine pesticides), and 504.1 (EDB). The sampling designations were CSS-1 through CSS-4.

5.2.12 FORMER UST AREA

According to discussions with Mr. McMurrain, an area was identified on the site where (2) 500-gallon underground storage tanks were located, which contained diesel fuel and gasoline. According to Mr. McMurrain, these tanks were removed in the late 1970's. No closure documents could be located for these tanks. Therefore, the soil and groundwater were analyzed by EPA Methods 8270 (polynuclear aromatic hydrocarbons), 8021 (volatile organic aromatics), and FL PRO (petroleum range organics). The soil borings in the former UST area are designated USTSB-1 and USTSB-2, while the monitoring well is designated USTMW. Figure 11 illustrates the locations of the soil borings and monitoring well (Attachment B).

5.3 INVESTIGATIVE METHODOLOGIES

5.3.1 SOIL BORING INSTALLATION

Soil borings were advanced in areas of potential environmental concern using a truck-mounted rotary drill equipped with standard split spoon samplers. The split spoon sampler consists of two-carbon steel half cylinders (spoons) that fit together to form a two inch diameter tube approximately 2 feet in length. The cylindrical arrangement was maintained by retaining head and bit rings that thread to either end of the spoon assembly.

Samples were collected by driving or pushing the spoon through the soil profile with a slide hammer attached to the drill rods. Typically, the spoons were driven 2 feet or to refusal and a sample was retrieved. The samples were collected by removing the split spoon from the boring and retrieving the soil from the barrel by unscrewing the bit and head rings and splitting the assembly. If a sufficient volume of soil was not obtained from an individual boring, additional borings were advanced in close proximity to the initial soil boring. Soil retrieved from the individual spoons was placed in a clean stainless steel bowl or tray and thoroughly mixed with the other soils using a stainless steel spoon or trowel.

5.3.2 GROUNDWATER MONITORING WELL INSTALLATION

Monitoring wells were installed by a State of Florida licensed driller in accordance with the guidelines specified in the Florida Department of Environmental Protection (FDEP) monitoring well construction guidelines. Monitoring wells were installed using a truck mounted rotary drill utilizing the hollow-stem auger method. This type of auger consists of a hollow, steel stem or shaft with a continuous, spiraled steel flight, welded onto the exterior side of the stem, connected to an auger bit, which when rotating, transports cuttings to the surface. This method is best suited in soils that have a tendency to collapse when disturbed.

The monitoring wells were installed inside of the hollow-stem augers. A wooden bottom plug or pilot bit assembly was fastened onto the bottom of the augers to keep sediments and/or water out of the interior of the augers during the drilling phase. Following the advancement of the augers to the desired depth, the monitoring well installation was accomplished by inserting the well assembly into the hollow stem auger and removing the bottom plug from the terminal end of the auger. As the sand pack material was introduced into the top of the hollow stem assembly, the augers were slowly extracted allowing the sand pack to fill the annular space of the borehole. The sand pack which consisted of a 6/20 grade silica sand extended from the bottom of the well to a depth of approximately 12 feet below grade. The remainder of the annular space was completed with a fine sand seal and grout to the ground surface. Most monitoring wells were finished with locking caps and flush mounted manholes. A generic monitoring well completion diagram is provided in Figure 16 (Attachment B).

The fully assembled, pre-cleaned monitoring well consisted of approximately ten feet of 0.020 inch slot threaded 2-inch diameter, flush joint PVC well screen, cap and 2 feet of threaded riser that is placed into the casing. Typically, the top of the well screen was placed at a depth slightly above the water table.

All well construction materials and drilling equipment were steam cleaned prior to and immediately after installation at each monitoring well. A detailed geologic log during the drilling of the well borings and well construction data was recorded for each monitoring well. Lithological logs are provided in Appendix C. Following monitoring well completion, each well was developed by pumping with a centrifugal pump for approximately 30 minutes. Pumping times and rates were recorded for each well development event.

A total of 19 monitoring wells and 23 soil borings were installed at the McMurrain Farms facility as part of the phase II assessment. Four sediment samples from surface water bodies were also collected.

5.3.3 SAMPLING PROCEDURES

Samples were collected at various locations across the property and included soil, groundwater and sediment samples. All samples were collected in accordance with ECT's approved CompQAP. Sample collection procedures are summarized below:

5.3.3.1 Field Screening

Soil samples were collected using composite sampling. All soil samples were submitted under chain-of-custody to PPB a State of Florida, certified, independent minority business enterprise (MBE) laboratory for analyses. Collected soil samples were analyzed using select EPA Methods that are described on the following table and in the following sections.

Table 3. Summary of Areas of Investigation

Area	Description	Soil Boring	Monitoring Well(s)	Proposed Analysis
1	Five (5) Pump Stations	5	5	**Soil** FL PRO (if positive OVA/FID) **Water** FL PRO
2	Central Fertilizer Tank	1	1	**Soil**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; EPA 8081, EPA 8141, EPA 8150. EPA 632, EPA 504.1
3	Area of Six Trailers	2	2	**Soil**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
4	Large Equipment Graveyard	2*	1	**Soil**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
5	Small Equipment Graveyard	2*	1	**Soil**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
6	Area Adjacent to small pesticide Shed	1	1	**Soil**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
7	New Mobile Home	1	1	**Soil**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1

Table 3. Summary of Areas of Investigation (cont'd)

Area	Description	Soil Boring	Monitoring Well(s)	Proposed Analysis
8	Vegetable Disposal Area	1	1	**Soil**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
9	Borrow Pit	2	1	**Soil**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
10	Central Storage Area	1	1	**Soil**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; FL PRO EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
11	Background	4	4	**Soil**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals; EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
12	Canal Sediment Samples	4	NA	**Sediment:** 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1
13	Underground Storage Tank Area	2	1	**Soil**: FL PRO, 8270, 8021 **Water**: FL PRO, 8270, 8021
	Duplicates/Blanks	3	4	**Soil**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1 **Water**: 8 RCRA Metals, EPA 8081, EPA 8141, EPA 8150, EPA 632, EPA 504.1

Source: ECT 2000

Legend:
*Composite Soil Samples
EPA 8081 - Organochlorine Pesticides
EPA 632 - Carbamate Urea Pesticides
EPA 8141 – Organophosphorous Compounds
EPA 8150 - Chlorinated Herbicides
EPA 8270 – Polynuclear Aromatic Hydrocarbons
EPA 504.1 - Ethylene DiBromide
EPA 8021 – Purgeable Aromatic
FL PRO - Petroleum Hydrocarbons

5.3.3.2 Soil Boring Sampling

Following removal of the split sampler, soil was placed in a stainless steel tray or bowl and thoroughly mixed with a cleaned, stainless steel spoon or trowel. The sample was thoroughly blended by mixing, and dividing into sections. Each section was then mixed separately, recombined and mixed thoroughly. Sectioning and mixing was repeated to ensure proper homogenization. Following mixing, the sample was placed in laboratory approved sample containers. The outside of the sample container was cleaned to remove excess; and the samples placed into ice filled coolers.

5.3.3.3 Groundwater Sample Collection

Groundwater samples were collected from nineteen monitoring wells as part of this investigation to evaluate the potential groundwater impacts on the subject properties. All wells were sampled in accordance with ECT's FDEP approved CompQAP #8900836. Each well was purged with a peristaltic pump to minimize turbidity.

Following the removal of five will volumes of groundwater, the metal samples were collected with the peristaltic pump. The samples for organic analysis were collected with a teflon laboratory pre-cleaned bailer. The water was poured directly from the dedicated bailer into laboratory-supplied containers and placed on ice. Groundwater samples were then delivered to PPB, following chain of custody procedures.

5.3.4 SAMPLE CUSTODY, LABORATORY PROCEDURES AND ANALYSES

All samples transmittal forms were placed in waterproof bags and sealed in transport containers with the samples. Chain-of custody (COC) seals were applied after the containers (coolers) were secured. All shipping bills from common carriers were kept with the forms. All samples that were submitted to a laboratory were accompanied by a sample transmittal or chain-of custody record.

5.3.5 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Quality assurance procedures utilized during this assessment including compliance with the Florida Department of Environmental Protection (FDEP) Standard Operating Procedures for Laboratory Operation and Sample Collection Activities. Specific quality assurance protocols and procedures for the analytical methodologies performed during this assessment were in accordance with PPB ComQAP #870017.

6.0 PHASE II ESA DISCUSSION OF RESULTS

The analytical laboratory results for the soil and groundwater samples for the McMurrain property are summarized on Exhibits 1 and 2 (respectively) of Attachment C. Results are discussed in the following sections. The laboratory analytical data is provided in Appendix D. Photographs illustrating phase II ESA activities are included in Attachment D.

6.1 DIESEL POWERED PUMP STATIONS (MP-2 THROUGH MP-7)

Based upon the soil and groundwater analytical data collected to assess site impacts for the pump station areas, the soil analytical data for MP4SB, MP5&6SB, and MP7SB were below detection limits (BDL) for petroleum hydrocarbons as determined by FL PRO. However, MP2SB and MP3SB had petroleum hydrocarbon detections of 720 and 4600 milligrams per kilogram (mg/kg), respectively. MP2SB was located adjacent to pump station 2 and MP3SB was located adjacent to pump station 3. Both detected concentrations were in excess of the soil cleanup target level of 350 mg/kg for total recoverable petroleum hydrocarbons, as stipulated in Table I of Table IV, Chapter 62-770, Florida Administrative Code, residential use assumptions, as well as Table V[a] of Table IV, Chapter 62-770, FAC, leachability criteria. No groundwater impacts were detected in MP2MW, MP4MW, MP5MW, or MP7MW. However, petroleum hydrocarbons were detected in MP3MW, located adjacent to pump station 3, at a concentration of 4.6 milligrams per liter (mg/L), which is below the groundwater cleanup target level of 5 mg/L, as stipulated in Table V, Chapter 62-770, FAC. Figure 8 is a sample location map illustrating the locations of the soil borings and monitoring wells proximal to each of the pump stations (Attachment B).

6.1.1 PUMP STATION (MP-2 & MP-3) CLOSURE ACTIVITIES

Between July 17 and July 21, 2000, ECT conducted oversight of soil excavation activities performed by CRB at pump station 2 and pump station 3. This work was performed under contract with Palm Beach County. A total of five (5) truck loads (approximately 110 tons of petroleum impacted soil) were removed from the two excavations. Soil

analytical results indicated elevated concentrations of petroleum constituents were detected around the pilings at both pump stations. Additional excavation activities were performed and the excavated areas were backfilled with limerock, compacted in two (2) foot lifts. After backfilling was completed, on July 21, 2000, Nutting Environmental (Nutting) installed two (2) 2-inch temporary wells; one well was installed in each excavation area, located as close to the pump as possible. Both wells were developed and purged by Nutting. Samples were collected from each well by ECT and submitted for laboratory analysis by EPA methods 8270 and FL PRO. After sample collection, both wells were removed and the borings were backfilled. Figures 17 and 18 illustrate the areas of excavation for MP-2 and MP-3, respectively (Attachment B).

6.1.2 LABORATORY ANALYTICAL DATA

Laboratory analytical results from the temporary well at pump station 2 (MP-2) indicated the presence of TPH at a concentration of 1.3 mg/L, naphthalene at 20 µg/L, and 2-methylnaphthalene at 16 µg/L. Laboratory analytical results from pump station 3 (MP-3) indicated the presence of TPH at a concentration of 2.8 mg/L, 2-methylnaphthalene at 64 µg/L, and 1-methylnaphthalene at 61 µg/L. Both concentration levels of TPH are below the groundwater cleanup target level of 5 mg/L, as stipulated in Table V, Chapter 62-770, FAC. The concentration of naphthalene at pump station 2 was at the groundwater cleanup target level of 20 µg/L, and well below the natural attenuation default source concentration of 200 µg/L, as stipulated in Table IX, Chapter 62-770, FAC. The concentration of 2-methylnaphthalene at pump station 2 is below the groundwater cleanup target level of 20 µg/L, as stipulated in Table 1, Chapter 62-777, FAC; the concentration at pump station 3 is above the groundwater cleanup target level, but below the natural attenuation default source concentration of 200 µg/L, as stipulated in Table V, Chapter 62-777, FAC. The concentration of 1-methylnaphthalene at pump station 3 is above the cleanup target level of 20 µg/L, but below the natural attenuation default source concentration of 200 µg/L, as stipulated in Table I and Table V (respectively), Chapter 62-777, FAC. Based upon the groundwater analytical results, ECT recommends a monitoring only plan be conducted for pump station 3. If this proposed monitoring plan

is implemented, ECT will perform these services under contract with Palm Beach County. No further action is recommended for pump station 2. A complete copy of the closure document, prepared by ECT for Palm Beach County, is provided in Appendix E.

6.2 CENTRAL FERTILIZER TANK

Based upon the soil and groundwater analytical data collected to assess site impacts in the area of the central fertilizer tank, the soil analytical data for CFTSB indicated the presence of arsenic, barium, cadmium, chromium, copper, lead, selenium and zinc. However, these levels were below applicable sediment quality assessment guidelines toxic effect levels or the applicable soil cleanup goals stipulated in Chapter 62-777, FAC. Groundwater collected from CFTMW indicated the presence of arsenic, barium, and chromium. However, the concentrations were less than the groundwater cleanup target levels as stipulated in Chapter 62-770, FAC. No further action or assessment is recommended for the central fertilizer tank area. Figure 9 illustrates the locations of the soil borings and monitoring wells in the central fertilizer tank area (Attachment B).

6.3 AREA OF SIX TRAILERS

Soil and groundwater analytical data was collected to assess site impacts in the area of the six trailers, north of the central fertilizer tank. STSB-1 was located east of the trailers and STSB-2 was located west of the trailers. Soil data from STSB-1 was BDL with the exception of barium, chromium, copper, selenium, and zinc. However, these levels were below applicable sediment quality assessment guidelines toxic effect levels (TELs) or the applicable soil cleanup goals stipulated in Chapter 62-777, FAC. STSB-2 indicated the presence of barium, chromium, copper, lead, selenium and zinc. These levels were also below applicable sediment quality assessment guidelines TELs or the applicable soil cleanup goals stipulated in Chapter 62-777, FAC. Total chlordane was detected at a concentration of 4.2 micrograms per kilogram (µg/kg) in STSB-2, which is above the referenced toxic effect level for Florida of 2.26 µg/kg. Based upon a site specific ecological risk assessment for the property, chlordane does not pose any significant risk to any target species. See Appendix F (McMurrain Farms Prospective Ecological Risk Assessment, URS, 2000) for a complete discussion of the ecological risk assessment.

Groundwater analysis for STMW-1 indicated the presence of arsenic, barium, chromium, lead, and selenium. Groundwater analysis for STMW-2 indicated the presence of arsenic, barium, and chromium. The concentrations detected in STMW-1 and STMW-2 were less than the groundwater cleanup target levels as stipulated in Chapter 62-770, FAC. No further action or assessment is recommended for the area of six trailers. Figure 9 illustrates the locations of the soil borings and monitoring wells in the area of six trailers (Attachment B).

6.4 LARGE EQUIPMENT GRAVEYARD

Soil and groundwater analytical data was collected to assess site impacts in the area of the large equipment graveyard. Three surface soil samples (0-6 inches) were collected on the northern end of the large equipment graveyard and submitted as a composite sample (LEGSS-1) for analysis. Laboratory analysis for LEGSS-1 indicated the presence of petroleum hydrocarbons, baygon, arsenic, barium, cadmium, chromium, copper, lead, silver, and zinc. All are below applicable regulatory standards or SQAGs with the exception of baygon, copper and lead. Copper and lead were detected at concentrations of 25.4 mg/Kg and 35.0 mg/Kg, respectively. The published SQAGs for copper and lead are 18.7 mg/Kg and 30.2 mg/Kg, respectively. Additionally, three surface soil samples were collected on the southern end of the large equipment graveyard and submitted as a composite soil sample (LEGSS-2) for analysis. Analytical results indicated the presence of baygon, arsenic, barium, cadmium, chromium, copper, lead, zinc and toxaphene. All concentrations are below applicable regulatory standard with the exception of baygon, copper, and toxaphene, which were detected at concentrations of 8.9 µg/kg, 34.1 mg/kg, and 450 µg/kg. Based upon the ecological risk assessment (Appendix F), the concentrations of baygon, copper and toxaphene in this area should not pose any significant risk to relevant ecological receptors. Groundwater analytical results indicated the presence of barium and chromium, both of which are below groundwater cleanup target levels as stipulated in Chapter 62-770, FAC. ECT does not recommend any further assessment or remediation in this area. Figure 10 illustrates the locations of the soil borings and monitoring well (Attachment B).

6.5 SMALL EQUIPMENT GRAVEYARD

Soil and groundwater analytical data was collected to assess site impacts in the area of the small equipment graveyard. Four surface soil samples (0-6 inches) were collected on the eastern potion of the small equipment graveyard and submitted as a composite sample (SEGSS-1). Analytical results indicated the presence of arsenic, barium, cadmium, chromium, copper, lead, selenium, silver, zinc, and toxaphene. All concentrations are below applicable regulatory standards or SQAGs, with the exception of toxaphene, which was detected at a concentration of 340 µg/kg. Based upon the ecological risk assessment (Appendix F), the concentration of toxaphene in this location should not pose any significant risk to relevant ecological receptors.

Additionally, four surface soil samples (0-6 inches) were collected on the western potion of the small equipment graveyard and submitted as a composite sample (SEGSS-2). Laboratory analytical results indicated the presence of arsenic, barium, chromium, copper, lead, zinc, and endosulfan. All concentrations were below applicable regulatory guidelines and applicable SQAGs. SEGMW was installed in the vicinity of SEGSS-1, the area of severest staining. Laboratory analytical results indicated the presence of arsenic, barium, chromium, and selenium. All concentrations were below applicable regulatory guidelines. On this basis, no further action or assessment is recommended for this area. Figure 10 illustrates the locations of the soil borings and monitoring well (Attachment B).

6.6 SMALL PESTICIDE SHED

Soil and groundwater analytical data was collected to assess site impacts in the area of the small pesticide shed. One soil boring (SPSSB) was installed on the eastern side of the shed, near the entrance. Laboratory analytical results indicated the presence of barium, chromium, copper, lead, and zinc. All concentrations are below applicable regulatory guidelines or applicable SQAGs. Groundwater collected from SPSMW indicated the presence of arsenic, barium, and chromium. All concentrations are below applicable regulatory standards. No further action or assessment is recommended for this area. Figure 11 illustrates the location of the soil boring and monitoring well (Attachment B).

6.7 MOBILE HOME AREA

Soil and groundwater analytical data was collected to assess site impacts in the area of the mobile home. One soil boring (MHBGSB) was installed southwest of the mobile home. Laboratory analytical results indicated the presence of barium, chromium, copper, and zinc. All concentration levels are below applicable regulatory guidelines or published SQAGs. Groundwater collected from the corresponding monitoring well (MHBGMW) indicated the presence of chromium and lead. This well was resampled on April 24, 2000, and the concentrations of both of the constituents were BDL. All concentration levels are below applicable regulatory standards. No further action or assessment is recommended for this area. Figure 11 illustrates the location of the soil boring and monitoring well (Attachment B).

6.8 VEGETABLE DISPOSAL AREA

Soil and groundwater analytical data was collected to assess site impacts in the vegetable disposal area. One soil boring (VDASB) was installed on the north side of the vegetable stock pile. Laboratory analytical results indicated the presence of barium, chromium, copper, lead, and zinc. All concentration levels are below applicable regulatory guidelines and applicable SQAGs. Groundwater collected from the corresponding monitoring well (VDAMW) indicated the presence of arsenic, barium, chromium, lead, selenium and silver. All concentration levels are below applicable regulatory standards. Figure 12 illustrates the location of the soil boring and monitoring well (Attachment B).

The vegetative staging area was historically and is currently used to stage vegetables (bell peppers and cucumbers) that are not suitable for sale. It is ECT's opinion as well as our understanding based on conversation with the USEPA and USFWS that the vegetative staging area would have a negative impact on the operation of the proposed reservior.

ECT recommends that samples of materials in the vegetative staging area be collected for characterization. Subsequent to characterizing this material, a corrective action plan should be prepared. The recommended corrective action for this area of the property

would include screening the staging area material to segregate non-vegetative material, such as plastic, steel, concrete, etc., from the organic materials. The organic materials should then be spread on the property. The non-organic material should be removed from the property for offsite disposal.

6.9 BORROW PIT

Soil and groundwater analytical data was collected to assess potential impacts in the area of the borrow pit. One soil boring (BPSB-1) was installed near the southwestern boundary of the borrow pit and one soil boring (BPSB-2) was installed near the southeastern boundary. Laboratory analytical results from BPSB-1 indicated the presence of barium, chromium, copper, lead, selenium, and zinc. Laboratory results from BPSB-2 indicated the presence of barium, chromium, copper, and zinc. All concentration levels are below applicable regulatory guidelines or SQAGs. Groundwater collected from the monitoring well (BPMW), installed near BPSB-1, indicated the presence of arsenic, barium, cadmium, chromium, mercury, and selenium. All concentrations were below groundwater cleanup target levels, except for chromium and lead. Confirmation sampling for chromium and lead was conducted on April 24, 2000. Laboratory results indicated the concentration of lead was BDL; the chromium concentration was below cleanup target levels. No further action or assessment is recommended for this area. Figure 13 illustrates the locations of the soil borings and monitoring well (Attachment B).

6.10 BACKGROUND LOCATIONS

Soil and groundwater analytical data was collected to assess historical agricultural impacts across the site in background locations. Soil boring BGSB-1 was centrally located on the western half of the property. Laboratory analytical results indicated the presence of chromium, copper and zinc. All concentration levels were below applicable regulatory standards or published SQAGs. Laboratory analytical results for the corresponding monitoring well, BGMW-1, indicated the presence of arsenic and barium. The barium concentration was below applicable cleanup target levels. Confirmation groundwater sampling for arsenic, conducted on April 24, 2000, indicated the concentration was BDL. Soil boring BGSB-2 was located on the northwestern portion of

the property. Laboratory analytical results indicated the presence of arsenic, barium, chromium, copper, selenium, zinc, and 4,4-DDE. All concentrations were below applicable regulatory standards or published SQAGs, with the exception of 4,4-DDE, which had a concentration of 24 µg/kg. The published SQAG for 4,4-DDE is 2.07 µg/kg. Laboratory analytical results for the corresponding monitoring well, BGMW-2, indicated the presence of barium, chromium, and lead. All concentrations are below the applicable cleanup target levels. Soil boring BGSB-3 was located on the northeastern portion of the property. Laboratory analytical results indicated the presence of barium, chromium, copper, lead, selenium, and zinc. All concentration levels were below applicable regulatory standards or published SQAGs. Laboratory analytical results for the corresponding monitoring well, BGMW-3, indicated the presence of barium and chromium. All concentration levels are below the applicable cleanup target levels. Soil boring BGSB-4 was located on the southern portion of the property. Laboratory analytical results indicated the presence of petroleum hydrocarbons, arsenic, barium, cadmium, chromium, copper, lead, selenium, and zinc. All concentration levels were below applicable regulatory standards or published SQAGs, with the exception of copper, which had a concentration of 73.8 mg/kg. The SQAG for copper is 18.7 mg/kg. Laboratory analytical results for the corresponding monitoring well, BGMW-4, indicated the presence of barium, chromium, and silver. All concentrations are below the applicable cleanup target levels. The concentrations of copper and DDE detected in this initial background screening should not pose any significant risk to any relevant ecological receptors, based upon the ecological risk assessment (Appendix F) for the subject property.

Since DDE and copper were detected in background locations, these areas could not be treated as point sources. During this assessment, toxaphene was detected in 16 of the 20 background sample locations throughout the property. As a result, ECT conducted supplemental assessment of these areas, which is described in Section 7.0 of this report. Figure 14 illustrates the locations of the soil borings and monitoring wells (Attachment B).

6.11 CANAL SEDIMENT SAMPLES

Samples were collected to assess site impacts in the canal sediment. The sediment analytical data for CSS-1, which is located in the south-central portion of the property, indicated concentrations of arsenic, barium, cadmium, chromium, copper, lead, selenium, silver, and zinc. All concentrations are either below detection limits or below the applicable published SQAG, with the exception of copper, which was detected at a concentration of 38.8 mg/kg. The published SQAG for copper is 18.7 mg/kg. CSS-2, CSS-3, and CSS-4 had some metals detections. All concentrations were either below detection limits or below the applicable SQAG. Figure 15 illustrates the locations of the sediment samples (Attachment B). Based upon the ecological risk assessment (Appendix F), the concentration of copper in this location should not pose any significant risk to relevant ecological receptors.

6.12 FORMER UNDEGROUND STORAGE TANK AREA

Soil and groundwater samples were collected to assess site impacts in the vicinity of the former underground storage tank. One soil boring (USTSB-1) was installed at the southern end of the former tank location and a second boring (USTSB-2) was installed at the northern end. Laboratory analytical results indicated all constituents were BDL for both borings. A monitoring well (USTMW) was installed in the central location of the former tank area. Laboratory analytical results for the groundwater sample indicated all analyzed constituents were BDL. Figure 11 illustrates the locations of the soil borings and monitor well (Attachment B). No further assessment or remediation is recommended for this area.

7.0 SUPPLEMENTAL SITE ASSESSMENT ACTIVITIES

7.1 SUPPLEMENTAL STATISTICAL OVERVIEW

Based upon preliminary phase II ESA results, a supplementary statistical assessment was performed to address elevated copper and DDE impacts across the site. This information preceded the ecological risk assessment but was used in obtaining maximum and average concentrations of toxaphene, DDE, and copper levels across the site (see Appendix D for the raw laboratory data). During this supplementary assessment, toxaphene was detected across the site. Toxaphene was initially only detected at the large and small equipment graveyard. Due to the magnitude of the apparent agri-chemical impacts to this property and its intended future land use, ECT recommended that a statistical approach be applied to the property to obtain a 95% upper confidence limit (UCL) average concentration for DDE and copper across the site. This statistical approach was also applied to toxaphene, which was detected in 16 of the 20 samples at elevated concentration levels. The methodology for the UCL is as follows:

7.2 STATISTICAL METHODOLOGY

At the suggestion of FDEP, a non-spatial 95 percent UCL of the mean was calculated to ensure a conservative estimate of the site average concentration (USEPA, 1993). The 95 percent UCL of a mean is defined as a value that, when calculated repeatedly for randomly drawn subsets of site data, equals or exceeds the true mean 95 percent of the time. The 95 percent UCL of the arithmetic mean concentration is used as the average concentration because it is not possible to know the true mean. The 95 percent UCL, therefore, accounts for uncertainties due to limited sampling at sites. As sampling data becomes less limited, uncertainties decrease, and the UCL moves closer to the true mean. Sampling data at sites which have data sets with fewer than 10 samples per exposure area provide poor estimates of the mean concentration (there is a large difference between the sample mean and the 95 percent UCL), while data sets with 10 to 20 to 30 samples provide fairly consistent estimates of the mean (the 95 percent UCL is close to the mean). In general, the UCL approaches the true mean, as more samples are included in the calculation.

7.3 SAMPLE LOCATIONS

For each background target area, fifteen random samples were collected from locations across the site. These locations are depicted in Figure 19 (Attachment B). These soil samples were collected with a hand auger from the surface to 6 inches in depth, composited and analyzed by EPA methods 8081 (organochlorine pesticides) and 6010 (cadmium and copper). Five samples were also collected within each background location within a several acre area. These samples were analyzed to target the constituent originally targeted at an elevated concentration.

For the canal location, five sediment samples were collected at approximately 200-foot intervals along the length of the canal (Figure 20 of Attachment B). These samples were analyzed for copper only.

7.4 DISCUSSION OF RESULTS – 95% UCL

The data collected from the soil and sediment sampling effort was used to calculate the UCL for toxaphene, DDE and copper for the site. The methodology is discussed in detail in Section 3.1.1 and Table 15 of Appendix F.

The UCL results indicated that the site average concentration for toxaphene was 354 μg/kg, for copper the UCL was 38.9 mg/kg, and for DDE the UCL was 5.35 μg/mg.

These results for toxaphene and copper were still significantly above any published SQAG for each respective constituent. The average concentration for DDE was close to the published SQAG for DDE.

Based upon ECT's collective work with Mark Goodrich of URS and Robert Taylor of Dames and Moore, it appears that the published guidelines for toxaphene are flawed. A discussion of the errors made in arriving at these guidelines is discussed in Mr. Goodrich's memorandum to Marc Lefebvre, dated 5/1/2000 (Appendix G, Prospective Risk of Toxaphene in Sediment).

On this basis, ECT recommended calculating site specific sediment guidelines based upon site specific soil type, organic carbon content, and site flooding with fresh water (non-saline).

8.0 ELUTRIATE TESTING

As part of the ecological risk assessment, elutriate testing was performed to derive sediment pore water concentration levels for toxaphene and copper. On May 8, 2000, ECT collected larger composite soil samples to represent the high, medium and low range toxaphene and copper concentration levels at the site. The areas selected were Areas 6, 9 and 15 (see Figure 21 of Attachment B). A total of 5 gallons of soil was recovered from each area to be used in an elutriate test. The elutriate test was designed to simulate flooding of the soils at the McMurrain Farms property to derive the concentration of toxaphene and copper in the interstitial pore water. The design of this method was based upon the approaches outlined in ASTM D 46 46-87 (93), E1195-87 (93) and E 1391-90. Area 6 represented the highest concentration of toxaphene detected on the property (1,500 µg/kg). To establish a baseline, a composite sample from each of the three 5 gallon buckets of soil was collected and analyzed for toxaphene (EPA method 8081) and copper (method 6010). Additionally, 10 gallons of canal water was collected from the site to flood the pore volume of the soil samples. It was confirmed that the canal water did not contain toxaphene or copper. The procedure for flooding the soil with the canal water was performed in the laboratory. A detailed description of the laboratory protocol for elutriate testing is included in Appendix H. It was believed that the canal water would more closely simulate the reservoir water than other water sources such as deionized water or tap water. Toxaphene was only detected in Area 6 after 21 days at a concentration of 1.1 µg/L; the initial concentration was 1500 µg/kg. The laboratory data indicating the initial sediment concentration prior to the elutriate testing is included in Appendix H. Toxaphene was not detected in Area 9 or 15. The concentrations of copper detected in Areas 6, 9, and 15 are presented below.

Table 4. Copper Concentrations During Elutriate Testing

Days of Contact Time	Location		
	Area 6 (mg/L)	Area 9 (mg/L)	Area 15 (mg/L)
3	0.270	0.078	0.034
7	0.074	0.077	0.045
14	0.087	0.012	0.037
21	0.078	0.020	0.033

Tests were then conducted to evaluate the concentration of toxaphene and copper in the pore water after 3, 7, 14 and 21 days of contact time between the canal water and the soil samples. The pore water was separated from the soil by filtration under a vacuum of 10 mm Hg for a period of one (1) hour. A centrifuge of sufficient size to accommodate soil volumes used in the testing was not available.

The results indicated that Area 6, which had a baseline toxaphene concentration of 1,500 µg/kg in the soils, exhibited a concentration of toxaphene in the pore water of 1.1 µg/L after 21 days of contact time. No toxaphene was detected in the pore water for any other area or any other elutriate test. Toxaphene was not detected in the pore water after the 3, 7, or 14 days.

These elutriate values were incorporated into the ecological risk assessment model for the property (Appendix F, Section 3.1.1.1).

9.0 SUPPLEMENTAL ECOLOGICAL RISK ASSESSMENT STUDIES

Based upon discussions with Robert Frakes, Ph.D., of the United States Fish and Wildlife Service, additional testing was requested in a June 8, 2000 memorandum addressed to Mr. Marc Lefebvre, PE., of ECT and Mr. Robert Kukleski of the South Florida Water Management District. The additional studies that were requested included a ten day sediment toxicity test of *Hyalella azteca*, a ten day sediment toxicity test of *Chironomus tentans* (midge) and a seven day larval fathead minnow (*Pimephales promelas*), growth and survival test. In addition, ECT also performed a twenty-eight day bioaccumulation test in *Lumbriculus variegatus* and *Pimephales promelas*.

On June 15, 2000, Ms. Gail Sloan of the South Florida Department of Environmental Protection requested that a catfish specimen be caught from the borrow pit area of the property and have the tissue samples from the catfish bioassayed for toxaphene and copper. ECT solicited the assistance of the Florida Fish and Wildlife Service to assist in capture of a catfish. ECT made several attempts with conventional fishing equipment to no avail. On June 27, 2000, a catfish specimen, as well as several cichlids, were captured with a large gill net. Photographs of these specimens are included in Attachment C.

9.1 SEVEN DAY LARVAL FATHEAD MINNOW STUDY

Based upon supplemental soil testing at the McMurrain Farms property, an area designated as Area 6 was selected to target the highest concentration level of toxaphene detected on the property at a concentration of 1,500 µg/kg. Copper was detected at a concentration of 28 mg/Kg in Area 6.

A 7-day static renewal sediment bioassay test was conducted at Toxikon Corporation, Jupiter, Florida, to determine the toxicity of a soil sample (Area 6) collected from the McMurrain Farm's site. Toxicity determinations were conducted using 7-day exposures of the fish, *Pimephales promelas*, to a single soil. The criteria for effect in the fish test was survival and growth via dry weight.

The testing soil sample was collected on June 12, 2000 from the McMurrain Farms site by ECT. Chain-of-custody documentation was included with the testing soil. The soil sample was stored in a Baxter Cryofridge set to maintain a target temperature of 4 °C. The soil sample was received in two plastic 5-gallon buckets. The soil was homogenized and large debris, such as rocks and wood, were removed prior to testing.

The control sediment used for the 7-day acute test was collected on May 5, 2000, by Chris McManis of Eastern Aquatic BioSupply (Middletown, RI). The sediment was received in six 1-gallon plastic buckets. The control sediment was logged in and stored in the same cooling unit as the testing soil. Prior to test initiation, the control sediment was wet sieved through a successive series of stainless steel mesh sieves (sieve sizes 1.0, 0.5, and 0.25 mm). The sediment passing through the 0.25 mm sieve was used as the control sediment. The sediment was allowed to settle for approximately 24 hours in dilution water (laboratory freshwater) designated for use in the test. A sample of the control sediment was collected and analyzed for contaminants of concern.

The fathead minnow, *P. promelas*, was used as the testing animal for the 7-day acute sediment bioassay. The test animals were reared at the Toxikon Aquaculture Facility. The fathead cultures were maintained at a photoperiod of 16 light hours and 8 hours darkness, and a temperature of 20 ± 1 °C. The testing animals were maintained on a diet of newly hatched brine shrimp during the holding period. No diseases/treatments were observed and/or required during this period. The animals appeared to be in good health at test initiation. A complete description of the testing methodology and results are presented in Appendix I.

Methods for the sediment bioassay test of *P. promelas* followed a modified outline of the USEPA testing manual: Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms EPA-600/4-91/002.

The test was initiated on June 19, 2000 by adding the weight of approximately 2 centimeters (cm) of Area 6 soil and control sediment to each of the replicate chambers. The 2-cm weight for the control sediment (188.8 grams) and Area 6 soil (177.2 grams) was determined from the initial 7-day bioassay experiment exposing the fathead minnow to the Area 6 sediment. A total of five (5) replicate chambers were prepared for the test soil and control sediment.

The McMurrain Farm's soil produced no statistically significant effect in survival or growth during the fathead minnow's 7-day exposure to the Area 6 location. A complete description of the testing methodology and results are presented in Appendix J.

9.2 TEN DAY BIOASSAY FOR *HYALELLA AZTECA*

The following test was conducted on soils collected from the McMurrain Farms property Area 6, as discussed in Section 9.1. This area represents the highest concentration of toxaphene detected at the site.

A 10-day flow through sediment bioassay test was conducted at Toxikon Corporation, Jupiter, Florida, to determine the toxicity of a soil sample (Area 6) collected from the McMurrain Farm's site. Toxicity determinations were conducted using the 10-day exposures of the amphipod, *Hyalella azteca*, to a single soil. The criterion for effect in the amphipod test was survival.

The amphipod, *Hyalella azteca*, was used as the test animal for the 10-day acute sediment bioassay. The test animals were received from Aquatic BioSystems (Ft. Collins, CO) on June 15, 2000. The animals were acclimated to testing conditions for a 24-hour period prior to test initiation. The amphipod cultures were maintained at a photoperiod of 16 hours light and 8 hours darkness, at a temperature of 23 ± 2 °C. The testing animals were fed a diet of yeast, cereal leaves (Cerophyll®), and trout chow (YTC) during the holding period. No diseases/treatments were observed and/or required during this period. The animals appeared to be in good health at test initiation.

Methods for the sediment bioassay test of *H. azteca* followed a modified outline of the USEPA Inland Testing Manual: Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.-Testing Manual EPA 823-B98-004 1998.

The test was initiated on June 16, 2000 by adding approximately 2 cm of sediment to one of the replicate chambers for the control and test sediment. The weight of the first replicate was measured and recorded in the study log. The remaining replicate chambers were filled with the respective sediments by weight. This technique of sediment addition is more accurate as compared to depth. A total of five (5) replicate chambers were prepared for the test sediment and control. The replicates were positioned on a plastic grid in the waterbath to allow ample water flow around each chamber for temperature regulation.

Following the addition of the sediment to the test chambers, dilution water was added to each 0.450–L glass test chamber to a pre-marked level (approximately 400 mL of overlying water in each test chamber). All test chambers were placed into a recirculating waterbath system set to maintain a target temperature range of 23 ± 1 °C.

Amphipod survival in the control sediment and Area 6 testing soil was 100 and 70%, respectively. The statistical analysis concluded that there was no significant difference between the survival of the control animals as compared to the animals exposed to the Area 6 soil.

The McMurrain Farm's soil produced no statistically significant effect in survival during the amphipod's 10-day exposure to the Area 6 location. A detailed description of this testing methodology is included in Appendix K.

9.3 NINETY-SIX HOUR STATIC SUSPENDED PARTICULATE BIOASSAY ON *PIMEPHALES PROMELAS* (FATHEAD MINNOW)

This test was conducted on soil samples collected from Area 6 at the McMurrain Farm's property. Area 6 soils represented the highest concentrations of toxaphene detected at the site.

A 96-hour static suspended particulate bioassay (water column) test was conducted at Toxikon Corporation, Jupiter, Florida, to determine the toxicity of a soil sample (Area 6) collected from the McMurrain Farm's site. Toxicity determinations were conducted using 4-day exposures of the fish, *Pimephales promelas*, to a single soil. The criterion for effect in the fish test was survival.

The fathead minnow, *P. promelas*, was used as the testing animal for the 96-hour acute suspended particulate bioassay. The test animals were reared at the Toxikon Aquaculture Facility. The fathead cultures were maintained at a photoperiod of 16 hours light, and 8 hours darkness, at a temperature of 20 ± 1 °C. The testing animals were fed a diet of newly hatched brine shrimp during the holding period. No diseases/treatment were observed and/or required during this period. The animals appeared to be in good health at test initiation.

Methods for the suspended particulate bioassay test of *P. promelas* followed a modified outline of the USEPA Testing Manual: Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.-Testing Manual EPA 823-B98-004 1998.

The test was initiated on June 23, 2000 by mixing an appropriate quantity of homogenized Area 6 soil to the dilution water (laboratory freshwater) in a ratio of 1:4 (ex. 500 mL of soil to 2000 mL of dilution water). The soil was added to the dilution water by volumetric displacement to achieve the correct soil-to-water volumetric ratio. The mixture was then stirred vigorously (manually with a stainless steel spoon) for approximately 30 minutes. After mixing was complete, the test mixture was allowed to settle for one hour. The liquid plus the material remaining in suspension represented the

100% liquid plus suspended particulate phase (elutriate). It should be noted that the elutriate appeared turbid with a significant quantity of suspended particles and organic debris one hour post mixing.

Fish survival in the water-only control replicates and the Area 6 testing sediment were each 100%.

The McMurrain Farm's soil produced no statistically significant effect in survival during the fathead minnow's 4-day exposure to the Area 6 location. A complete description of this testing methodology can be found in Appendix L.

9.4 TEN DAY BIOASSAY ON MIDGE CHIRONOMUS TENTANS

This study was conducted on soils collected from Area 6 of the McMurrain Farms property, which represents the highest concentrations of toxaphene detected at the site.

A 10-day flow through sediment bioassay test was conducted at Toxikon Corporation, Jupiter, Florida, to determine the toxicity of a soil sample (Area 6) collected from the McMurrain Farm's site. Toxicity determinations were conducted using 10-day exposures of the midge, *Chironomus tentans*, to a single soil. The criterion for effect in the midge test was survival and growth.

The midge, *Chironomus tentans*, was used as the testing animal for the 10-day acute sediment bioassay. The test animals were received from Aquatic BioSystems (Ft. Collins, CO) on June 15, 2000. The animals were acclimated to testing conditions for a period of 24-hours prior to test initiation. The midge cultures were maintained at a photoperiod of 16 light hours and 8 hours darkness, at a temperature of 23 ± 2 °C. The testing animals were fed a diet that consisted of a slurry of Tetra Min flake fish food during the holding period. No diseases/treatments were observed and/or required during this period. The animals appeared to be in good health at test initiation.

Methods for the sediment bioassay test of *C. tentans* followed a modified outline of the USEPA Inland Testing Manual: Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.-Testing Manual EPA 823-B98-004 1998.

The test was initiated on June 16, 2000 by adding approximately 2 cm of sediment to one of the replicate chambers for the control and test sediment. The weight of the first replicate was measured and recorded in the study log. The remaining replicate chambers were filled with respective sediments by weight. This technique of sediment addition is more accurate as compared to depth. A total of five (5) replicate chambers were prepared for the test sediment and control. The replicates were positioned on a plastic grid in the waterbath to allow ample water flow around each chamber for temperature regulation.

Following the addition of the sediment to the test chambers, dilution water was added to each 0.450-L glass test chamber to a pre-marked level (approximately 400-mL of overlying water in each test chamber). All test chambers were placed into a recirculating waterbath system set to maintain a target temperature range of 23 ± 1 °C.

Midge survival in the control sediment and Area 6 testing soil was 90% and 70%, respectively. The statistical analysis concluded that there was a significant difference between the survival of the control animals as compared to the survival of the animals exposed to the Area 6 soil. Additionally, there was a statistically significant difference in the dry weight of the control animals as compared to the dry weight of the animals exposed to the Area 6 testing soil. It appears likely, based upon the results of the ecological risk assessment (Appendix F), that this was the result of elevated copper levels in the sediment.

The McMurrain Farm's soil produced a statistically significant effect in midge survival during the 10-day exposure to the Area 6 location. Additionally, the Area 6 soil produced a statistically significant effect in growth via dry weight to the *C. tentans* testing animals. A complete discussion of this testing methodology is included in Appendix M.

9.5 TWENTY-EIGHT DAY BIOACCUMULATION STUDY ON LUMBRICULUS VARIEGATUS

A 28-day bioaccumulation study using *Lumbriculus variegatus*, under static renewal conditions, was performed on Area 6 soil samples. The purpose of the study was to evaluate the bioaccumulation of toxaphene and copper over a 28-day period on this oligochaete. Area 6 at the McMurrain property represented the highest measured concentration of toxaphene detected on the property. The results, tabulated below, were used in the ecological risk assessment for the subject property (Appendix F). A detailed description of the 28-day study is included in Appendix N. The study was conducted in accordance with US EPA 1794, Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates; Method 100.3 *Lumbriculus variegatus* Bioaccumulation Tests for Sediments, EPA /600/R-94/024; US EPA and US Army Corps of Engineers, 1998 Great Lakes Dredged Material Testing and Evaluation Manual, September 30, 1998; US EPA and US Army Corps of Engineers, 1998, Evaluation of Dredged Material Proposed for Discharge in Waters of the US - Testing Manual Inland Testing Manual, EPA 823/B-98/004.

Table 5. Area 6 28-Day Bioaccumulation Results– *Lumbriculus Variegatus*

Sample ID Replicates	Copper (µg /g)	Toxaphene (µg /g)
Area 6A	27	0.40
Area 6B	35	0.48
Area 6C	22	0.40
Area 6D	52	0.20
Area 6E	47	0.22
Area 6F	15	0.48
Area 6G	50	0.34
Area 6H	24	0.21

The results of the ecological risk assessment utilizing this data is presented in Section 10.

9.6 TWENTY-EIGHT DAY BIOACCUMULATION STUDY ON *PIMEPHALES PROMELAS* (FATHEAD MINNOW)

A 28-day bioaccumulation study using Pimephales promelas, under static renewal conditions, was performed on Area 6 soil samples. The purpose of the study was to evaluate the bioaccumulation of toxaphene and copper over a 28-day period on this freshwater minnow. Area 6 at the McMurrain property represented the highest measured concentration of toxaphene detected on the property. The results, tabulated below, were used in the ecological risk assessment for the subject property (Appendix F). A detailed description of the 28-day study is included in Appendix N. The study was conducted in accordance with US EPA 1794, Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates; Method 100.3 Pimephales promelas Bioaccumulation Tests for Sediments, EPA /600/R-94/024; US EPA and US Army Corps of Engineers, 1998 Great Lakes Dredged Material Testing and Evaluation Manual, September 30, 1998; US EPA and US Army Corps of Engineers, 1998, Evaluation of Dredged Material Proposed for Discharge in Waters of the US - Testing Manual Inland Testing Manual, EPA 823/B-98/004.

Table 6. Area 6 28-Day Bioaccumulation Results– *Pimephales promelas*

Sample ID Replicates	Copper (µg /g)	Toxaphene (µg /g)
Area 6A	2.3	0.45
Area 6B	3.0	0.43
Area 6C	2.2	0.36
Area 6D	1.7	0.35
Area 6E	2.2	0.51
Area 6F	1.6	0.64
Area 6G	2.3	0.48
Area 6H	2.5	0.41

The results of the ecological risk assessment utilizing this data are presented in Section 10.

9.7 BIOASSAY OF CATFISH AND CICHLIDS FROM MCMURRAIN SITE

On June 15, 2000 at the request of Ms. Gail Sloan of the Florida Department of Environmental Protection, ECT arranged for the capture of a catfish and cichlids from the borrow pit located on the property. The borrow pit area was selected due to the isolation of water in the borrow pit from any canals on the property which could lead offsite. Any toxaphene or copper within the tissues of the catfish or cichlids would therefore originate from the site, since these fish would not have access to any of the canals, which may lead offsite. Photographs of the captured fish are presented in Attachment C.

The catfish was selected as a species most likely to ingest any pesticides or metals since it primarily resides on the bottom or near the sediments within the borrow pit. The cichlids were selected as a mid-water carnivore, which could bioaccumulate pesticides through the ingestion of other lower trophic species.

The results of these bioassays indicated that no toxaphene was detected in any of the tissue samples. Copper was detected in all tissue samples but at normal concentrations. The copper results indicated a concentration of 2.2 μg/g and 2.4 μg/g in the catfish and cichlids, respectively.

A summary of the testing results discussed in this section is presented in the following table.

Table 7. Bioassay Results Summary

Test	Results
3, 7, 14, and 21-Day Elutriate Tests for Toxaphene and Copper	Toxaphene was only detected in Area 6 after 21 days at a concentration of 1.1 µg/L; in pore water the initial concentration was 1500 µg/kg. Toxaphene was not detected in Area 9 or 15. Copper was detected as follows: **Area 6** (mg/L) / **Area 9** (mg/L) / **Area 15** (mg/L) **Day 3** 0.270 / 0.078 / 0.034 **Day 7** 0.074 / 0.077 / 0.045 **Day 14** 0.087 / 0.012 / 0.037 **Day 21** 0.078 / 0.020 / 0.033
7-Day Larval Fathead Minnow (Pimephales promelas) Growth and Survival (Old Sediment)	No significant differences in survival were noted.
Hyalella azteca (amphipod) Sediment Toxicity Test (at least 10 days) (New Sediment)	No significant differences in survival were noted.
Chironomus tentans (midge) Sediment Toxicity Test (at least 10 days) (New Sediment)	Results indicated a significant difference in mortality between the controls and the animals exposed to the test soil/sediment. Mortality are probably due to the presence of copper at elevated concentration levels.
7-Day Larval Fathead Minnow (Pimephales promelas) Growth and Survival (New Sediment)	No significant differences in survival were noted.
Fathead Minnow 96-Hour Water Column Toxicity Test	No significant differences in survival were noted.
Bioaccumulation Test of Catfish & Cichlids from McMurrain Property	Toxaphene was not detected in the tissue of either the catfish or cichlid. Copper was detected in both species of fish; however, at normal or expected concentrations.
Bioaccumulation Test in Fish (28-30 days) for Fathead Minnow and Lumbriculus Variegatus	Copper and toxaphene were detected in tissue samples of both species. (See Appendix N)

Source: Toxikon, 2000
ESI, 2000

10.0 RISK ASSESSMENT RESULTS

The potential for adverse effects associated with copper on sediment-dwelling invertebrates appears fairly conclusive. There is evidence from the laboratory toxicity assays that suggests copper may be at toxic levels; evidence from the elutriate testing that copper is bioavailable and released from the soil when flooding; and evidence associated with the predicted tissue concentrations and literature-based effective residue levels in invertebrates. It is not clear whether the observed potential for risk will be long-lived or short-lived in duration. The release of copper from the soils would be expected to initially result in high concentrations within the pore water, yet the rate and magnitude of the release would decrease over time. The time frame is the uncertainty.

The significance of the potential risks associated with copper to ruminant herbivores is primarily due to the uncertainty associated with HQs near unity. It is not clear whether ruminants will play a significant role within the ecosystem and as such, the significance of this uncertainty cannot be fully determined. It is not believed that ruminants foraging within the prospective ecosystem would be at any acute risk and it would be doubtful that the suggested effects on fertility would be detectable within a wild population.

There do not appear to be any significant risks associated with the residual pesticides at the measured concentrations within the McMurrain Farms soils. There is some weak evidence that top predatory fish may accumulate sufficient toxaphene to experience a reduction in growth but such a scenario requires a toxaphene concentration at or near the maximum concentrations so far detected. Given the high organic carbon partitioning observed for the toxaphene found within the McMurrain Farm soils, the time frame associated with the potential release might be long. However, the actual flooding of the soil, with an associated anaerobic soil / sediment condition would enhance the degradation of the toxaphene. Here again the time frame for significant degradation is uncertain.

For all of the foregoing reasons, it is believed, overall, the potential adverse effects of site-related COPECs are of low ecological significance.

Evaluation of Uncertainty

Key conclusions from the problem formulation process (e.g., regarding spatial scope and effective sequestration of the COPECs) and the results of evaluating assessment endpoints provide a substantial weight of evidence in support of the generalizations stated in Section 4.2 of Appendix F. However, the nature and degree of uncertainties inherent in those findings must be considered. There are basically four sources of uncertainty in ERA (USEPA 1992; Suter 1993a):

- stochasticity (natural variation);
- lack of information (i.e., data gaps);
- flawed model assumptions; and
- human error.

Natural variation (stochasticity) is an inherent characteristic of ecological systems and the factors that influence the systems (e.g., weather). Of all of the contributions to uncertainty, stochasticity is the only one that can be acknowledged and described but not reduced (Suter 1993a). An example of such a confounding factor in the present context is the prospective characterization of the ecosystem at risk. The initial flooding of the property and the species present and available for colonization, the timing of the flooding, and amplitude and timing of water level fluctuations are all potential complex influences on any ecosystem that develops in and around the prospective reservoir.

In this ERA, lack of information is of particular relevance. Much of the assessment is based on a limited number of values for the COPECs in soil. The true average concentrations for the COPECs may or may not be reflective of the values used within the ERA presented here. Other examples of information gaps that contribute to overestimation of exposures or effects include, but are not limited to the following:

Table 8. Information Gaps

Information Gap	Specific Impact
No consideration of assimilation efficiency (i.e., assuming 100% assimilation of materials ingested)	Per basic thermodynamic laws, assimilation cannot be complete; overestimates absorbed dose via ingestion
Assumption that "resident" ROCs obtain all drinking water from the reservoir	Many ROCs are at least as likely to drink from rain pools, accumulations of condensate or precipitation in hollow stems, cavities, etc.; overestimates exposure
Extrapolation of effects from hypothetical individuals to higher levels of organization (e.g., populations)	In particular reference to territorial behavior (e.g., as manifested in certain wading birds) a "worst case" exposure would be peculiar to a specific individual; and by definition other individuals (the remainder of the "population") could not be as exposed
Extrapolation from literature-based TRVs (specifically laboratory bioassay results, where test chemicals are typically administered in forms and/or by methods intended to enhance uptake)	Generally, this is more likely to overestimate bioavailability under field conditions (although this may not always be true)

There are two main information gaps that conceivably result in underestimation of potential adverse effects, inadequate analytical sensitivity and lack of reliable toxicological information on amphibians and reptiles. The former results in the failure of screening (Subsection 2.2) to definitively select or reject COPECs (e.g., selenium). The inability to address amphibians and reptiles as ROCs is probably the more important contribution to potential underestimation of adverse effects, at least with respect to ecological relevance. Certain frogs, lizards, and smaller snakes (all carnivores) are likely to be the most vulnerable of any "wildlife" to exposures, because they will derive virtually all of their diets from relatively confined areas. Whether these animals are more or less sensitive to the toxic effects of the COPECs is an unresolved issue.

There are also many data gaps that could result in either underestimation or overestimation of potential effects, including, but not limited to:

- use of single-point estimates of EECs
- use of surrogate species in TRV selection
- lack of information on the potential synergistic or antagonistic interactions of multiple COPECs

An example of potentially flawed model assumptions in this ERA is the assumed dietary composition of a particular ROC. The diets are based on careful consideration of published information on populations considered most relevant to the site, but professional judgement necessarily played a role. To the extent that the assumed diets are wrong, they could result in either under- or overestimation of exposures.

The model used incorporated estimates of bioconcentration and bioaccumulation of COPECs from soil/sediment into the forage species within the foodweb. The greatest uncertainty associated with the model used for the assessment involves the assumption that the system is at "steady-state" (thermodynamic equilibrium) and in the use of COPEC concentration without consideration of COPEC mass. Steady-state as a model assumption refers to the relationship between media concentrations, in that the concentration relationships are constant and unchanging. This is required to solve the concentration-based equations used within the model. Ecosystems and environments are highly dynamic in function and structure such that an assumption of equilibrium is rarely valid. The result of this assumption is an over-estimation of the potential concentrations and thereby, the potential for risk(s).

Concentration-based models do not account for mass-balance, where the mass required to produce the predicted concentrations is assumed to be unlimited. This assumption is seldom valid considering small study areas but may not be a severe issue here. There is a certain mass required for each component or environmental phase within the ecosystem. For example, there must be enough mass available for the algae to reach equilibrium, and enough for the zooplankton, and enough for the forage fish, and so on. Considering the potential biomass associated with these organisms in a productive reservoir, the required

mass can be significant. In the natural environment, the mass required to fill the environmental phases can, at times, exceed the mass available, i.e., be limited. This assumption, again, results in an over-estimation of the potential accumulation and potential exposure concentrations.

Human error is always possible, although most, if not all, simple mistakes of transcription and calculation are generally eliminated through meticulous technical review. ERA necessarily relies heavily on professional judgement (USEPA 1992, 1998a; Suter 1993a), which, to the extent that it may be erroneous, can also contribute to either under- or overestimation of risk.

On balance, SFWMD believes that most of the uncertainty is associated with the degree to which exposures and toxicities are overestimated. There is a lesser possibility for "false negative" inferences (underestimation of risk) due to lack of absolute certainty in the predicted dietary composition for some ROCs, as well as the use of TRVs derived from tests with surrogate organisms. The weight of evidence presented herein provides a reasonable level of confidence that risks are not underestimated, especially for the more ubiquitous resident and transient receptors.

The following table summarizes the results of the risk characterization of the McMurrain Farms as a freshwater reservoir – lacustrine ecosystem. The complete ecological risk assessment in included in Appendix F.

Potential direct or indirect adverse ecological effects appear to be limited primarily (if not entirely) to:

- sensitive individuals or populations of infaunal benthic macroinvertebrates potentially exposed to copper in the interstitial waters of the sediment; and
- sensitive individuals or populations of ruminant herbivores feeding on vegetation with elevated levels of copper due to uptake from the soil and/or sediment.

Table 9. Risk Characterization Results Summary

Assessment Endpoint	**Result**
1 – Primary Producers	No significant risks were identified
2 – Decomposers and Detritivores	Copper was identified as a stressor
3 – Herbivores	Copper was identified as a *potential* stressor (evidence for risk is inconclusive)
4 – Omnivores	No significant risks were identified
5 – 1st Order Carnivores	No significant risks were identified
6 – 2nd Order Carnivores	No significant risks were identified

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of the ecological risk assessment, the property appears to be suitable as a regional attenuation reservoir. Target species that have been discussed with the United States Fish and Wildlife Services, such as the wood stork and white pelican, do not appear to be at risk from toxaphene or copper impacts in the soils at the McMurrain Farms property. None of the pesticides appear to be sufficiently elevated such that risks will be present for relevant ecological receptors. The risks associated with copper appear to be isolated to the **benthic macroinvertebrate** community and do not appear to pose any persuasive risk to any other ecological resources. On this basis, ECT does not recommend any further assessment or remediation of any areas on the property, with the exception of pump station MP-3. It is assumed that surface water sampling and monitoring will be performed under a National Pollutant Discharge Elimination System (NPDES) permit once the property is developed into a reservoir.

Petroleum contaminated soil from pump stations MP-2 and MP-3 have been removed and no longer pose a concern as identified in the phase I assessment. The total volume of soil removed from these two (2) pump stations was approximately 110 tons. Some low levels of petroleum impacts were detected in the groundwater at pump station MP-3. ECT recommends natural attenuation monitoring for groundwater impacts at pump station MP-3. If the monitoring plan is implemented, this work will be performed under contract with Palm Beach County.

ECT recommends that samples of materials in the vegetative staging area be collected for characterization. Subsequent to characterizing this material, a corrective action plan should be prepared. The recommended corrective action for this area of the property would include screening the staging area material to segregate non-vegetative material, such as plastic, steel, concrete, etc., from the organic materials. The organic materials should then be spread on the property. The non-organic material should be removed from the property for offsite disposal.

Our recommendations further include development and implementation of Best Management Practices (BMPs) associated with the removal of solid waste to prohibit accumulation of solid waste during interim land use. In addition, Best Management of petroleum products should be implemented to reduce the risk of spillage and mishandling of petroleum products. ECT understands that the farm will continue to operate for a period of approximately 5 years. To minimize the potential of future impact during this period, a BMP should be developed with a goal of limiting the use of copper and any environmentally sensitive agrochemicals. The BMP should identify the appropriate storage, handling, mixing, and application of pesticides. Preliminary review of the McMurrain Farms practices indicate that the farm is operating with generally accepted industry standards. However, a document should be developed to establish what are acceptable operating standards for the future. A section of the BMP would identify appropriate agricultural chemicals that could minimize potential future risk.

12.0 REFERENCES

All references to regulatory records, public documents, and published references are listed as document references. These documents were judged not to be significant to support findings of conditions imposing or threatening an environmental impairment, liability, or restriction to the subject property.

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ATTACHMENT A

FDEP RESPONSE LETTER

Jim Hammer
5770
561 681 6600

UNIVERSITY OF FLORIDA

Center for Environmental & Human Toxicology

P.O. Box 110885
Gainesville, Florida 32611-0885
Tel.: (392) 392-4700, ext. 5300
Fax: (352) 392-4707

June 29, 2000

Ligia Mora-Applegate
Bureau of Waste Cleanup
Florida Department of Environmental Protection
Room 471A, Twin Towers Office Building
2600 Blair Stone Rd.
Tallahassee, FL 32399

Dear Ms. Mora-Applegate:

We have reviewed at your request the Interim Report conducted on McMurrain Farms, Tract No. 100-085, in Palm Beach County Florida. The document is dated May, 2000 and was prepared for the South Florida Water Management District by Environmental Consulting and Technology, Inc. This report describes the protocol used to obtain and analyze sediment samples at the site. The McMurrain Farms property encompasses 640 acres and has been used for the farming of vegetables since at least the early 1940's. The site is now under consideration by the South Florida Water Management District (SFWMD) as a potential site for a regional water attenuation reservoir. Levels of toxaphene, DDE, and copper in soil were found to exceed currently available guidelines. Toxaphene in particular was found throughout soils on the property at concentrations above 120 µg/kg, which would represent a potential human health and ecological risk if the site becomes flooded with water.

On the basis of these results, and on the assertion made in the document (supported by a memo by Mark Goodrich of URS Corp, included as Attachment A) that the published guidelines for toxaphene are flawed, the authors propose the calculation of site-specific Sediment Quality Assessment Goals (SQAGs). To that end, it is proposed that an assay be conducted to determine the rate at which toxaphene (and copper) will migrate from the soil-sediment to pore water after 3, 7, 14, and 21 days of contact. In addition, transcripts from a conference call made available to us suggest that 14- and 96-h bioassays will be also conducted in water in contact with contaminated soil. These bioassays would be used to assess sediment toxicity to benthic macroinvertebrates, as well as to quantitate bioaccumulation of toxaphene. We have the following comments regarding the results of the initial site assessment, as well as the proposed methodology to derive site-specific SQAGs.

1. It is stated in the introduction that "Based upon discussions with FDEP, in the absence of sediment cleanup criteria, the most conservative soil cleanup criteria from FAC 62-777, 62-785, or 62-770 were applied." The Soil Cleanup Target Levels (SCTLs) in Chapter 62-777, F.A.C. supercede the numbers in Chapters 62-785 and 62-770. Chapter 62-777 should be the sole source of SCTLs based on protection of human health.

2. We are concerned that the results of the proposed elutriate testing may be misinterpreted. Given the age of the site, it is expected that toxaphene residues in soil-sediments will have a high K_{oc}. Using the upper range of K_{oc} values for toxaphene discussed in the memorandum dated May 1, 2000 from Mark Goodrich of URS — 210,000 — expected concentrations of toxaphene in water will likely be below current detection limits in water (0.75 µg/kg, per telephone conversation with Tim Fitzpatrick, Administrator Bureau of Labs, FDEP). With the proposed methodology, sediment concentrations would have to exceed 2,000 µg/kg to produce detectable levels in water. The absence of measurable toxaphene concentrations in water might be interpreted as indicating no environmental hazard exists. This would be a mistake. Empirical observations clearly show that toxaphene can have an adverse effect on aquatic species at concentrations below this detection limit and its corresponding sediment concentration.

3. The URS memo criticizes the use of the tier II toxicity value of 0.011 µg/L for freshwater proposed by USEPA (1996) instead of the value 0.21 µg/L listed by USEPA in 1986. It does not explain that the value of 0.21 µg/L toxaphene is intended for use in marine environments. The 1996 EPA document develops separately a SQAG for toxaphene in freshwater systems. Given uncertainty due to incompleteness of data for freshwater species, a tier II approach was applied, including the use of confidence limit estimates derived from a range of possible SQAGs. The current USEPA recommendation for toxaphene in freshwater environments is 0.028 µg/g-OC_f which translates to a water concentration of 0.011 µg/L. The URS memo states that much higher concentrations have been observed to have no adverse effects on aquatic species. A value of 0.8 µg/L is listed as a no-effect level, taken from a study of macroinvertebrates reported by USEPA. URS uses 11 µg/L as the lowest-observable effect concentration, although the source of this number is not provided.

Eisler and Jacknow (1985) recommend much lower toxaphene concentration limits for protection of freshwater species. Based on studies of fish exposed to toxaphene in water, they report maximum acceptable toxicant concentrations (MATC) of toxaphene for the fathead minnow and channel catfish ranging between 0.025 and 0.072 µg/L. They propose a freshwater life protection value of 0.013 µg/L. A recent study of zebrafish fed toxaphene found a significant reduction in oviposition rate of females at concentrations 10-times lower than those producing visible abnormalities. (Fabracius-Van Ree and Payne, 1997). Unfortunately, the doses in food in this study cannot be readily converted to concentrations in water. However, the study nonetheless suggests that adverse reproductive effects of toxaphene may occur in fish at concentrations that are not otherwise overtly toxic. This aspect of toxaphene toxicity may not be well addressed in current aquatic toxicity criteria.

We do not consider the URS-proposed Toxicity Value of 11 µg/L to be adequately protective. The current USEPA recommendation of 0.011 µg/L is more consistent with existing toxicity data and other recommendations for freshwater fish.

Even if toxaphene levels in soil-sediments or in water are shown to be harmless to bottom invertebrates and fish, they may still pose significant risks to fish-eating wildlife such as egrets, pelicans, cormorants, ospreys, and the state and federally endangered American wood stork. The assessment of risk posed by toxaphene present at the site cannot be limited to aquatic species, but must consider piscivorous birds as sensitive endpoints.

with toxaphene-containing soil (>60 days) in order to more accurately [illegible] chronic exposure conditions. In addition, the possibility that toxaphene residues in sediments may elicit subtle (but nonetheless extremely important) effects on fish reproduction should also be evaluated.

We hope these comments and recommendations are helpful. Should you have any questions, please do not hesitate to contact us.

Sincerely,

Hugo G. Ochoa, D.V.M., Ph.D.

Stephen M. Roberts, Ph.D.

References

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Response to Comments
INTERIM REPORT MCMURRAIN FARMS Tract No. 100-085 Palm Beach County, Florida
Prepared by Environmental Consulting and Technology, Inc.
Comments made by H.G. Ochoa and S.M. Roberts (University of Florida)
Submitted to Ms. L. Mora-Applegate
Comments dated June 29, 2000
Comments Received July 14, 2000

General Comment:

Levels of toxaphene, DDE, and copper in soil were found to exceed available guidelines. Toxaphene, in particular was found throughout soils on the property at concentrations above 120 ug/kg, which would represent a potential health and ecological risk if the site becomes flooded.

Response: The statement that a concentration of 120 ug/kg poses a potential human and ecological risk if the property is flooded is essentially didactic. It appears that the Sediment Quality Assessment Guidelines (SQAGs) are being interpreted as deterministic values, which they are not.

Specific Comment #1

It is stated in the introduction that "Based upon discussions with FDEP, in the absence of sediment cleanup criteria, the most conservative soil cleanup criteria from FAC 62-777, 62-785, or 62-770 were applied." The soil Cleanup Target Levels (SCTLs) in Chapter 62-777, FAC supercede the numbers in Chapters 62-785 and 62-770. Chapter 62-777 should be the sole source of SCTLs based on the protection of human health.

Response: Comment noted. Please note that no value for toxaphene is available from Chapter 62-777.

Specific Comment #2

We are concerned that the results if the proposed elluriant (sic) testing may be misinterpreted. Given the age of the site, it is expected that toxaphene residues in soil-sediments will have a high K_{oc}. Using the upper range of K_{oc} values discussed in the memorandum dated May 1, 2000 from Mark Goodrich of URS – 210,000 – expected concentrations of toxaphene in water will likely be below current detection limits in water (0.75 ug/kg; per telephone conversation with Tim Fitzpatrick, Administrator Bureau of Labs, FDEP). With the proposed methodology, sediment concentrations would have to exceed 2,000 ug/kg to produce detectable levels in water. The absence of measurable concentrations in water might be interpreted as indicating no environmental hazard exists. This would be a mistake. Empirical observations clearly show that toxaphene can have an adverse effect on aquatic species at concentrations below this detection limit and its corresponding sediment concentration.

Response: Overall, we agree with the comment. The salient point of the elutriate test was to determine where within the range of reported K_{oc}'s does the toxaphene within the

McMurrain Farms soil fall. Given that the reported range is from 298 *to* 210,000 it was believed prudent to determine the site specific K_{oc}. If the lowest reported K_{oc} is considered, the minimum soil / sediment concentration to produce a pore water concentration of 0.75 ug/L would be about 40 ug/kg of toxaphene. It is agreed that a non-detection of toxaphene in pore water could be erroneously used to suggest that no environmental risks are present, however, that was not the intent of the elutriate test. The intent was to empirically determine the level of "bioavailability" associated with the residual toxaphene on-site. The detection limit issue was thoroughly discussed internally and the limitations were recognized, detection limits of 0.04 to 0.27 ug/L were obtained and toxaphene was detected within the pore water during the test (see Section 3.1.1.1 of the draft Ecological Risk Assessment [ERA] report). It is also agreed that toxaphene can elicit adverse effects at concentrations below 0.75 ug/L in sensitive aquatic species. It is not agreed that empirically derived effective sediment concentrations have been clearly demonstrated in the peer-reviewed scientific literature. As discussed within the May 1, 2000 URS memorandum, empirical sediment testing reported within FDEP (1993 – Bolten *et al.* 1985) for benthic species richness and bulk-sediment toxicity showed no adverse effects at concentrations from 280 to 11,683 ug/kg of toxaphene.

Specific Comment #3 (Part 1)

> *The URS memo criticized the use of the tier II toxicity value of 0.011 ug/L for freshwater proposed by USEPA (1996) instead of the value 0.21 ug/L listed by USEPA in 1986. It does not explain that value of 0.21 ug/L is intended for use in marine environments. The 1996 EPA document develops separately a SQAG for toxaphene in freshwater systems. Given uncertainty due to incompleteness of data for freshwater species, a tier II approach was applied, including the use of confidence limit estimates derived from a range of possible SQAGs. The current USEPA recommendation for toxaphene in freshwater environments is 0.028 ug/g-OC, which translates to a water concentration of 0.011 ug/L. The URS memo states that much higher concentrations have been observed to have no adverse effects on aquatic species. A value of 0.8 ug/L is listed as a no-effect level, taken from a study of macroinvertebrates reported by USEPA. URS uses 11 ug/L as the lowest-observable effect concentration, although the source of this number is not provided.*

Response: The reason or rationale for the use of a tier 2 value by USEPA (1996) rather than the FCV used to develop the SQAG in USEPA (1993) is not provided by USEPA (1996[1]), nor is the rationale presented in either USEPA document for not using the FCV for freshwater as developed for toxaphene in 1986 (0.039 ug/L – to protect brook trout). The point of discussion made within the memo is the illustration of the highly variable range in toxaphene values based on variable methodologies, even as reported within the relevant USEPA documentation.

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[1] It is notable that the "safety" or "uncertainty" factors used in deriving the secondary acute and chronic toxicity values reported in USEPA 1996 where based on the proposed GLWQI ruling, which were changed in the final rule (USEPA 1995). Thus, the numbers presented are, presently, incorrectly calculated. Please refer to Section 2.2.2 of the Draft McMurrain Farms ERA for a more detailed discussion of the use of "ecotoxicological benchmarks."

USEPA (1996) basically derived a value (tier 2 or secondary chronic value [SCV]) from which they derived another value (equilibrium partitioning value), which is based on highly variable K_{oc} (which is not reported by USEPA 1996), from which they then derived a lower confidence limit. The salient point is that this final value is highly uncertain, subjected to multiple uncertainties, and should *NOT* be used deterministically in declaring an ecological hazard. This is the crux of the criticism. To call such a derived value as an ecotoxicological "*threshold*" is misleading given the potential for alternate solutions.

The URS memo did not propose that 11 ug/L is the lowest-*observable* effect level in all aquatic species but presents it as the value USEPA used to compare the use of FCVs in establishing SQAGs for the method's specified purpose – *Protection of* ***Benthic*** *Organisms* (USEPA 1993). The source of the NOEL and LOEL results for benthic macroinvertebrate colonization is USEPA (1993), which performed validation tests for the approach presented therein. USEPA (1993) states that the sensitivity of benthic macroinvertebrates appears to be less than then for more pelagic life forms. Thus, while it is true that certain fish species are quite sensitive to toxaphene (thus its use as a piscicide), benthic macroinvertebrates are not equally as sensitive.

With regards to the regression analysis as reported by USEPA (1996), USEPA appears to have used the equation $SQC = f_{oc} * K_{oc} * FCV$ where the variable is based on yet another derivation, i.e., K_{oc}; $\log_{10}K_{oc} = 0.00028 + 0.983 * \log_{10}K_{ow}$. Thus, the lower confidence limit is based on the estimation of the K_{oc} from the K_{ow} rather than on the more appropriate equation as presented within USEPA (1993); $LC_{50\text{-}oc}$'s = K_{oc}*$LC_{50\text{-}water}$ (Eq. 38, USEPA 1993). This equation represents the "predictive" ability of the method in estimating toxicity whereas the former represents the predictability of the K_{oc} based on the K_{ow}. Such a regression analysis has little relevancy in method validation. To state that USEPA derived their confidence interval of a range of possible SQAGs is erroneous and is in fact, more accurately presented in the URS May 1, 2000 memo (which was its intent).

Specific Comment #3 (Part 2)

> *Eisler and Jacknow (1985) recommend much lower toxapahene concentrations limits for protection of freshwater species. Based on studies of fish exposed to toxaphene in water, they report maximum acceptable toxicant concentrations (MATC) of toxaphene for the fathead minnow and channel catfish ranging from between 0.025 and 0.072 ug/L. They propose a freshwater life protection value of 0.013 ug/L. A recent study of zebrafish fed toxaphene found a significant reduction in oviposition (sic) rate of females at concentrations 10-times those producing visible abnormalities (Fahraeus-Van Ree and Payne, 1997). Unfortunately, the doses of food in this study in this study cannot be readily coverted to concentrations in water. However, the study nevertheless suggests that adverse reproductive effects of toxaphene may occur in fish at concentrations that are not otherwise overly toxic. This aspect of toxaphene toxicity may not be well addressed in current toxicity criteria.*

We do not consider the URS-proposed Toxicity Value of 11 ug/L to be adequately protective. The current USEPA recommendation of 0.011 ug/L is more consistent with existing toxicity data and other recommendations for freshwater fish.

Response: The URS memo did not propose any toxicity values. The memo used the range in reported concentrations to illustrate the uncertainty associated with the presently disseminated SQAGs. The vast majority of the discussion in the above comment is specific to water concentrations and not sediment concentrations, which is the issue at hand. Additionally, the SQAG are specific to the protection of benthic macroinvertebrates and do not include fish. The techniques used to estimate the SQAG are specific to the estimation of a sediment pore-water concentration and not a surface water concentration. It is agreed that fish are more sensitive to toxaphene than benthic macroinvertebrates. However, this is not the issue addressed within the memo nor were surface water concentrations.

As for the tier 2 value reported by USEPA (1996), notwithstanding its agreement with the range as described above, the value cannot be fully supported due to more recent changes in the calculation process (i.e., USEPA 1995) and the unsupported use of the regression analysis procedures used. A more credible value would be that from Eisler and Jacknow (1985) who recommend 0.013 ug/L. While this may seem trivial, invalidly derived numbers should not be supported.

Specific Comment #4

Even if toxaphene levels in soil-sediments or in water are shown to be harmless to both invertebrates and fish, they may still pose significant risks to fish-eating wildlife such as egrets, pelicans, cormorants, ospreys, and the state and federally endangered American Wood Stork. The assessment of risk posed by toxaphene present at the site cannot be limited to aquatic species, but must consider piscivorous birds as sensitive endpoints.

Response: Concur. The draft ERA evaluated omnivorous and carnivorous birds, including the clapper rail, wood stork, and white pelican.

Specific Comment #5

The USEPA, while recommending a toxicity value of 0.011 ug/L for toxaphene, explicitly acknowledges that their ecological thresholds "may not be low enough for those chemicals where significant bioaccumulation in the food chain may occur at the site" (USEPA 1996). Toxaphene is clearly such a chemical. It has a high K_{ow} and is consequently likely to bioaccumulate in aquatic organisms. Fathead minnows exposed to have bioaccumulation factors (BAFs) of 52,000 after 98 days of exposure to toxaphene in water (Eisler and Jacknow 1985). BAFs for two of the most persistent polychlorinated bornanes that comprise toxaphene (Parlar No 26 and Parlar No 50) averaged—1,337,000 for longnose sucker, lake white fish, and lake trout in a Canadian lake (Geyer et al. 1999). Of course, top predators will be much more exposed than primary consumers.

There is little discussion in the URS memo or in the ECT interim report of addressing bioaccumulation in the food chain. The only step clearly described is a proposed bioaccumulation study of 24 and 96 hours. First the duration of the study is not adequate, in our opinion, to accurately measure full bioaccumulation potential. Second, assessing bioaccumulation in macroinvertebrates is not sufficient to address food chain accumulation and risks to top predators, including piscivorous birds. A much more comprehensive analysis will be required than is suggested by the very limited proposed tests, in order to determine whether toxaphene in soils at this site will have adverse ecological impacts.

Response: While there is basic agreement with the contentions made within the comment, it is unclear whether the subsection within the memo entitled "*Bio-concentration, Magnification, and Risks to Humans and Higher Forms of Wildlife*" or the section entitled "*Ecological Risk Assessment Background and Technical Approach*" were reviewed. The potential for bioaccumulation and magnification of toxaphene is recognized, discussed and addressed within the draft ERA (see specifically Subsections 2.2, Subsection 2.4.4, and Subsection 3.1.2).

The use of macroinvertebrates in assessing bioaccumulation of chemicals for sediments into an ecological foodweb is not only appropriate but the recognized methodology for risk assessment (see USEPA 1994, 2000 [*Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates*], EPA 600/R-99/064). The duration of this standardized test is 28-days, which unfortunately was not explicitly stated within the memo. The intent was to perform all standard tests according to USEPA and ASTM guidelines.

The analysis proposed was an ecological risk assessment, which was completed (see draft ERA report). This analysis utilizes the results of the laboratory tests in evaluating the risk potential associated with the residual toxaphene concentrations in the soils of the McMurrain Farms to not just fish-eating birds but all of the ecological entities considered important and relevant to the stability and integrity of the prospective reservoir ecosystem.

Concluding Remarks:

We suggest a complete revision of the approach used to determine if toxaphene contamination at McMurrain Farms represents a significant ecological risk. Bioaccumulation test should be performed using a species resembling that consumed by piscivorous birds (e.g., the fathead minnow). Minnows should be exposed for a significant amount of time to water that is in contact with toxaphene-containing soil (>60 days) in order to more accurately estimate BAFs under chronic exposure conditions. In addition, the possibility that toxaphene residues in sediments may elicit subtle (but nonetheless extremely important) effects on fish reproduction should also be evaluated.

Response: A complete revision of the approach is unwarranted. Bioaccumulation tests with fathead minnows will not (did not) accurately estimate the BAF for the

prospective fish within the reservoir. The results of such testing do not account for the exposure due to dietary consumption of contaminated organisms and will under-estimate the potential exposure concentrations to piscivorous birds. The entry point of sediment-associated contaminants into an ecological food web is through the accumulation of the chemical in benthic organisms. This is the rationale for the use of these species in bioaccumulation testing. The potential for toxaphene-related adverse effects on three trophic levels of fish was evaluated within the draft ERA.

ATTACHMENT B

FIGURES

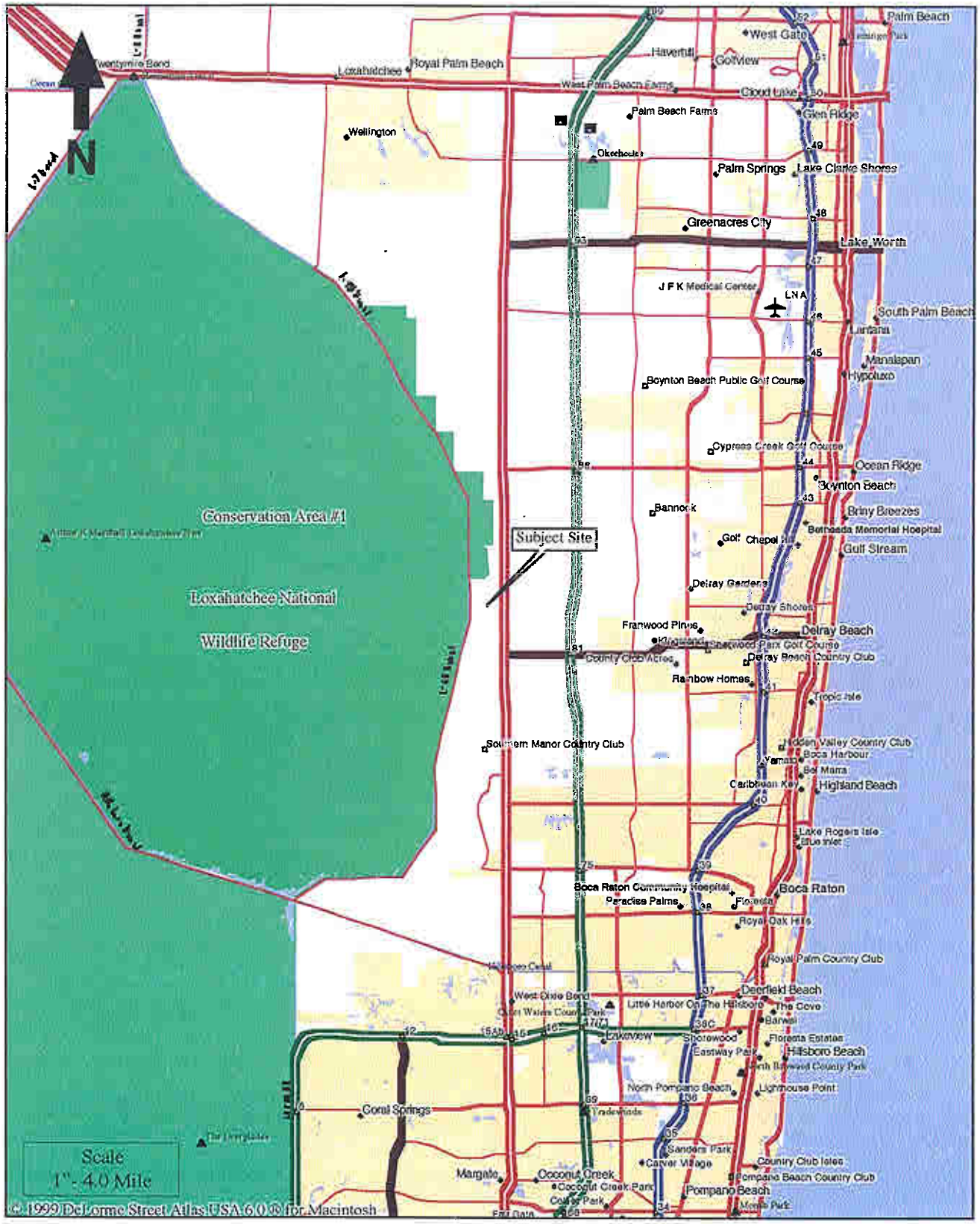


FIGURE 1
SITE VICINITY MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

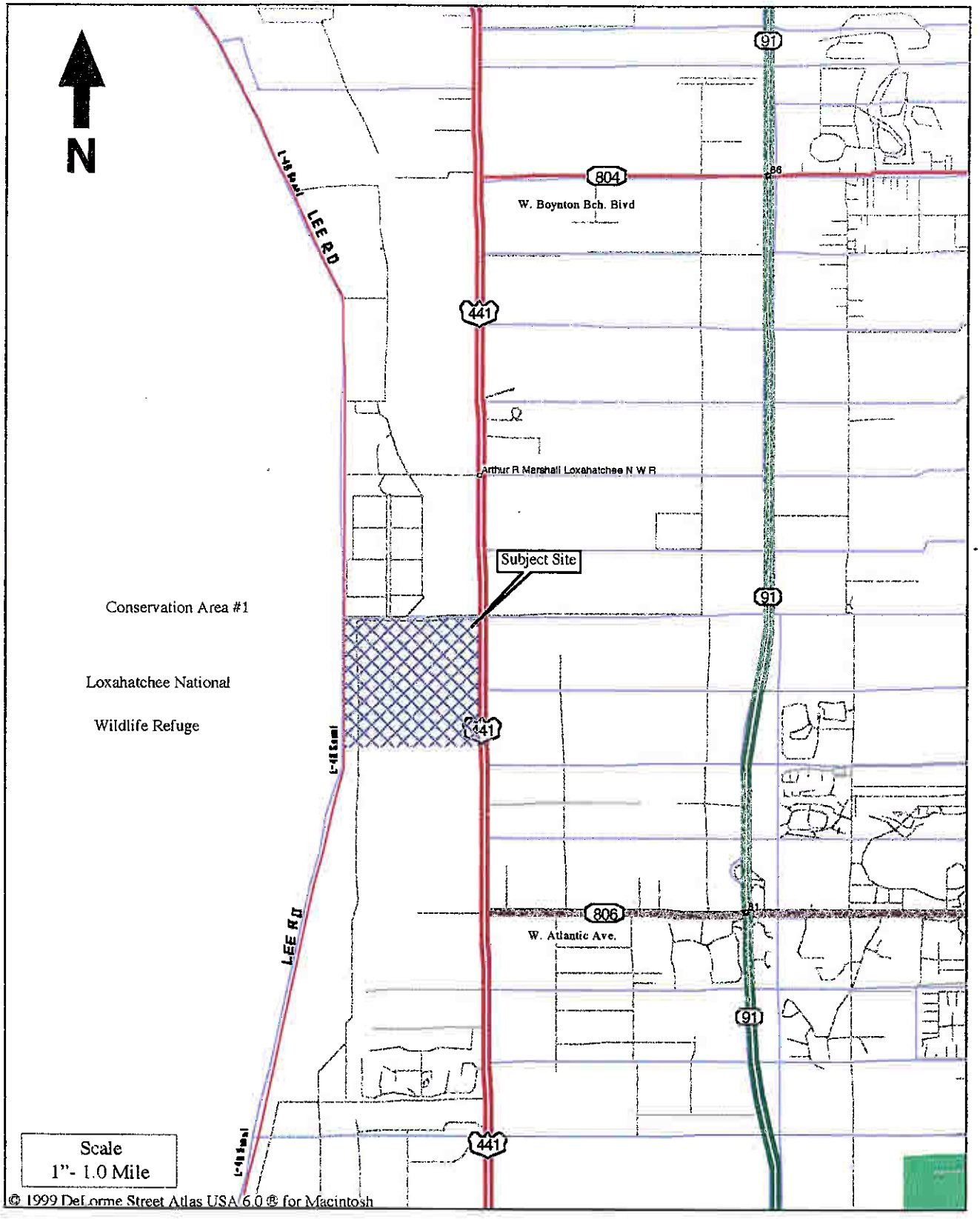


FIGURE 2
SITE MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

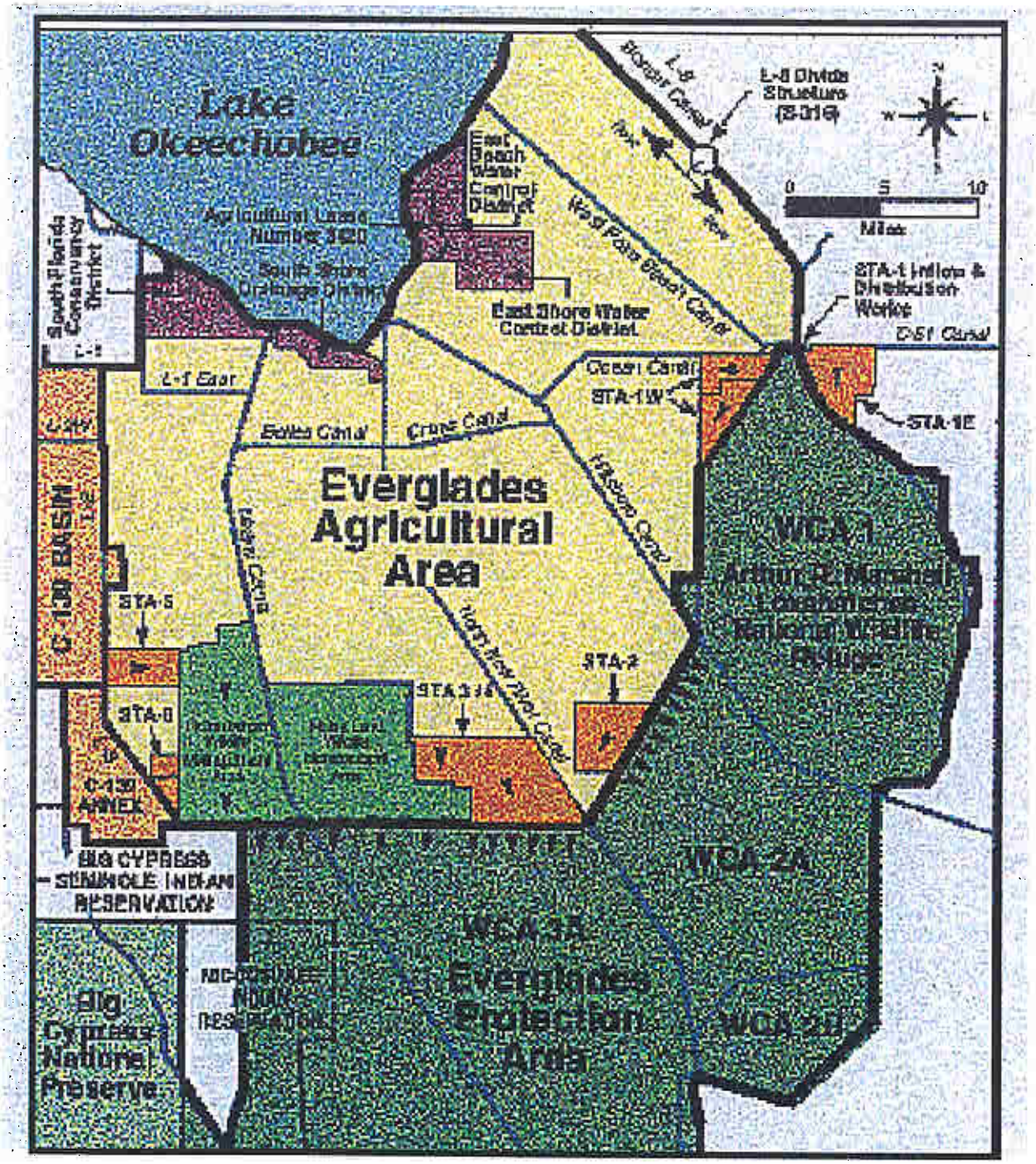


FIGURE 3
EVERGLADES PROGRAM MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

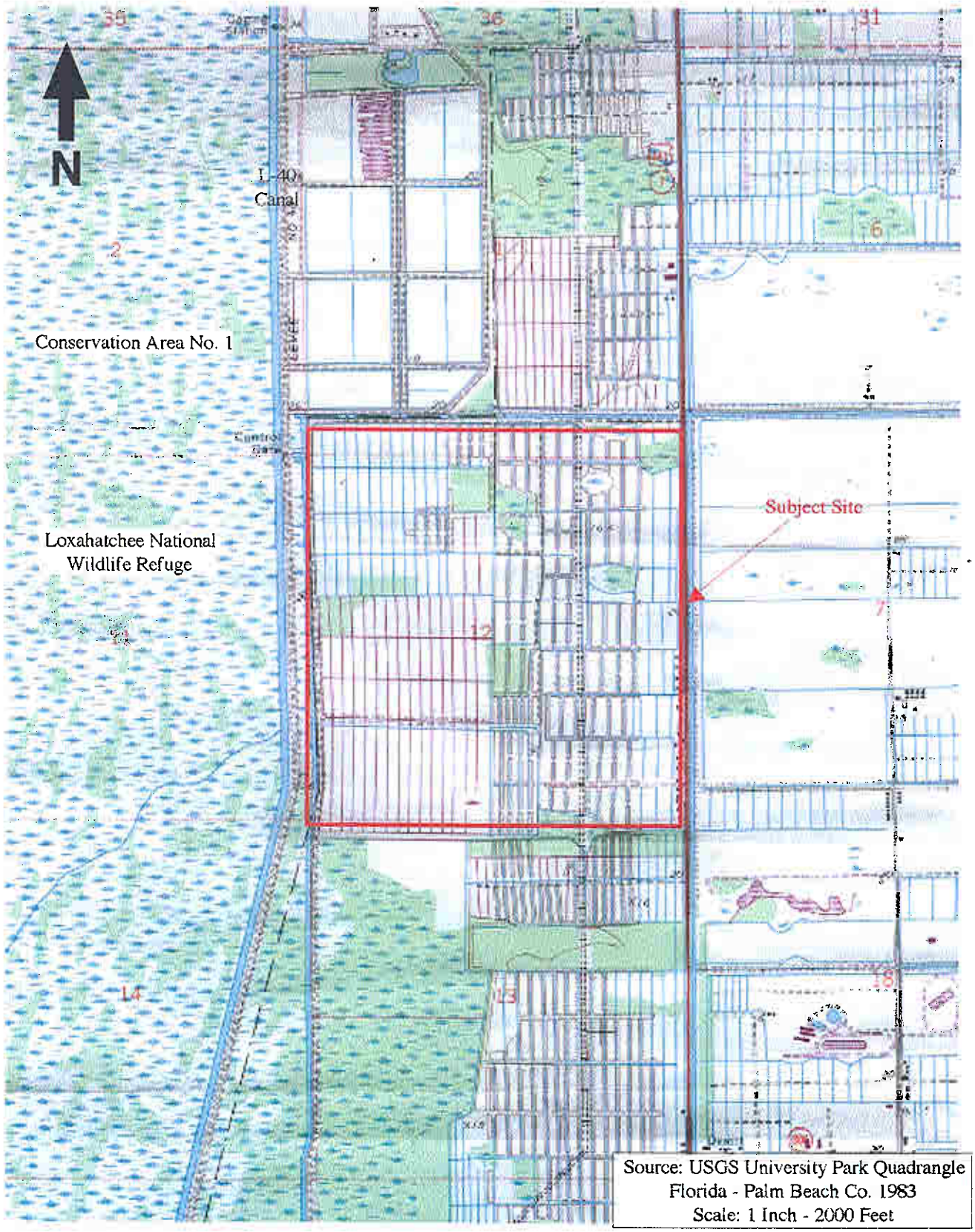
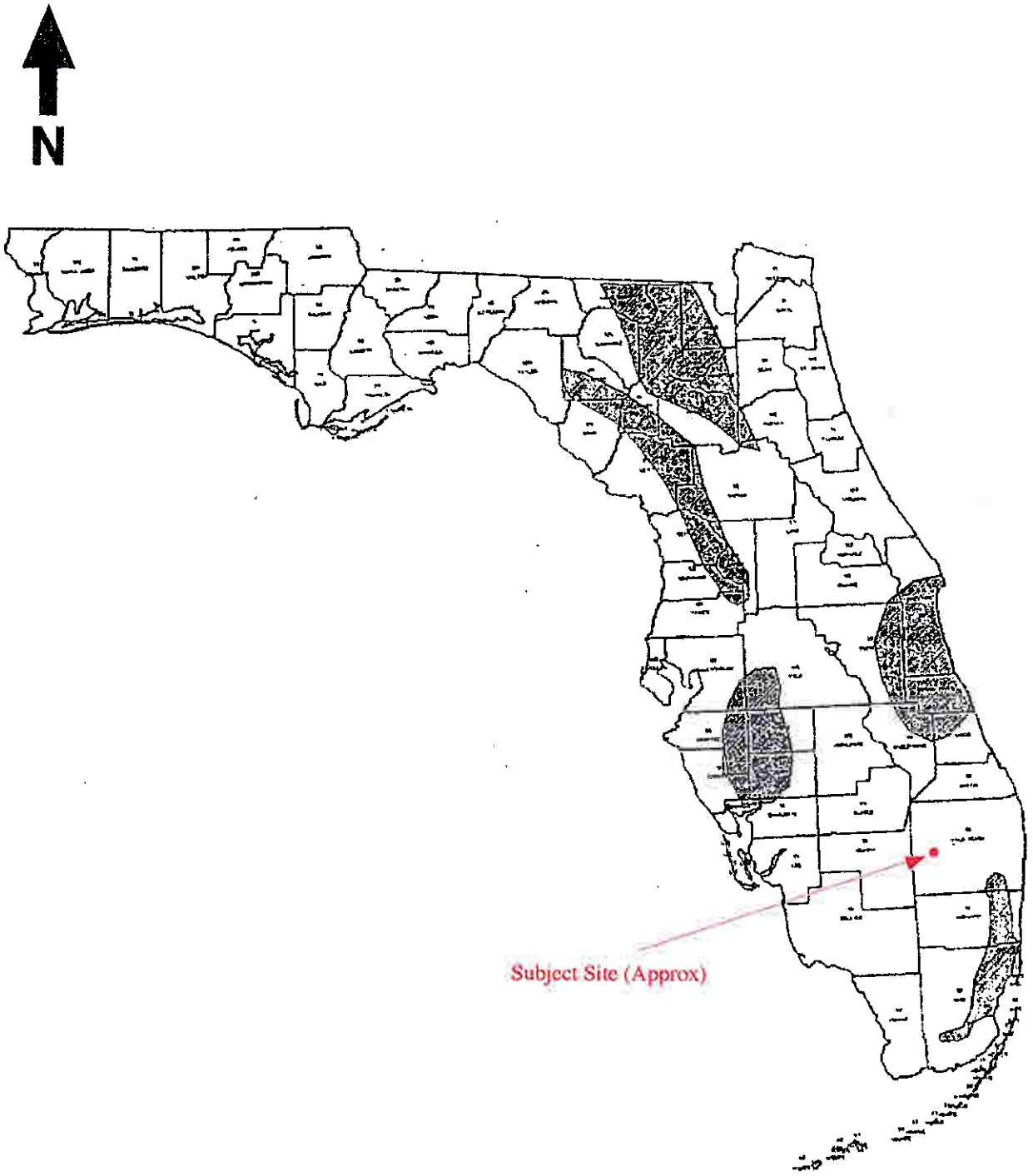


FIGURE 4
TOPOGRAPHIC MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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Environmental Consulting & Technology, Inc.



Areas of Elevated Radon Potential

Source: Department of Community Affairs
Department of Health and Rehabilitative Services

NOT TO SCALE

FIGURE 5
RADON POTENTIAL MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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Environmental Consulting & Technology, Inc.

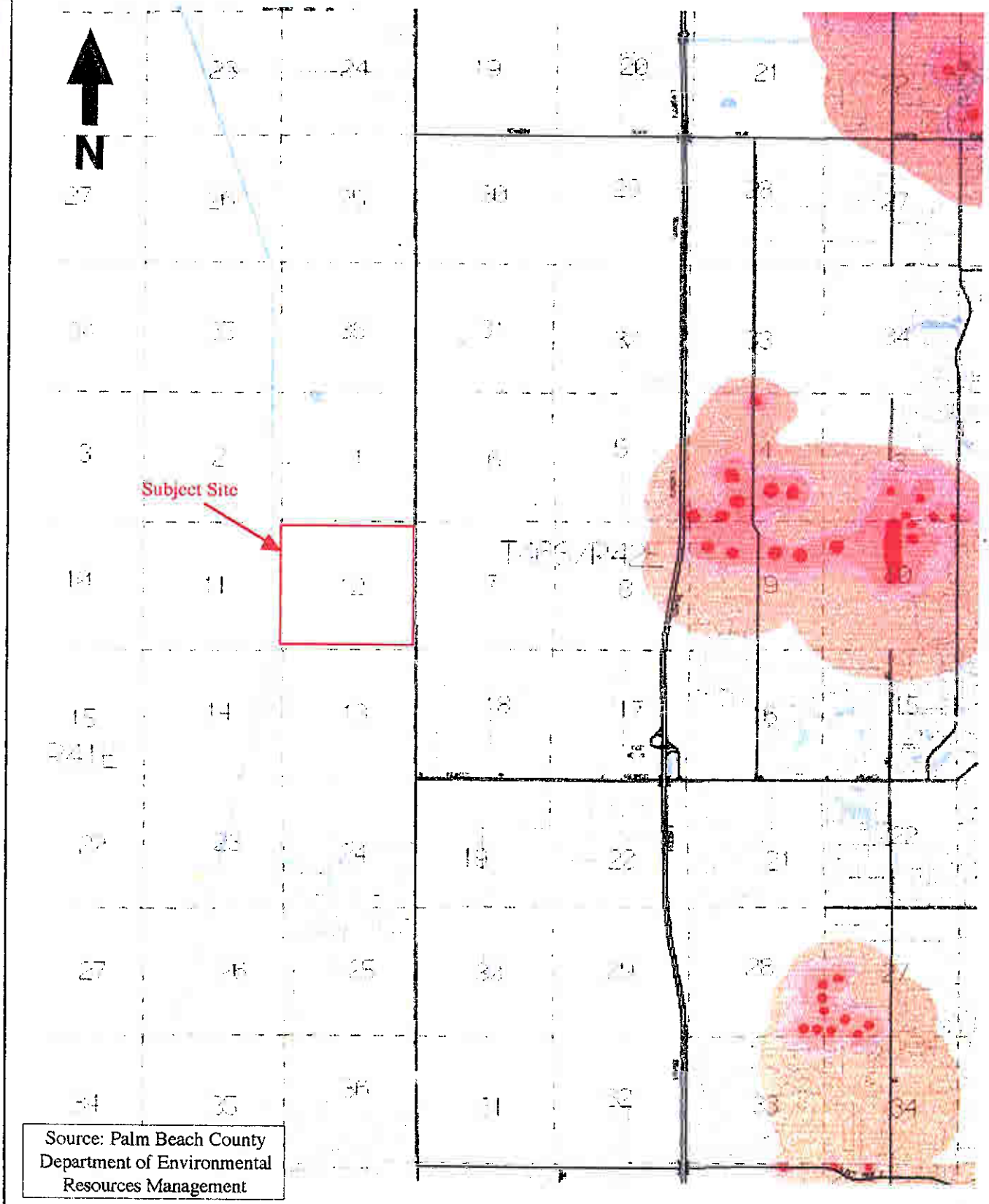


FIGURE 6
WELLFIELD PROTECTION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

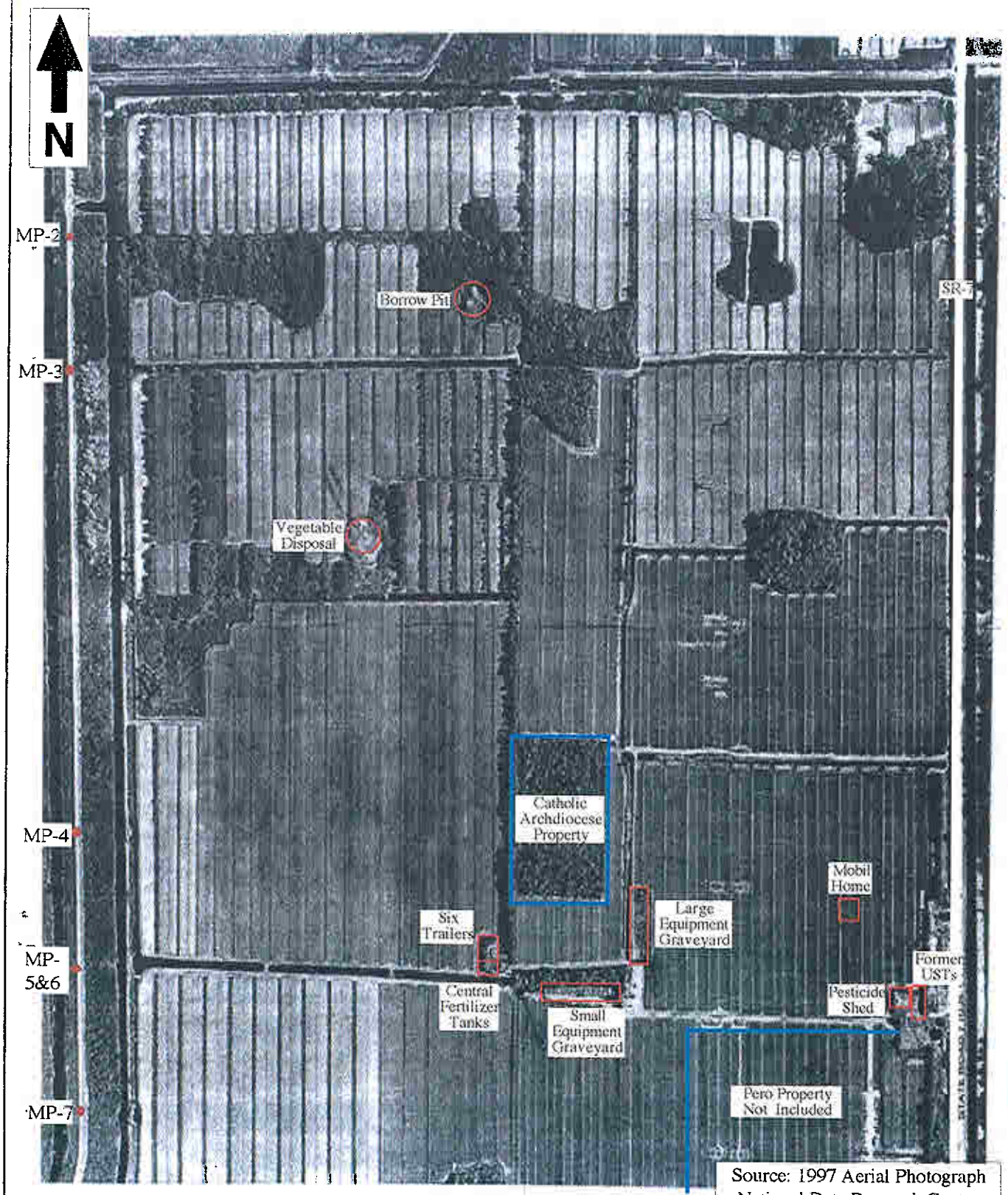


FIGURE 7
AREAS OF INVESTIGATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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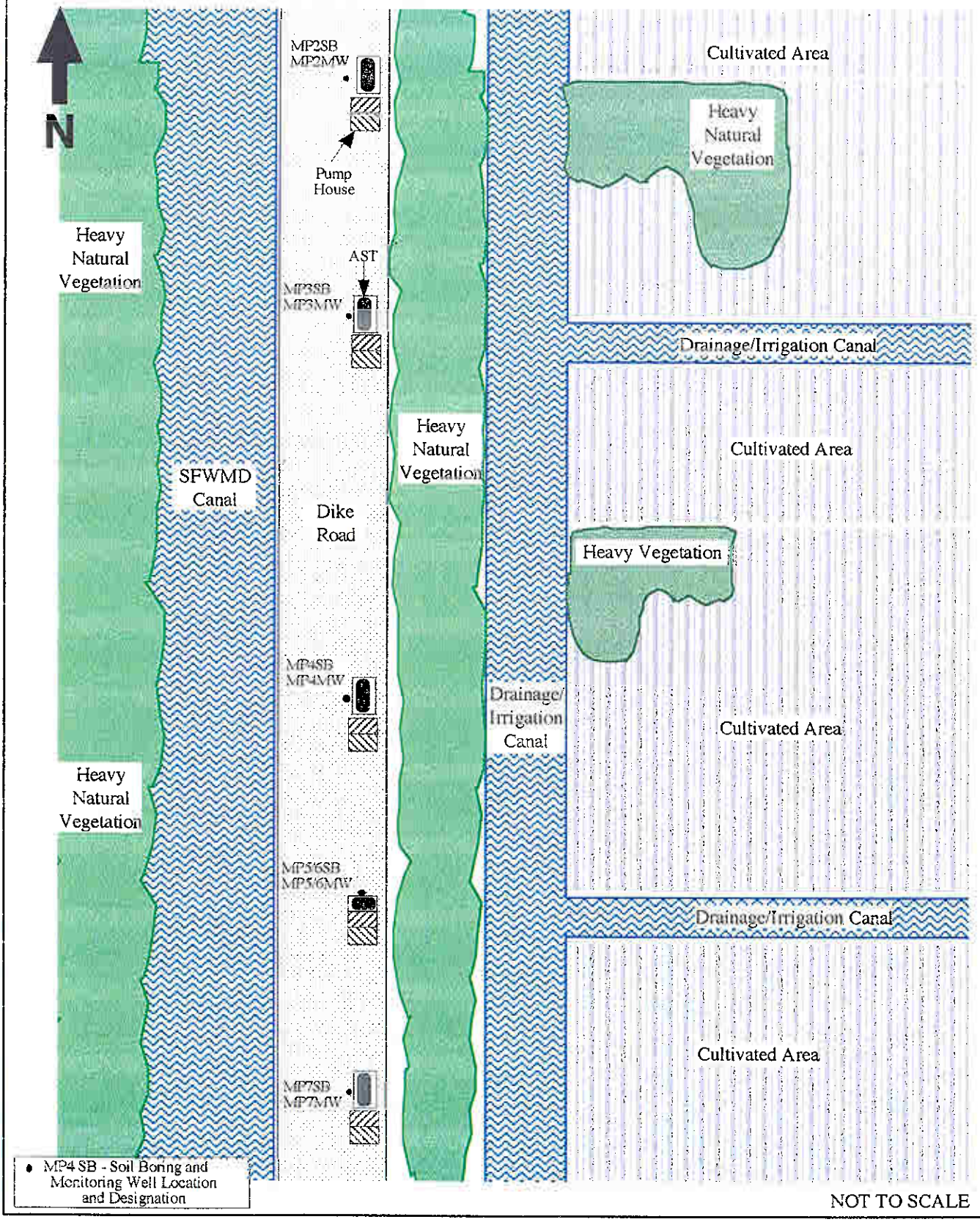
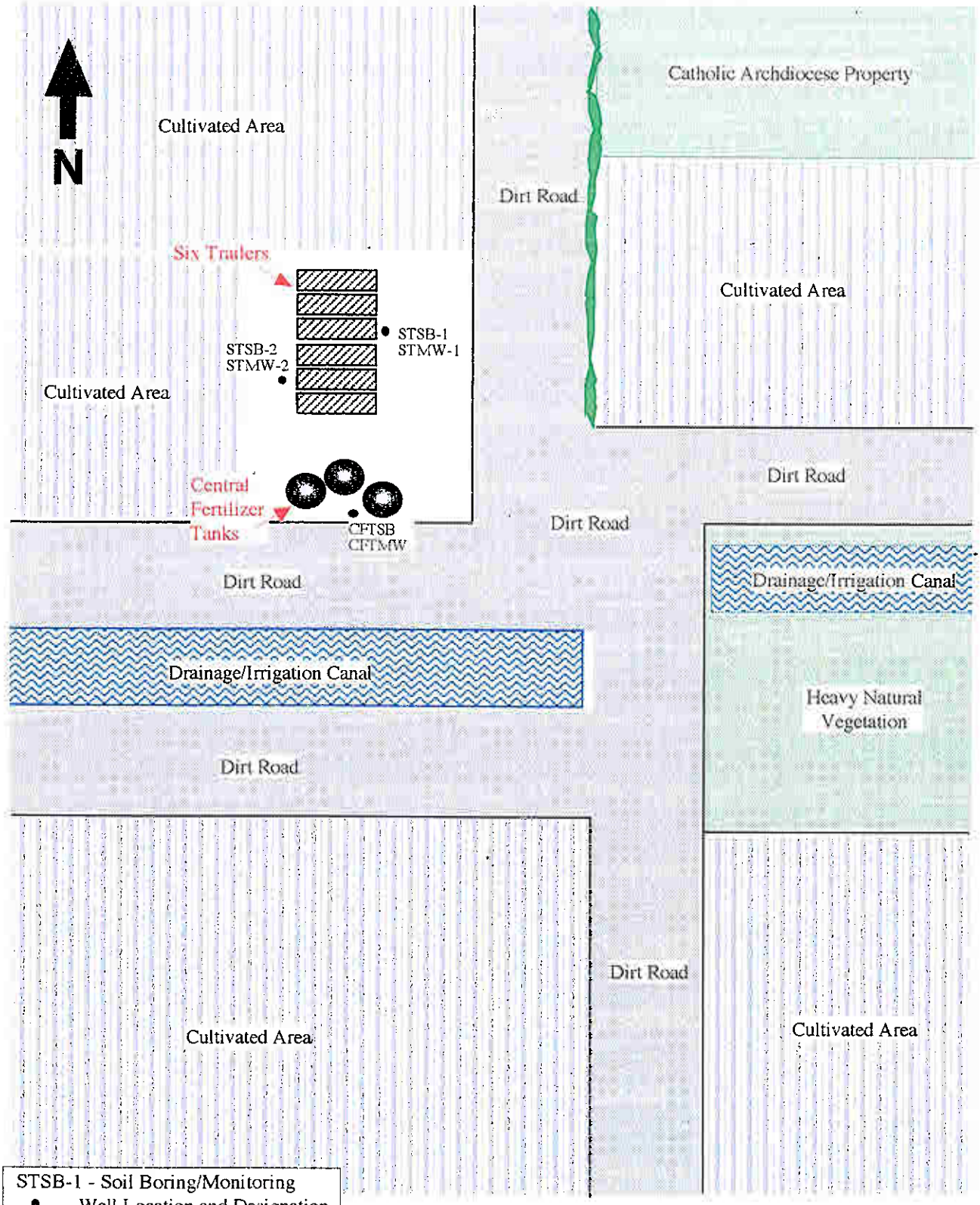


FIGURE 8
PUMP STATION SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

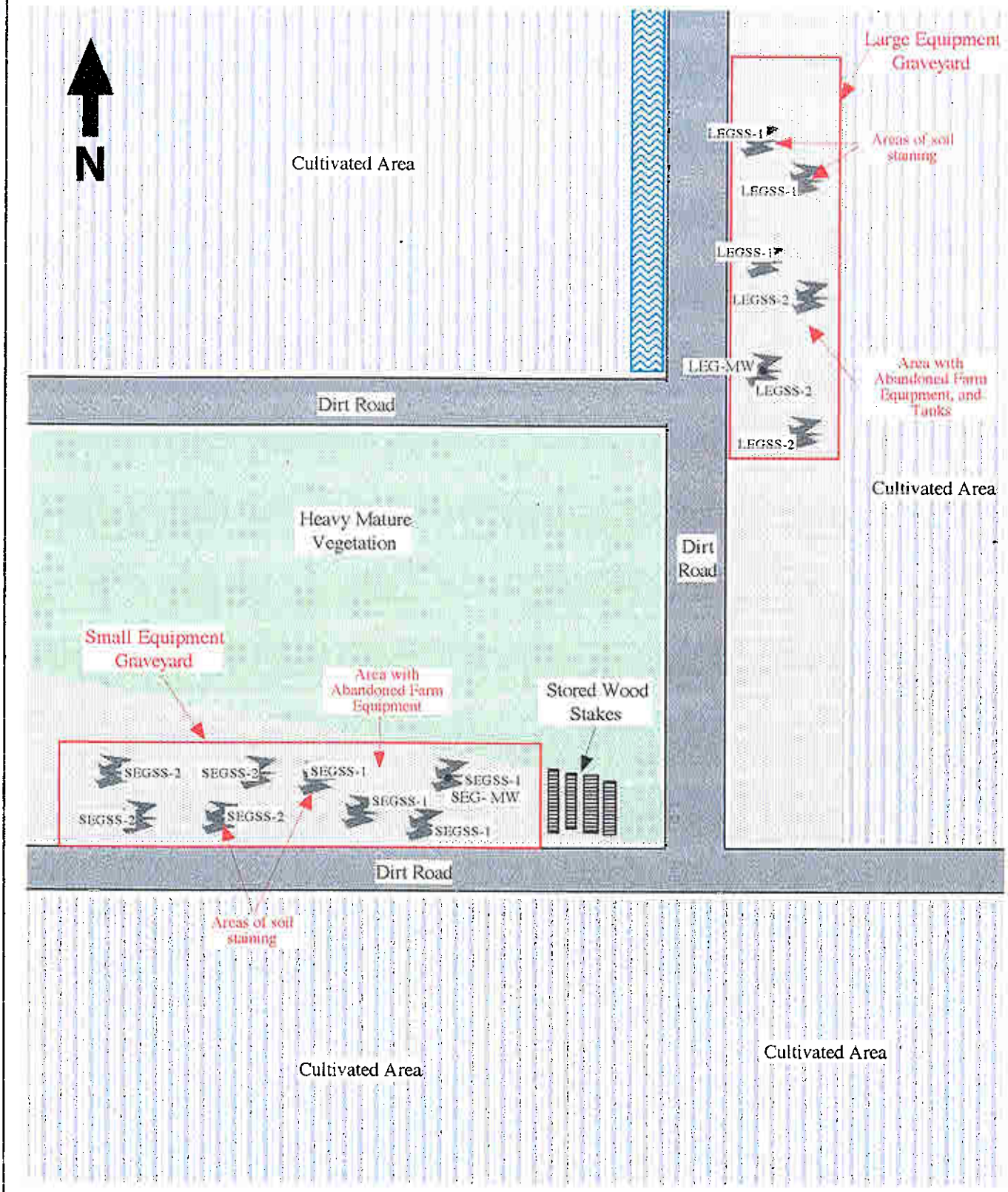
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NOT TO SCALE

FIGURE 9
CENTRAL FERTILIZER TANK & SIX TRAILERS SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

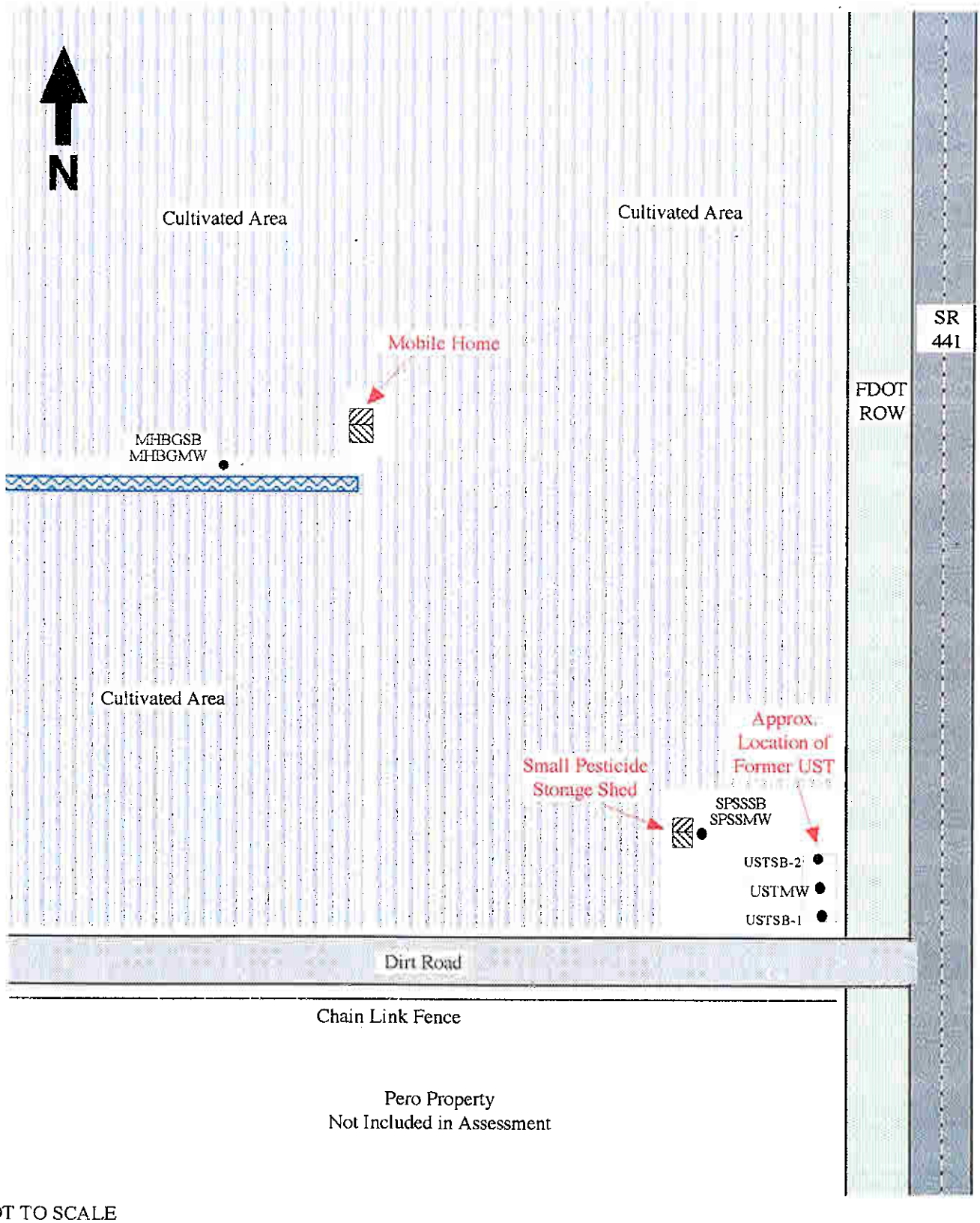
ECT
Environmental Consulting & Technology, Inc.



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FIGURE 10
LARGE & SMALL EQUIPMENT GRAVEYARD SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

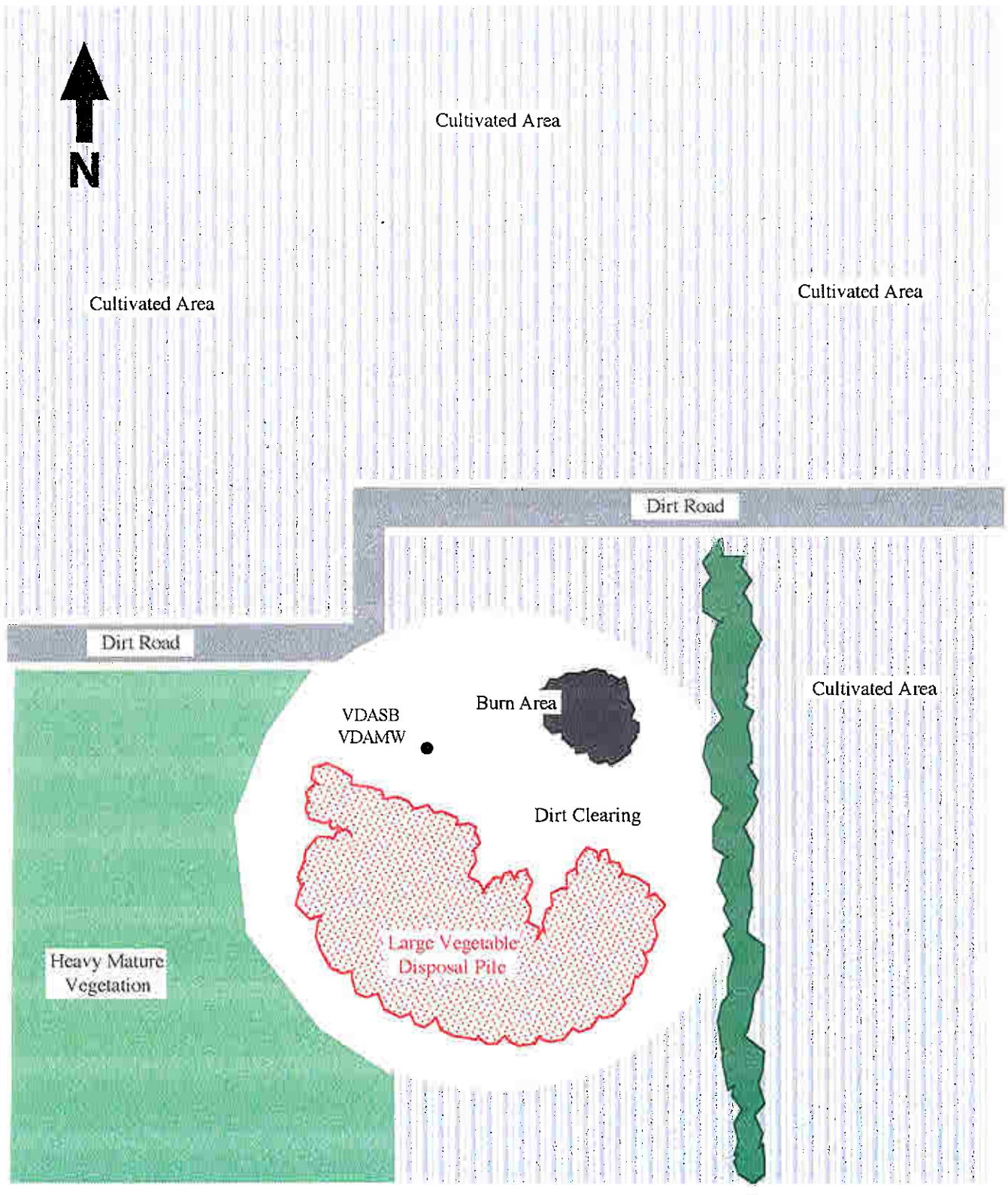
ECT
Environmental Consulting & Technology, Inc.



NOT TO SCALE

FIGURE 11
FORMER UST / PESTICIDE SHED & MOBILE SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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FIGURE 12
VEGETABLE DISPOSAL AREA SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

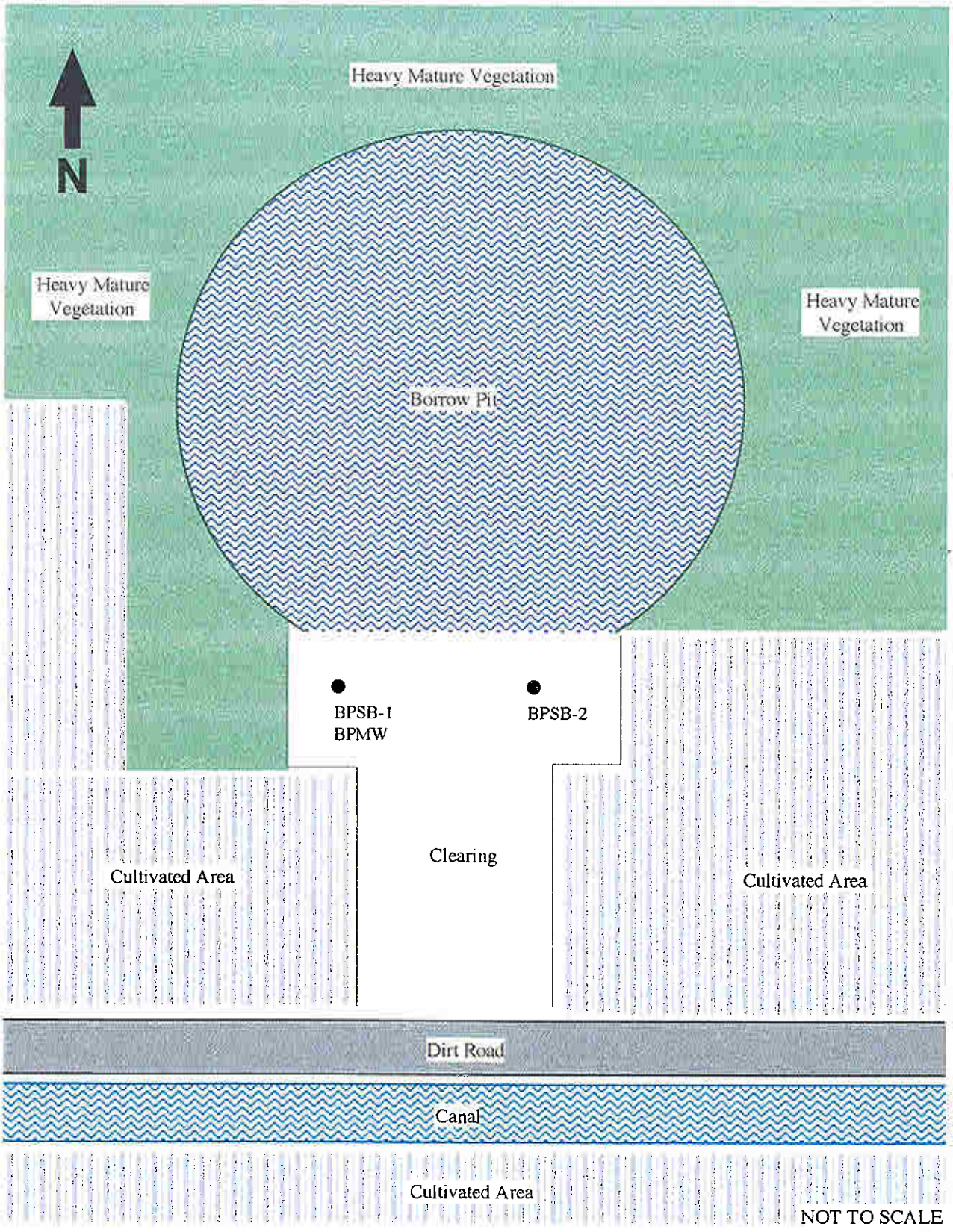


FIGURE 13
BORROW PIT SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

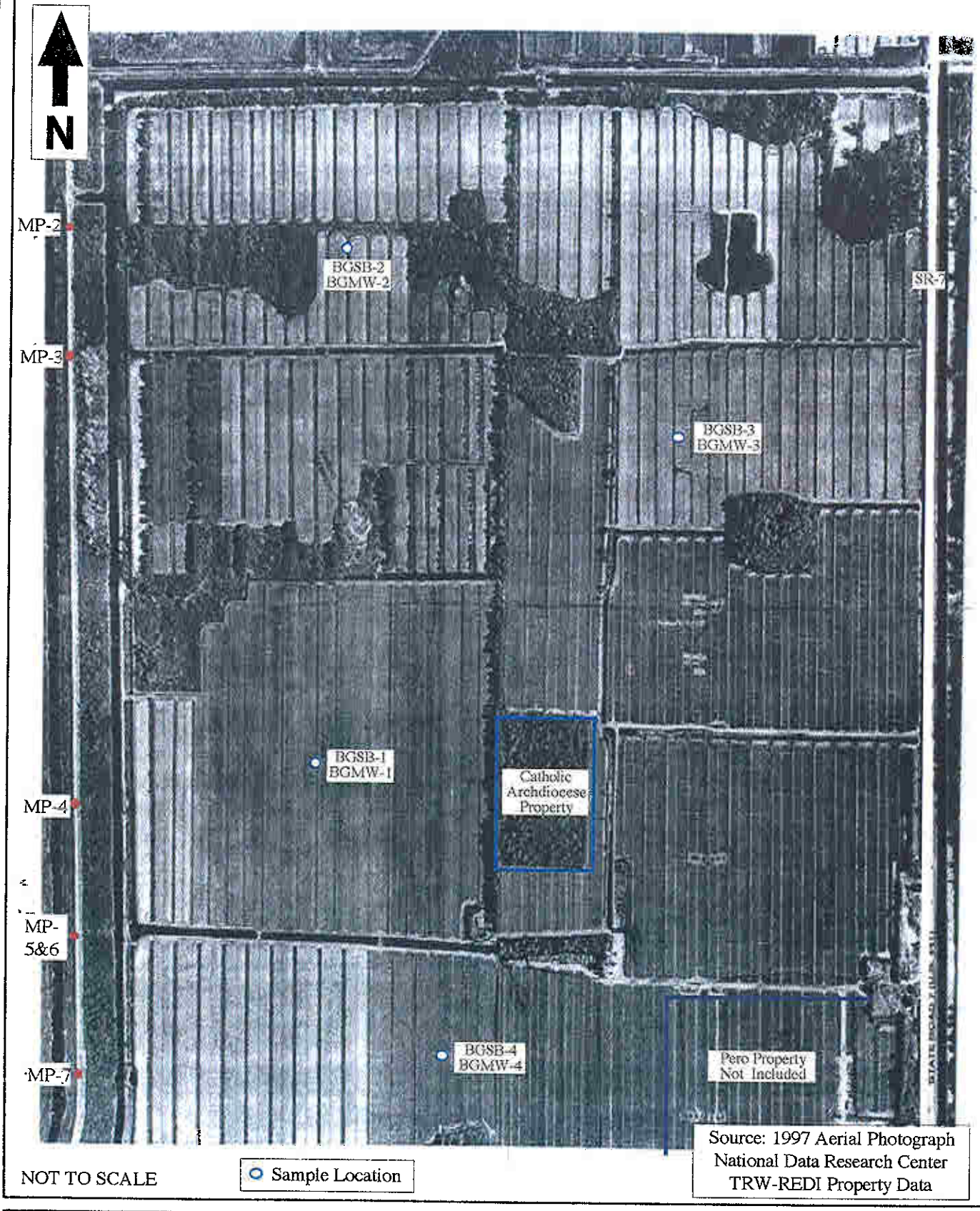


FIGURE 14
BACKGROUND SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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Environmental Consulting & Technology, Inc.

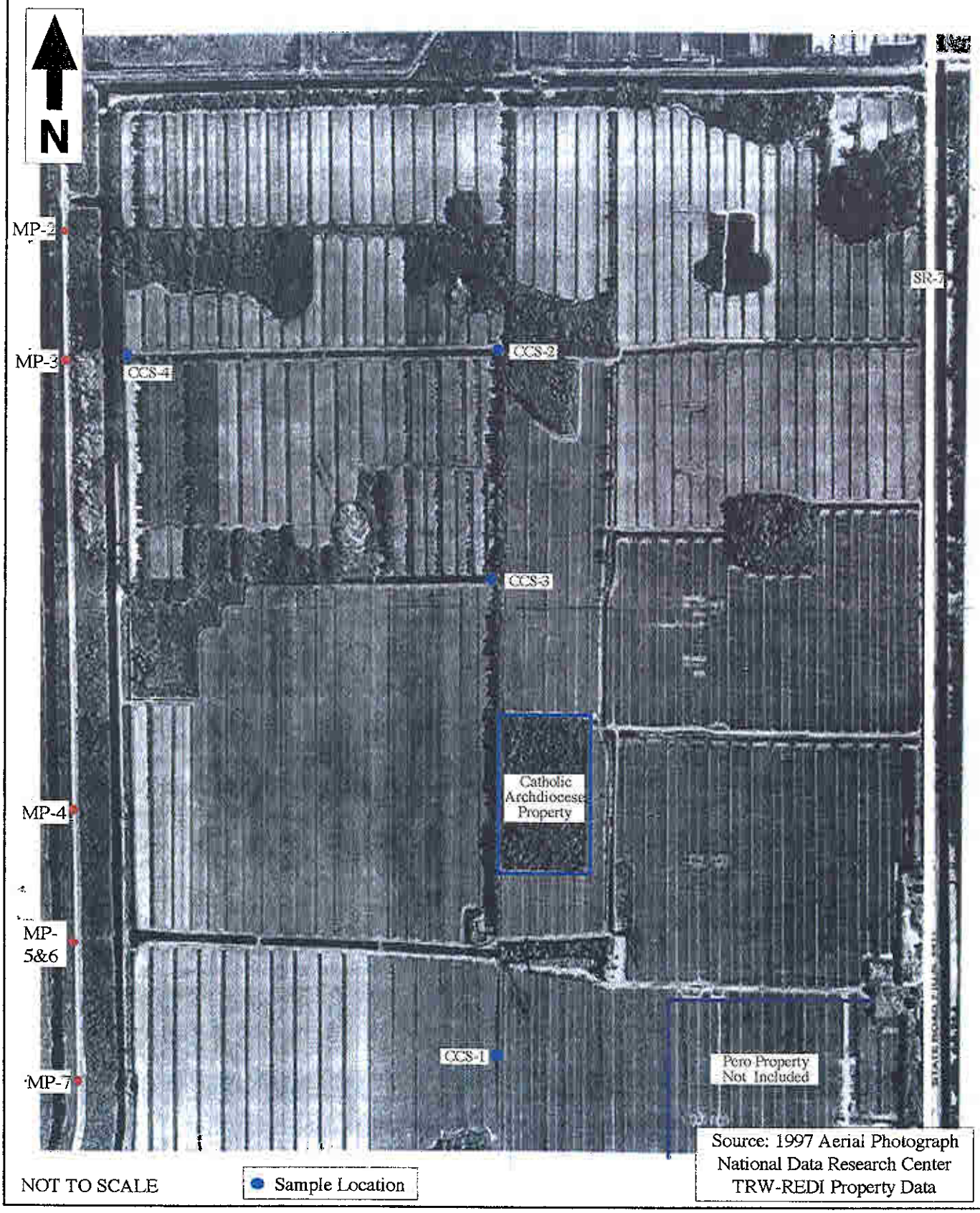
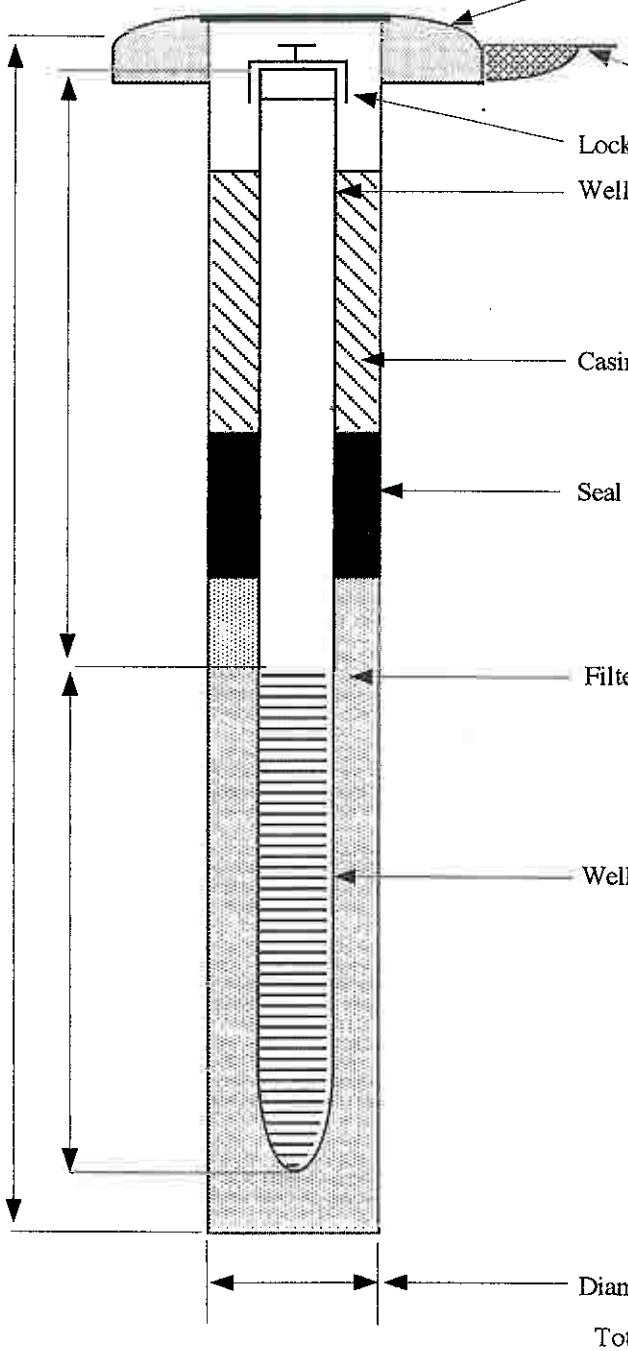


FIGURE 15
SEDIMENT SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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CROSS-SECTIONAL VIEW



Installation Date	03/20-21/00
Protective Casing and Concrete Pad	
Ground Surface	
Locking Cap	
Well Casing	
Material	PVC
Diameter	2.0 inch
Joint Type	welded
Length	2 ft
Casing Backfill	
Material	Portland Cement
Thickness	1.5 feet
Seal	
Type	Fine Sand
Thickness	0.5 feet
Filter Pack	
Type	Sand
Distance above Screen	1.0 feet
Well Screen	
Material	PVC
Diameter	2.0 inch
Slot Size	.020 inch
Length	10.0 feet
Diameter of Borehole	6.0 inch
Total Depth	12.0 ft

FIGURE 16
MONITORING WELL CONSTRUCTION DETAIL
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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Environmental Consulting & Technology, Inc.

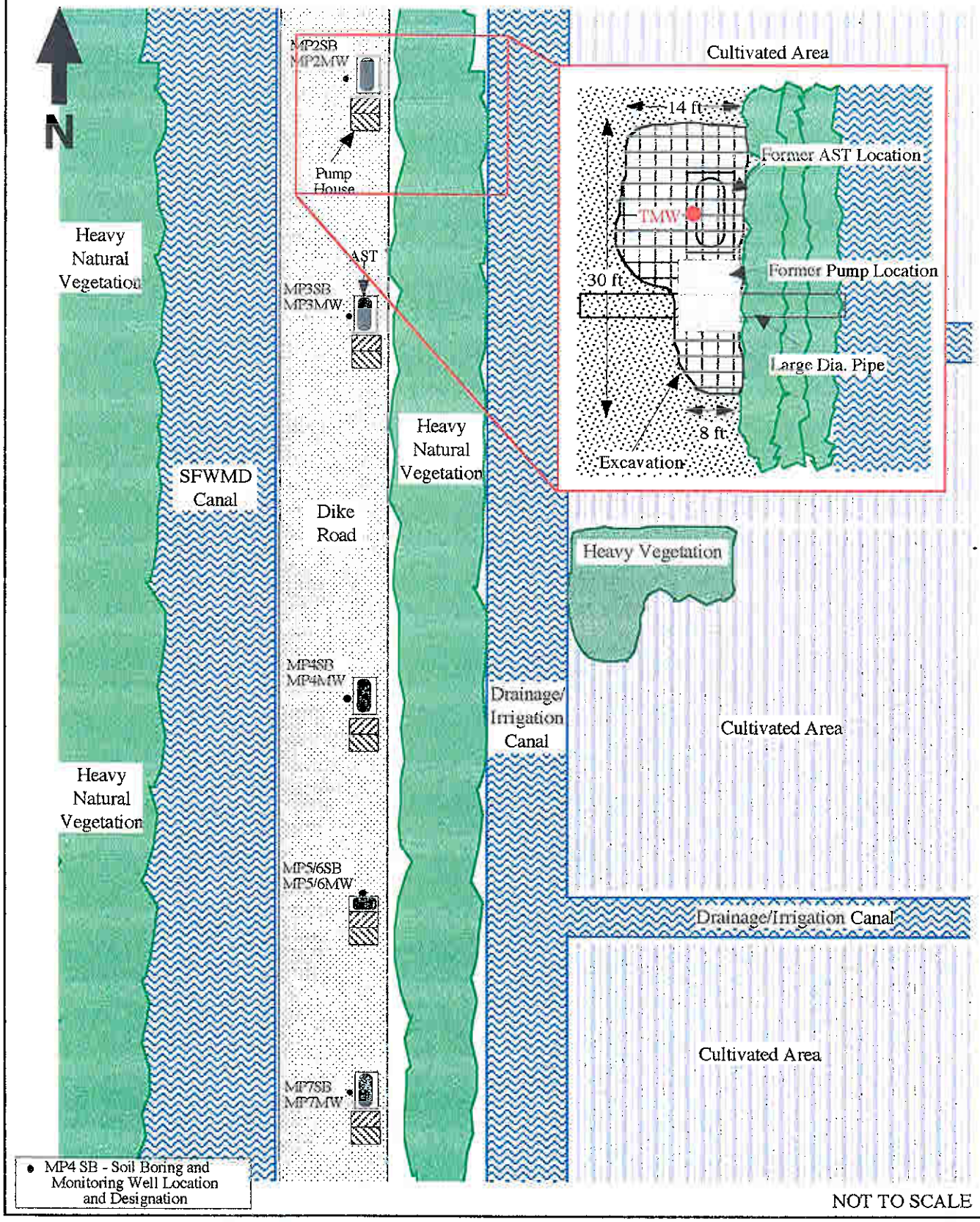


FIGURE 17
PUMP STATION (MP-2) CLOSURE MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

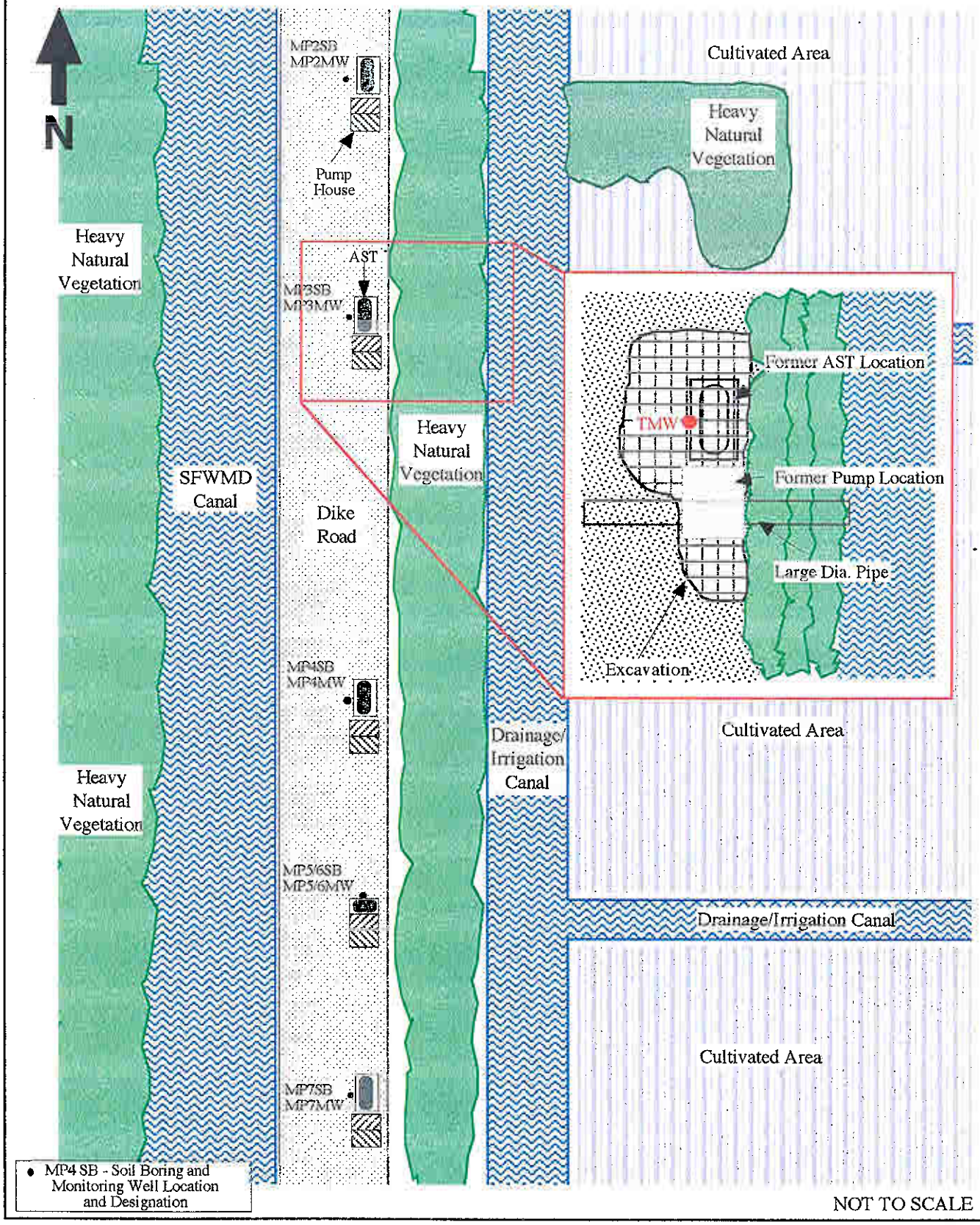


FIGURE 18
PUMP STATION (MP-3) CLOSURE MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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Environmental Consulting & Technology, Inc.

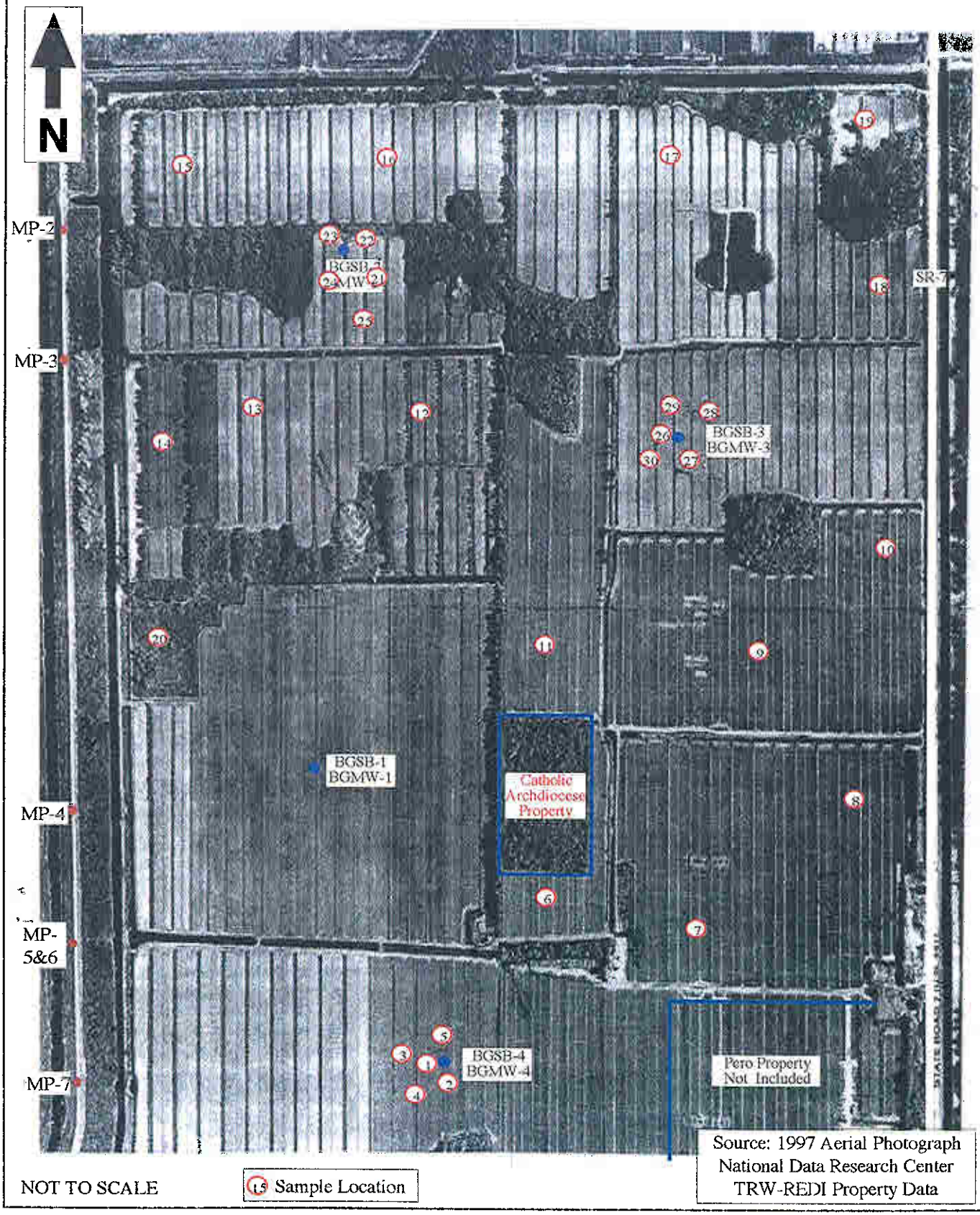


FIGURE 19
SOIL CONFIRMATION SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

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Environmental Consulting & Technology, Inc.



FIGURE 20
SEDIMENT CONFIRMATION SAMPLE LOCATION MAP
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

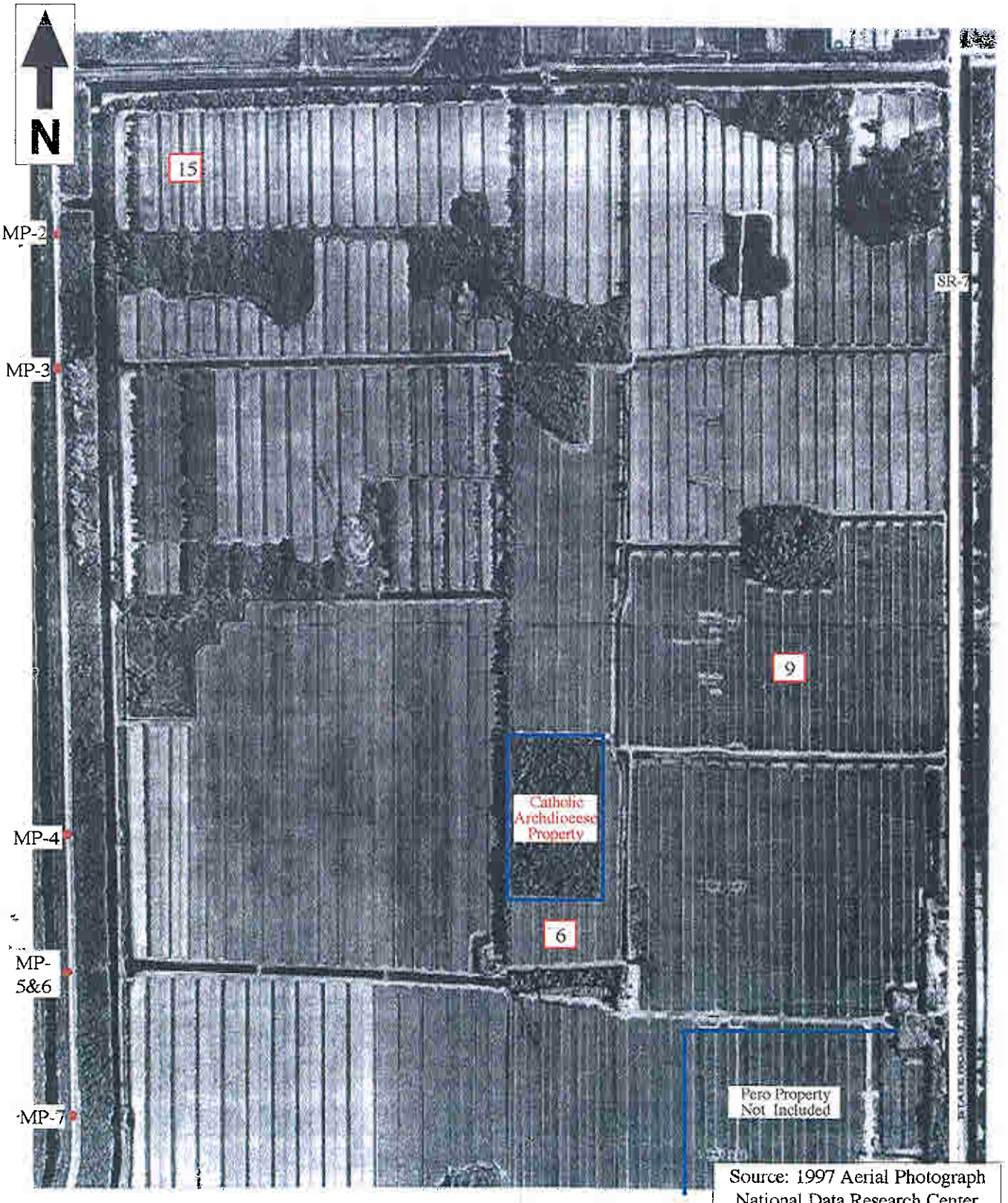


FIGURE 21
COMPOSITE SAMPLE LOCATION MAP FOR AREAS 6, 9 AND 15
McMURRAIN FARMS
SR 7 / HIGHWAY 441
PALM BEACH COUNTY, FLORIDA

ECT
Environmental Consulting & Technology, Inc.

ATTACHMENT C

EXHIBITS

McMurrain Farms
Palm Beach County

EXHIBIT 1. SOIL ANALYTICAL RESULTS

			FL PRO	8318	3050/6010	3050/6010	3050/6010	3050/6010	3050/6010	3050/6010	3050/6011	3050/6012	3050/6013	3050/6010	3550/8081	3550/8081	3550/8082	3550/8084	3550/8081	3550/8081
SITE NAME	**SITE SPECIFIC INFORMATION**	**SOIL BORING I.D.#**	**Petroleum Hydrocarbons (mg/kg)**	**Propoxur (Baygon) (ug/kg)**	**Arsenic (mg/kg)**	**Barium (mg/kg)**	**Cadmium (mg/kg)**	**Chromium (mg/kg)**	**Copper (mg/kg)**	**Lead (mg/kg)**	**Mercury (mg/kg)**	**Selenium (mg/kg)**	**Silver (mg/kg)**	**Zinc (mg/kg)**	**4,4-DDE (ug/kg)**	**4,4-DDD (ug/kg)**	***Chlordane (ug/kg)**	**Endosulfan I (ug/kg)**	**4,4-DDT (ug/kg)**	**Toxaphene (ug/kg)**
McMurrain Farms	Pump Station 2	MP2SB	**720**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pump Station 3	MP3SB	**4600**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pump Station 4	MP4SB	BDL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pump Station 5 & 6	MP5SB	BDL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pump Station 7	MP7SB	BDL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Central Fertilizer Tank	CFTSB	NA	BDL	1.2	7	0.08	8.6	7.8	6	BDL	0.6	BDL	9.6	BDL	BDL	BDL	BDL	BDL	BDL
	Area of Six Trailers	STSB-1	BDL	BDL	BDL	0.1	BDL	0.3	0.1	BDL	BDL	0.2	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL
		STSB-2	BDL	BDL	BDL	0.2	BDL	0.3	0.8	0.3	BDL	0.3	BDL	0.8	BDL	BDL	**4.2**	BDL	BDL	BDL
	Large Equipment Graveyard	LEGSS-1	45	**2.5**	0.5	4.6	0.6	17.0	**25.4**	**35.0**	BDL	BDL	0.055	19.9	BDL	BDL	BDL	BDL	BDL	BDL
		LEGSS-2	BDL	**8.9**	2.0	8.7	**0.8**	26.7	**34.1**	30.0	BDL	BDL	BDL	104.0	BDL	BDL	BDL	BDL	BDL	**450**
	Small Equipment Graveyard	SEGSS-1	BDL	BDL	3.0	8.2	0.04	5.1	14.3	3.4	BDL	0.3	0.014	94.2	BDL	BDL	BDL	BDL	BDL	**340**
		SEGSS-2	BDL	BDL	3.3	5.8	BDL	3.5	13.7	3.2	BDL	BDL	BDL	74.1	BDL	BDL	BDL	36	BDL	BDL
	Small Pesticide Shed Area	SPSSB	NA	BDL	BDL	0.5	BDL	1.1	1.1	0.4	BDL	BDL	BDL	2.6	BDL	BDL	BDL	BDL	BDL	BDL
		SPSSB-A (DUPLICATE)	NA	BDL	BDL	0.3	BDL	0.4	0.6	BDL	BDL	BDL	BDL	1.7	BDL	BDL	BDL	BDL	BDL	BDL
	Mobile Home Area	MHBGSB	NA	BDL	BDL	0.4	BDL	0.7	1.6	BDL	BDL	BDL	BDL	1.5	BDL	BDL	BDL	BDL	BDL	BDL
		MHBGSB-A (DUPLICATE)	NA	BDL	BDL	0.4	BDL	0.2	0.6	BDL	BDL	BDL	BDL	0.9	BDL	BDL	BDL	BDL	BDL	BDL
	Vegetable Disposal Area	VDASB	NA	BDL	BDL	1.1	BDL	5.6	4.7	0.8	BDL	BDL	BDL	4.4	BDL	BDL	BDL	BDL	BDL	BDL
		VDASB-A (DUPLICATE)	NA	BDL	BDL	1.0	BDL	4.3	1.0	0.6	BDL	BDL	0.015	1.7	BDL	BDL	BDL	BDL	BDL	BDL
	Borrow Pit	BPSB-1	BDL	BDL	BDL	9.6	BDL	2.2	1.6	2.1	BDL	0.6	BDL	5.4	BDL	BDL	BDL	BDL	BDL	BDL
		BPSB-2	BDL	BDL	BDL	0.6	BDL	0.3	0.06	BDL	BDL	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL
	Background	BGSB-1	BDL	BDL	BDL	BDL	BDL	0.3	0.4	BDL	BDL	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL
		BGSB-2	BDL	BDL	0.8	7.8	BDL	8.8	2.90	2.6	BDL	1.5	0.028	6.0	**24**	BDL	BDL	BDL	BDL	BDL
		BGSB-3	BDL	BDL	BDL	1.6	BDL	2.2	6.80	3.5	BDL	0.2	0.011	6.3	BDL	BDL	BDL	BDL	BDL	BDL
		BGSB-4	7.1	BDL	1.5	13.5	0.2	28.6	**73.8**	8.3	BDL	0.9	0.074	33.8	BDL	BDL	BDL	BDL	BDL	BDL

EXHIBIT 1. SOIL ANALYTICAL RESULTS

			FL PRO	8318	3050/6010	3050/6010	3050/6010	3050/6010	3050/6010	3050/6010	3050/6011	3050/6012	3050/6013	3050/6010	3550/8081	3550/8081	3550/8082	3550/8084	3550/8081	3550/8081
SITE NAME	SITE SPECIFIC	SOIL BORING	Petroleum Hydrocarbons (mg/kg)	Propoxur (Baygon) (ug/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)	4,4-DDE (ug/kg)	4,4-DDD (ug/kg)	*Chlordane (ug/kg)	Endosulfan I (ug/kg)	4,4-DDT (ug/kg)	Toxaphene (ug/kg)
	Canal Sediment Samples	CSS-1	NA	BDL	0.8	8.5	0.08	12.8	**38.8**	4.4	BDL	0.5	0.047	20.7	BDL	BDL	BDL	BDL	BDL	BDL
		CSS-2	NA	BDL	0.2	4.0	BDL	1.1	0.8	0.4	BDL	BDL	BDL	1.1	BDL	BDL	BDL	BDL	BDL	BDL
		CSS-3	NA	BDL	BDL	2.2	BDL	1.5	5.4	0.5	BDL	BDL	BDL	2.4	BDL	BDL	BDL	BDL	BDL	BDL
		CSS-4	NA	BDL	0.5	3.2	0.12	4.0	6.3	1.4	BDL	0.2	BDL	4.9	BDL	BDL	BDL	BDL	BDL	BDL
	Underground Storage Tank Area	USTSB-1	BDL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		USTSB-2	BDL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volume 1. Sediment Quality Assessment Guidelines - Toxic Effect Levels (TEL)			---		7.24	---	0.676	52.3	18.7	30.2	0.13	---	0.73	124	2.07	1.22			1.19	**
F.A.C CHAPTER 62-777 Proposed Soil Clean Goals, Effective October 1999 (Direct Exposure, Residential)			340		0.8	110	75	210	110	400				23000	3.3	4.6		410	3.3	1000
F.A.C CHAPTER 62-777 Proposed Soil Clean Goals, Effective January 1999 (Leachability based on Groundwater Criteria [mg/kg])			980		---	---	---	---	---	---				6000	18	4			11	---
F.A.C. CHAPTER 62-785 Brownsfields Soil Cleanup Goals (Direct Exposure, Residential) (mg/kg)			350		0.8	---	75	290	105	500				23000	3.2	4.5			3.2	1.0
F.A.C. CHAPTER 62-785 Brownsfields Soil Cleanup Goals (Leachability based on Groundwater Criteria [mg/kg])			340		---	---	---	---	---	---				1200	0.3	0.2			2.7	---
F.A.C. CHAPTER 62-770, Table IV, Selected Soil Cleanup Target Levels (Direct Exposure, Residential [mg/kg])			350		0.8	---	75	290	----	500				---	---	---			---	---
F.A.C. CHAPTER 62-770, Table IV, Selected Soil Cleanup Target Levels (Leachability based on Groundwater Criteria [mg/kg])			340		TCLP 100	---	TCLP 20	TCLP 100	---	TCLP 100				---	---	---			---	---

Note: BDL = Below Detection Limits BG = Background
NA = Not Analyzed TCLP = Toxicity Characteristic Leaching Procedure
* Alpha and Gamma-Chlordane combined for total chlordane
** See risk assessment

McMurrain Farms
Palm Beach County

EXHIBIT 2. GROUNDWATER ANALYTICAL RESULTS

SITE NAME	SITE SPECIFIC INFORMATION	MONITORING WELL I.D. #	3050/6010 Arsenic (ug/l)	3050/6010 Barium (ug/l)	3050/6010 Cadmium (ug/L)	3050/6010 Chromium (ug/l)	3050/6010 Lead (ug/l)	3050/6010 Mercury (ug/l)	3050/6010 Selenium (ug/l)	3050/6010 Silver (ug/l)	8081 4,4-DDE (ug/l)	FL PRO Petroleum Hydrocarbons (mg/L)
McMurrain Farms	Pump Station 2	MP2MW	NA	NA	NA	NA	NA	NA	NA	NA	NA	BDL
	Pump Station 3	MP3MW	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6
	Pump Station 4	MP4MW	NA	NA	NA	NA	NA	NA	NA	NA	NA	BDL
	Pump Station 5 & 6	MP5MW	NA	NA	NA	NA	NA	NA	NA	NA	NA	BDL
	Pump Station 7	MP7MW	NA	NA	NA	NA	NA	NA	NA	NA	NA	BDL
	Central Fertilizer Tank	CFTMW	3.8	52.6	BDL	0.9	BDL	BDL	BDL	BDL	BDL	NA
		CFTMW-A (DUPLICATE)	30.4	55.8	BDL	1.3	BDL	BDL	BDL	BDL	BDL	NA
	Area of Six Trailers	STMW-1	49.3	96.3	BDL	68.4	13.1	BDL	2.8	BDL	BDL	BDL
		STMW-2	3.2	47	BDL	3.6	BDL	BDL	BDL	BDL	BDL	BDL
	Large Equipment Graveyard	LEGMW	BDL	53.3	BDL	4.5	BDL	BDL	BDL	BDL	BDL	BDL
	Small Equipment Graveyard	SEGMW	18.5	71.8	BDL	5.5	BDL	BDL	2.8	BDL	BDL	BDL
	Small Pesticide Shed Area	SPSMW	17.6	34.3	BDL	2.1	BDL	BDL	BDL	BDL	BDL	NA
		SPSMW-A (DUPLICATE)	17	33.8	BDL	1.8	BDL	BDL	BDL	BDL	BDL	NA
	Mobile Home	MHBGMW	12.4	121	BDL	BDL	BDL	0.2	2.2	BDL	BDL	NA

ATTACHMENT D

PHOTOGRAPHS



Views of large equipment graveyard and monitoring well installed.





View of former underground tank location.



View of pesticide storage shed and monitoring well installed.



View of catfish captured from McMurrain Farms borrow pit used in bioassay.



View of cichlids captured from McMurrain Farms borrow pit used in bioassay.



View of catfish captured in gill net at McMurrain Farms borrow pit.



View of cichlid captured in gill net at McMurain Farms burrow pit.



View of 7-day fathead minnow tests.



PHASE I/II ENVIRONMENTAL SITE ASSESSMENT REPORT AND SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

HARMONY RANCH PROPERTY
BRIDGE ROAD (STATE ROAD 708) AND PRATT WHITNEY ROAD
STUART, MARTIN COUNTY, FLORIDA
Tract No. JE 100-075

Prepared For:
South Florida Water Management District
23500 Southwest Kanner Highway
Canal Point, Florida
August 15, 2008

Prepared By:
URS Corporation
7800 Congress Avenue, Suite 200
Boca Raton, FL 33487
URS Job No.: 38617-040

August 15, 2008

Mr. Robert Kukleski
Lead Environmental Engineer
Land Acquisition Support Division
South Florida Water Management District
23500 Southwest Kanner Highway
Canal Point, Florida 33438

Re: Phase I/II Environmental Site Assessment
And Screening Level Ecological Risk Assessment
Harmony Ranch Property
Bridge Road (State Road 708) and Pratt Whitney Road 700
Martin County, Florida
Tract No. JE 100-075
URS Job # 38617-40

Dear Mr. Kukleski:

Herewith transmitted is URS Corporation's report of the Phase I/II Environmental Site Assessment and Screening Level Ecological Risk Assessment of the Harmony Ranch Property, approximately 1,118 acres of land, referred to as the "subject property" located in south central Martin County, Florida. This report has been prepared in accordance with URS' proposal to the South Florida Water Management District (District) and Work Order No. 35. The report has been submitted to Robert Frakes, Ph.D. of the U.S. Fish and Wildlife Service in Vero Beach, Florida , to Joseph Lurix of the Florida Department of Environmental Protection (FDEP) – Southeast District, and to Brian Doughtery of the FDEP – Tallahassee office.

URS appreciates the opportunity to support the District on this important project. If you have any questions with the information contained in this report, please contact URS at your convenience.

Respectfully Submitted,

URS CORPORATION

Edward A. Leding, P.G.
Project Manager

William F. Marcus
Projects Director

August 15, 2008

Robert A. Frakes, Ph.D.
Environmental Contaminants Coordinator
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

Re: Phase I and II Environmental Site Assessment
And Screening Level Ecological Risk Assessment
Harmony Ranch Property
Bridge Road (State Road 708) and Pratt Whitney Road 700
Martin County, Florida
Tract No. JE 100-075
URS Job # 38617-40

Dear Dr. Frakes:

Herewith transmitted is URS Corporation's (URS) Phase I and Phase II Environmental Site Assessment and Screening Level Ecological Risk Assessment of the Harmony Ranch Property, approximately 1,118 acres of land, located in south Martin County, Florida. This report has also been submitted to the Florida Department of Environmental Protection for review.

If you have any questions with the information contained in this report, please contact URS at your convenience.

Respectfully Submitted,

URS CORPORATION

Edward A. Leding, P.G.
Project Manager

William F. Marcus
Projects Director

C: Robert Kukleski, District

August 15, 2008

Joseph Lurix
Florida Department of Environmental Protection, Southeast District
400 North Congress Avenue
West Palm Beach, Florida 33401

Re: Phase I / Phase II Environmental Assessment
And Screening Level Ecological Risk Assessment
Harmony Ranch Property
Bridge Road (State Road 708) and Pratt Whitney Road 700
Martin County, Florida
Tract No. JE 100-075
URS Job # 38617-40

Dear Mr. Lurix:

Herewith transmitted is our report of the Phase I / Phase II Environmental Assessment and Screening Level Ecological Risk Assessment of the Harmony Ranch Property, approximately 1,118 acres of land, located in south Martin County, Florida. At the request of the South Florida Water Management District, this report has been also been submitted to the U.S. Fish and Wildlife Service in Vero Beach, Florida and the Florida Department of Environmental Protection's Tallahassee office.

If you have any questions with the information contained in this report, please contact URS at your earliest convenience.

Respectfully Submitted,

URS CORPORATION

Edward A. Leding, P.G.
Project Manager

William F. Marcus
Projects Director

C: Robert Kukleski, District
Robert Frakes, Ph.D., U.S. Fish and Wildlife Service – Vero Beach, FL
Brian Daugherty, FDEP – Tallahassee

August 15, 2008

Brian Dougherty
Florida Department of Environmental Protection
Bureau of Waste Cleanup
2600 Blair Stone Road
MS 4500
Tallahassee, FL 32399

Re: Phase I / Phase II Environmental Assessment
And Screening Level Ecological Risk Assessment
Harmony Ranch Property
Bridge Road (State Road 708) and Pratt Whitney Road 700
Martin County, Florida
Tract No. JE 100-075
URS Job # 38617-40

Dear Mr. Dougherty:

Herewith transmitted is our report of the Phase I / Phase II Environmental Assessment and Screening Level Ecological Risk Assessment of the Harmony Ranch Property, approximately 1,118 acres of land, located in south Martin County, Florida. At the request of the South Florida Water Management District the report has been also been submitted to the U.S. Fish and Wildlife Service in Vero Beach, Florida and the Florida Department of Environmental Protection's West Palm Beach office.

If you have any questions with the information contained in this report, please contact URS at your convenience.

Respectfully Submitted,

URS CORPORATION

Edward A. Leding, P.G.
Project Manager

William F. Marcus
Projects Director

C: Robert Kukleski, District
Robert Frakes, Ph.D., U.S. Fish and Wildlife Service – Vero Beach, FL
Joseph Lurix, FDEP – West Palm Beach, FL

August 15, 2008

Thomas G. Kenny, III
President
Seabranch Management, Inc.
8340 S.E. Fazio Drive
Hobe Sound, FL 32455

Re: Phase I / Phase II Environmental Assessment
And Screening Level Ecological Risk Assessment
Harmony Ranch Property
Bridge Road (State Road 708) and Pratt Whitney Road 700
Martin County, Florida
Tract No. JE 100-075
URS Job # 38617-40

Dear Mr. Kenny:

Herewith transmitted is our report of the Phase I / Phase II Environmental Assessment and Screening Level Ecological Risk Assessment of the Harmony Ranch Property, approximately 1,118 acres of land, located in south Martin County, Florida.

If you have any questions with the information contained in this report, please contact URS at your convenience.

Respectfully Submitted,

URS CORPORATION

Edward A. Leding, P.G.
Project Manager

William F. Marcus
Projects Director

C: Robert Kukleski, District

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EXECUTIVE SUMMARY

URS Corporation (URS) was retained by the South Florida Water Management District (District) to conduct a Phase I and Phase II Environmental Site Assessment (ESA) on the property known as the Harmony Ranch Property, located in Martin County, south of Bridge Road, west and adjacent to Pratt Whitney Road. The Harmony Ranch Property, referred to as the "subject property", is comprised of approximately 1,118 acres and identified as Tract Number 100-075. The subject property is located in the south portions of Sections 29 and 30 and in Sections 31 and 32, Township 39 South, Range 41 East. It is URS' understanding that the District has developed a conceptual plan to restore the natural hydrologic flow on the property as part of the Indian River Lagoon – Palmar Complex Natural Storage and Water Quality Area. This project was conducted in accordance with URS' proposal, dated March 20, 2008, to Mr. Robert M. Kukleski, Lead Environmental Engineer of the South Florida Water Management District.

The proposed acquisition area was evaluated in accordance with protocol developed by the District in conjunction with the U.S. Fish and Wildlife Service (Service) and approved by the Florida Department of Environmental Protection, *Protocol for Assessment, Remediation and Post-Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects*. The Phase I ESA was also performed in general accordance with the ASTM "Standard Practice for Site Assessments: Phase I Environmental Site Assessment Process" (ASTM E 1527-05). The purpose of the Phase I was to evaluate the historical and present use and activities on or near the subject property which may have resulted in the contamination by hazardous substances, especially agrochemicals, which may represent a "Recognized Environmental Concern". The Phase II ESA was conducted concurrent with the Phase I ESA to evaluate those areas determined to be a Recognized Environmental Concern by soil, sediment, and groundwater sampling events. These samples were analyzed for potential impacts through handling and use of hazardous substances or materials. The soil, sediment, and groundwater analytical results were reviewed from the Phase II ESA to evaluate the necessity for corrective actions.

The majority of the property, 718 acres, is improved pasture, utilized for cattle grazing, with the remaining 400 acres being wooded depressional/wetland areas. The property is well maintained. No stressed vegetation, stained or discolored soils, chemical odors, or evidence of impacts to soil or water was observed on the property. A farm tractor, skid mounted 500-gallon AST, and grass mowing equipment were observed in the central portion of the property. No cattle pens, cattle vices or cattle dip vats were identified and no structures, or historic mixing/staging areas were observed. The property is not listed on any environmental databases as a regulated facility.

A network of drainage ditches are located in the Improved Pasture Areas, a remnant of the former agricultural operation on the property. It is URS' understanding that site restoration will consist mainly of infilling these drainage ditches.

During the Phase I investigation and taking into consideration the intended use of the subject property the following areas were considered Recognized Environmental Concerns:

- Skid-mounted AST

- Former Cultivated / Improved Pasture Areas
- Interior Drainage Ditches

In order to evaluate these areas, soil, sediment, and groundwater samples were collected and analyzed for Constituents of Potential Concern (COPCs). The COPCs include organochlorine pesticides, organophosphorus pesticides, chlorinated herbicides, the eight RCRA metals, copper and zinc. These samples were collected in order to evaluate the potential presence or absence of contamination from hazardous substances and waste associated with historical agricultural use as well as the current cattle ranching and grazing operations.

The investigation included the collection and analysis of 15 composite soil samples, 198 close proximity discrete soil samples, five sediment samples, and three groundwater samples. Additionally, 12 confirmation soil samples, 14 split soil samples, and 1 split sediment sample were collected.

CONCLUSIONS

Based on the results of the Phase II ESA, URS has the following conclusions:

Skid mounted AST

Soil and groundwater samples collected in the vicinity of the Skid mounted AST have not been impacted with petroleum above applicable SCTLs or GCTLs.

Former Cultivated Area/Improved Pasture Areas

The organochlorine pesticide 4,4-DDD was detected in the composite soil sample collected from Grid-1 in the Former Cultivated Areas/Improved Pasture Area above the SQAGs PEC. Three other COPECs, 4,4-DDE, alpha and gamma chlordane, were identified in the composite soil samples in the Former Cultivated Areas/Improved Pasture Grid 2, Grid 3 and Grid 7 at concentrations above their SQAG TECs. These four grids are located in the northwest and north central portions of the project area, which correspond with the area that was historically cultivated with row crops for the longest period of time.

Per the District and Service's protocol, close composite discrete soil samples were collected from Grids 4, 8, 12, and 15 and analyzed by EPA Method 8081 to evaluate the potential of "false negatives" in the former cultivated areas. None of the samples collected exhibited elevated COPECs above their respective SQAG PECs, which is consistent with the composite soil sample results. Based on these results, if "hot spots" are present, they are small and are not expected to be masked by the composite sampling methodology.

One or more COPECs - 4,4-DDD, 4,4-DDE, alpha and gamma chlordane, were detected above the SQAG PECs in six close composite discrete soil samples collected in Grid-1, and one close composite discrete sample collected from Grid-2 exhibited 4,4-DDD (130 µg/kg) and alpha chlordane (33 µg/kg) parameters at concentrations above the SQAG PEC. Two samples collected from Grid-3 exhibited both 4,4-DDD

and 4,4-DDE at concentrations above the SQAG PEC. Based on the results of the discrete samples the COPECs that exceed the SQAG PECs are co-located with 4,4-DDD being the most prevalent.

Nineteen of the 40 close composite discrete soil samples collected from Grids 2, 3, 9 and 10 exhibited one or more COPECs above their SQAG TEC.

Vertical close composite discrete soil samples collected indicate that 4,4-DDD, 4,4-DDE and chlordane impacts do not extend past 12-inches bls. Based on this and the discrete soil sample data, an estimated 46 acres or 74,213 cubic yards of soil impacted with 4,4-DDD above the SQAG PEC of 28 µg/kg are present in the Grids 1, 2, and 3.

Organophosphorus pesticides, chlorinated herbicides, the eight RCRA metals, copper and zinc were not detected in soil or groundwater at concentrations that exceed established SQAGs, any applicable SCTL or GCTLs in the areas of potential concern.

Interior Drainage Ditches

Organochlorine and organophosphorus pesticides, chlorinated herbicides, the eight RCRA metals, copper and zinc were not detected in sediment that exceed established SQAGs, any applicable SCTL or GCTL in the areas of potential concern.

95 % UCL Evaluation

The overall mean and 95% UCL concentrations of 4,4-DDD for the property based on the composite soil sampling were calculated to be 6.92 µg/kg and 12.44 µg/kg, respectively. These concentrations are above the 4,4-DDD SQAG TEC of 4.9 µg/kg. The composite soil sample mean and 95% UCL concentrations for 4,4-DDE were calculated to be 4.07 µg/kg and 7.65 µg/kg. These concentrations are above the 4,4-DDE SQAG TEC of 3.2 µg/kg. The composite soil sample 95% UCL for total chlordane was 5.11 µg/kg, which is above the SGAG TEC of 3.2 µg/kg.

Screening Level Ecological Risk Assessment

The 4,4-DDD, 4,4-DDE, and 4,4-DDT impacted soils within Grids 1, 2, 3, 9 and 10 are expected to pose potential risks to aquatic-feeding wildlife. Potential risks to the aquatic community and aquatic-feeding birds, specifically the Clapper Rail, Everglades Snail Kite, Little Blue and Great Blue Herons, Osprey, and Tri-colored Heron, once the hydroflow is restored, are predicted to be isolated to the approximately 90 acres situated in the northwest corner of the proposed acquisition. The remaining 1,028 acres do not contain COPCs at concentrations with the potential to cause unacceptable risks to the future aquatic communities or aquatic-feeding wildlife.

The approximately 90 acres have 4,4-DDD, 4,4-DDE and 4,4-DDT concentrations above the SLERA Risk-Based Concentrations (RBC) of 12.7 µg/kg, 3.9 µg/kg, and 2.9 µg/kg, respectively.

RECOMMENDATIONS

Skid mounted AST

No petroleum impacts were identified in the area of the Skid mounted AST. Therefore URS recommends that no additional investigations are warranted.

Former Cultivated Area/Improved Pasture Areas

An estimated 90 acres containing soils that the RBC are present, including an estimated 46 acres of soils impacted with 4,4-DDD above the SQAG PEC are located in the northwest portion of the project area. These impacted soils potentially pose an environmental risk once the natural hydroflow is restored. The impacts extend to 12 inches below land surface. The remaining portion of the property is suitable for the District's intention to restore the hydroflow.

It is URS' understanding that on previous District projects the Service has recommended that elevated COPECs that exceed their RBC be remediated. Therefore URS recommends that the 90 acres with COPEC concentrations above the RBC be remediated to reduce the potential ecological risk. URS has evaluated the options to mitigate the 90 acres or 145,200 cubic yards of impacted soil which are present above the RBC.

The District had indicated that no reservoir or storm water treatment area is planned, therefore with the exception of infilling of the interior ditches, no construction activities are anticipated. Considering this, for the District to excavate and dispose/relocate the impacted soils or to cap the 90 acres with two feet of clean fill is cost prohibited. Also the interior drainage ditches do not have the capacity for the soils to be re-located in lower portions of the ditches and covered with 2 feet of clean fill. Given below are the two feasible options to mitigate the 90 acres of impacted soils.

Option 1 – Soil Inversion – Disc Plow

This soil inversion consists of using a Disc Plow, and inverting the upper 12-inch section of the soil horizon where as the impacted soils are placed three feet below land surface, and soils that are not impacted cover the impacted soils. This methodology has been successful on several District projects in reducing or eliminating the ecological risks associated with the metals impacted soil. It is assumed that the District will provide the disc plow and a tractor.

URS does not anticipate having to de-grub the 90-acre before plowing. Prior to implementing, additional soil sampling will need to be conducted before the soil inversion to further define the limits of impacts. Confirmation soil sampling will need to be conducted after the soil inversion to document the effectiveness of the corrective actions. In the event that the confirmation samples indicate inverted soils in an area or areas do not meet the RBC threshold, then the identified area(s) will be excavated and placed into the lower portions of the interior drainage/irrigation canals on the subject property and capped with two feet of clean soil. URS

has estimated that up to 23,232 cubic yards of impacted soils can be placed in the canals. This amount of soil represents 16 % of the total volume of impacted soils present on the property.

The estimated cost for this option is $ 325,727. **Figure 21** illustrates the areas of proposed corrective actions, where impacted soils exceed the RBC. **Table 9** is a summary of budgetary estimates for the corrective actions.

Option 2 – Exclude Areas of Impacts

The 90 acres of impacted soils above the RBC are grouped together in the northwest portion of the proposed acquisition. Using Option 2, the current landscape/soils in the Improved Pasture would remain as is. That is, the interior drainage ditches would not be filled in and the hydroflow would not be restored in this area. However, it is URS' opinion that a buffer zone (area of non-impacted soils) would need to be established in the northwest portion of the property to separate the impacted soils from the restoration area. Using a 200-foot buffer zon, the estimated area that would be excluded from restoration is an estimated 197 acres. The District would need to negotiate with the Service the exact area (s) and amount of acreage required for the buffer zone that would be excluded from the restoration of the property. **Figure 21** illustrates the proposed 200-foot wide buffer zone.

Interior Drainage Ditches

No impacts were indented in the sediment samples collected from the Interior Drainage Ditches. Therefore URS recommends that no additional investigations are recommended.

In the event that the District leases the property, the land use for cattle grazing does not justify the development of a Best Management Practices (BMP) plan during the interim period prior to restoring the hydroflow on the property. Therefore URS recommends that standard cattle grazing requirements following the 1999 Florida Cattlemen's Association Water Quality Best Management Practices for Cow/Calf Operations be included in the lease agreement.

Corrective Action Cost by Land Use

As requested by the District, URS evaluated the recommended corrective actions associated with the acquisition scenarios. The first scenario consists of acquiring the land with the continued use of the land being specifically for cattle grazing operations with the remainder of the land undeveloped. The other scenario consists of the corrective actions based on restoring the hydroflow in the area.

Environmental Concern	Approximate Remedial Cost	Agri, Residential & Industrial Land Use	Restored Hydroflow
Soil Inversion – Disc Plow	$ 84,108		**$ 325,727**
		TOTAL	**$ 325,727**

The Phase II ESA scope of work at the Harmony Ranch property did not identify any point sources. It is the opinion of URS that upon the completion of the above referenced actions, the site will be acceptable for its intended use.

1.0 INTRODUCTION

URS Corporation (URS) was retained by the South Florida Water Management District (District) to conduct a Phase I/Phase II Environmental Site Assessment (ESA) for Tract Number JE 100-075, totaling approximately 1,118 acres, referred to as "Harmony Ranch Property", herein referred to as the subject property. The Harmony Ranch Property is located on the west side of Pratt Whitney Road, just south of Bridge Road (State Road 708), in south central Martin County, Florida. The subject property is currently use for cattle grazing.

A General Site Vicinity Map is provided as **Figure 1**. An aerial photograph of the project area is given in **Figure 2**. It is URS' understanding that the District has developed a conceptual plan to restore the natural hydrologic flow on the property as part of the Indian River Lagoon – Palmar Complex Natural Storage and Water Quality Area. The conceptual plans call for filling ditches and restoring the natural hydroflow on the property. This project was conducted in accordance with URS' proposal, dated March 20, 2008, to Mr. Robert M. Kukleski, Lead Environmental Engineer of the South Florida Water Management District. The project purpose, scope, and limitations are described below.

1.1 OBJECTIVE

The objective is to evaluate the proposed acquisition area in accordance with protocol developed by the District in conjunction with the U.S. Fish and Wildlife Service (Service) and approved by the Florida Department of Environmental Protection (FDEP), *Protocol for Assessment, Remediation and Post-Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects*.

1.1.1 Phase I Environmental Site Assessment

The purpose of the Phase I ESA was to evaluate environmental concerns or issues that may be associated with the aforementioned properties. Such environmental concerns or issues are subsequently referred to in this report as a "Recognized Environmental Condition" in general accordance with the ASTM Standard E 1527-05. A Recognized Environmental Condition is defined as:

> "The presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies."

1.1.2 Phase II Environmental Site Assessment

The purpose of the Phase II ESA is to further evaluate areas of potential environmental concern that may be associated with present or past land use by performing soil, sediment, groundwater sampling. The Phase II ESA was conducted in conjunction with the Phase I ESA to expedite completion of the site project.

Phase II ESA activities included the collection of soil, sediment, and groundwater samples from the areas of potential concern identified during the Phase I ESA and laboratory analysis of collected samples, and evaluation of the assimilated data.

1.2 SCOPE OF WORK

The Phase I ESA included a site reconnaissance of the property, a review of federal and state environmental databases and related agency information for the site and surrounding properties, interviews with owner representatives and regulatory agency contacts, historical aerial photograph review, a review of published geologic information, and other related items. This information was used to evaluate existing or potential environmental impairment at the site due to current or past land use.

The Phase I ESA scope of work included the following items:

- Conduct field inspections of the subject property to identify hazardous or toxic materials used or stored on site; and identify stressed vegetation or areas of disturbance that may indicate areas of past on-site disposal or use;
- Interview current tenants or owners having knowledge of current and/or past operations or construction activities;
- Review available aerial photographs to evaluate current and historical land use for the site and adjacent properties;
- Inspect possible agrochemical storage areas/equipment storage areas and agrochemical mix and load areas, discharge and disposal areas;
- Review commercially available environmental databases;
- Observations of regional land use within ¼-mile of the properties, including readily visible conditions posing significant environmental concerns to the subject site;
- Review of agrochemical inventory list as available;
- Review appropriate environmental agency information pertaining to the site (if available in a timely manner).

1.3 LIMITING CONDITIONS

URS was provided access to the entire area covered by the subject property. No conditions that limited URS' ability to complete the Scope of Work were encountered during the performance of the Phase I/II ESA.

2.0 PHASE I ENVIRONMENTAL SITE ASSESSMENT

2.1 PHYSICAL LOCATION AND DESCRIPTION OF PROPERTY

The subject property consists of approximately 1,118 acres of land located on the west side of Pratt Whitney Road and south of Bridge Road in south Martin County, Florida (**Figure 1**). This area is mainly rural, with undeveloped tracts of land, pasture areas, some citrus farming, and areas where ranchette style single family residences have been built. The main use of the land is for cattle grazing and ranching operations. Improvements include a network of drainage ditches associated with former agricultural operations on the property, improved pasture areas, and unpaved, access roads. The subject property, identified as Tract JE 100-075, is located in Section 31, and the west portion of Section 32, in Township 39 South, and Range 41 East.

2.2 ENVIRONMENTAL SETTING

Environmental characteristics including topography, soils, geology and hydrogeology were evaluated based on site observations, published literature and available maps. These environmental characteristics can affect local groundwater flow, surface water flow and the potential for contaminant migration.

2.2.1 Topography

The United States Geological Survey (USGS), 7.5 Minute Topographic Quadrangle *Indiantown SE* dated 1953 and photorevised 1983, depicts the subject property as nearly level with several small depressional areas. The average elevation on the site is approximately 22 feet above mean sea level. Elevation data are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Based on the site reconnaissance and a review of the topographic map, the subject property is flat containing surface depression areas. Networks of drainage ditches ranging between two to four feet below land surface are present throughout the subject property.

2.2.2 Soils

The United States Department of Agriculture (USDA), Soil Conservation Service *Soil Survey of Martin County Area, Florida* indicates that the surficial soils at the subject property are the Riviera fine sand, depressional, the Pinell fine sand, the Floridana fine sand, depressional, the Pineda sand, the Riviera fine sand, and the Wabasso sand. The following is a brief description of the major soils located on the subject property.

> **Riviera fine sand, depressional** is a poorly drained, sandy soil found in depressions. The surface layer is typically gray fine sand to a depth of 2 inches. The subsurface layers include light gray to gray fine sand to a depth of 28 inches. The available water capacity is low in the surface and subsurface layers, medium in the upper 10 inches of the sub soils and low below this. The soil is ponded for 6 to 9 months in most years.
>
> **Pinella fine sand** is a nearly level, poorly drained soil. These soils are located in flatwoods and hammock areas bordering sloughs and depressions.

The surface layer of the soils is black fine sand five inches thick. The subsurface layer is fine sand to a depth of 24 inches. The subsoil is about 12 inches thick and is an olive gray fine sandy loam, followed by 14 inches of light olive gray fine sand over light gray fine sand and shell fragment to a depth of 60 inches or greater.

The available water capacity is very low in the surface layer and medium in the subsurface layer and subsoil. The water table is within a depth of 10 inches for less than 3 months and 10 to 40 inches for 4 to 6 months.

Floridana fine sand, depressional is a nearly level soil that is poorly drained and generally occupies wet sloughs and depressions. The surface layer consists of black fine sand to a depth of 15 inches. The subsurface layer to a depth 37 inches is gray and white sand. The subsurface layer is light brownish gray fine sand to a depth of 27 inches. The subsoil is grayish brown sandy clay loam followed by grayish brown fine sandy loam, and below this is light gray fine sand to a depth of 62 inches or more. This soil is ponded for more than 6 months during most years. Permeability is rapid in the surface and subsurface layers and slow to very slow in the subsoil. The water capacity is medium to low.

Pineda sand is a nearly level soil that is poorly drained and generally occupies low grassy flats. The surface layer consists of dark gray and dark grayish brown sand. The subsurface layer consists of brown fine sand and has yellow and brownish yellow mottles. The subsurface layer is underlain by subsoil consisting of brownish yellow and very pale brown fine sand that is coated with iron oxides. The lower part of the subsoil is mottled, gray fine sandy loam underlain with grayish fine sandy loam and a mixture of gray sand and white shell fragments to a depth of 72 inches or more. The water table is within a depth of 10 inches for 2 to 6 months during wet seasons in most years and at a depth of 10 to 40 inches most of the remaining time. Some areas are covered in places with shallow water for 1 to 2 months. Under natural conditions, this soil has severe limitations for cultivated crops due to wetness, unless intensive water control measures are used to remove excess water during wet seasons and provide subsurface irrigation in dry seasons. The soil is well suited to improved pasture, particularly when regularly fertilized.

Riviera fine sand is a nearly level, poorly drained soil that generally occupies broad, low flats and in drainageways. The surface layer is typically about 4 inches thick and consists of gray fine sand. The subsurface layer is a grayish brown to light gray fine sand and extends to a depth of 36 inches. The subsoil of olive gray sandy loam has tongues or pockets of light subsurface material and is underlain by light gray fine sand to 56 inches and mixed sand and shell fragments to a depth of 80 inches or more. The water table is at a depth of less than 10 inches for 2 to 4 months in most years, and at depths between 10 and 30 inches the remainder of the time. The water table may recede to depths greater than 40 inches for short periods during dry seasons. Under natural conditions, this soil has severe limitations for cultivated crops due to wetness, unless intensive water control measures are used to remove excess water during wet seasons and provide subsurface irrigation in dry seasons. The soil is suited for common vegetable crops, pasture and hay crops.

Wabasso sand is a nearly level soil that is poorly drained and generally occupies broad, open land areas in the flatwoods. Typically the surface layer is black and very dark gray sand about 7 inches thick. The subsurface layer consists of gray and light brownish gray sand underlain by a subsoil of black sand and very dark grayish brown, dark grayish brown and olive gray sandy clay loam. The substratum is olive gray and greenish gray sandy clay loam. The water table is at a depth of 10 to 40 inches for more than 6 months in most years and at a depth of less than 10 inches for 1 to 2 months. Under natural conditions, this soil has severe limitations for cultivated crops due to wetness, unless intensive water control measures are used to remove excess water during wet seasons and provide subsurface irrigation in dry seasons. The soil is well suited to pastureland grasses.

Pineda sand is a nearly level, poorly drained soil in low, broad, flatwoods areas. The surface layer is black fine sand to a depth of 4 inches. The subsurface layer to a depth of 24 inches consists of light gray to light brownish gray sand. The subsoil is a black to dark brown sand to a depth of 80 inches. Water capacity is very low with the permeability moderate. The water table is at a depth of 12 inches during the rainy season and between 12 to 40 inches for the remainder of the year.

Riviera fine sand is a nearly level soil that is poorly drained and is in the flatwoods areas adjacent to sloughs and streams. The surface layer is very dark gray fine sand to a depth of 4 inches. The subsurface is intermixed of light to dark gray, brown, and black fine sand to a depth of 60 inches. Yellowish brown fine sand is found in the substratum to a depth of 80 inches. The water capacity is low and permeability is slow to very slow. The water table is within 12 inches during the rainy season and between 12 to 40 inches for the rest of the year.

Wabasso sand is a nearly level, poorly drained soil located in low, narrow to broad sloughs or in poorly defined drainage ways on the flatwoods. The surface layer is dark gray fine sand with the subsurface light gray fine sand to a depth of 14 inches. The upper subsoil is a yellowish light brown to brown to a depth of 48 inches and the remainder to a depth of 80 inches is a greenish gray fine sandy loam. The water capacity is low and the permeability is slow to very slow. The water table is at a depth of 12 inches during the summer rainy season and to a depth between 12 to 40 inches for the remainder of the year.

2.2.3 Geology and Hydrogeology

Martin County is in the coastal lowlands unit of the Atlantic Coastal Plain physiographic province on the southeastern coast of peninsular Florida. Martin County extends from the Atlantic Ocean on the east side to Lake Okeechobee on the west. The County is divided into three physiographic subdivisions, which include the coastal ridge; the broad sandy flatlands; and a narrow extension of the Everglades marsh along the shore of Lake Okeechobee. The Harmony Ranch Property is located within the broad sandy flatland area or flatwoods.

The shallow sandy soils of the flatwoods are underlain by calcareous to clayey quartz sand, fossiliferous to sandy limestone, shell beds and coquina limestone of the Anastasia and Caloosahatchee Formations.

The combined thickness of these formations is approximately 150 feet and represents the surficial aquifer in this area. The Hawthorn Group of Miocene age consisting of sandy to calcareous and phosphatic clays, clayey sands and sandy to phosphatic carbonates underlies these formations. Locally, the approximate thickness of the Hawthorn Group is 700 feet. The Hawthorn Group represents a major confining unit between the overlying surficial aquifer and the underlying Floridan aquifer system. The top of the Floridan aquifer is composed of cavernous, hydraulically connected carbonates consisting of the Suwannee Limestone, the Ocala Limestone, and the Avon Park Formation. Beneath much of Southern Florida, the Floridan aquifer contains water under artesian pressure; however, the water generally is corrosive and high in dissolved mineral content (Florida Geological Survey RI #20, 1959).

Regional groundwater flow is typically a subdued reflection of the topography and is locally influenced by soil permeability and nearby water bodies such as ponds, drainage ditches and canals. The network of drainage canals influences the general direction of groundwater flow in the area of the subject property.

3.0 HISTORICAL SITE AND SURROUNDING PROPERTY CONDITIONS

3.1 CURRENT AND PRIOR OWNERSHIP

At the time of the site reconnaissance, Mr. Thomas Kenny, President of Seabranch Management, Incorporated was manager of the subject property. Based on the Martin County Property Appraiser's Office, the property was purchased in 1995 by Turtle Beach, Limited, which is located in Palm Beach Gardens, Florida. A chain-of-ownership record was not included in the scope of work for this Phase I/II ESA; therefore, previous ownership is not further noted or discussed.

3.2 INTERVIEWS

URS interviewed Mr. Kenny regarding environmental concerns or issues at the subject property. Mr. Kenny stated that the subject property has been utilized solely for livestock grazing and ranching operations since his company began managing the property in 2001. He was unaware of any previous agricultural activities, such as row crop or sod-grass farming. Mr. Kenny indicated no applications of agrochemicals are applied regionally, and that spot applications of herbicides are used on exotic vegetation in the wetland areas. The subject property is presently being utilized as a cattle grazing operation.

Mr. Kenny was unaware of any cattle dipping vats (of the tick eradication program) located on the property. URS also conducted regulatory telephone interviews. These regulatory interviews are further discussed in Section 5.2.

3.3 AERIAL PHOTOGRAPHY

Historical aerial photographs covering the subject property for years 1940, 1958, 1966, 1970, 1986, and 1996 were reviewed by URS. The aerial photographs, were obtained from the Martin County Water and Soil Conservation District and for the State University System of Florida Publication of Archival Library and Museum Materials.

1940 The subject property and surrounding area is undeveloped. The property contains numerous surface depressions inundated with water.

1958 In the northern portions of both Sections 31 and 32, a network of drainage ditches have been constructed and appears to be cultivated with row crops. The southern portions of these two sections are undeveloped with numerous surface depressions inundated with water. Bridge Road has been constructed to the north and west of the subject property.

1966 The remainder of the property appears to be cultivated with row crops with the exception of several surface depressional areas which are inundated with water. The initial construction phase of Pratt Whitney Road which extends south from Bridge Road to the lower portion of the subject property is visible.

1970 The southern portion of Sections 31 and 32 appear fallow and possibly used for pasture. The northern portions of the subject property are cultivated with row crops. Pratt Whitney Road is visible on the west side of the property.

1986 No significant changes appear to the subject property.

1996 No significant changes appear to the subject property. The FP&L substation is present just to the north of the subject property, along the west side of Pratt Whitney Road.

3.4 OTHER DOCUMENTS

URS contacted Environmental Data Resources, Inc. (EDR) to conduct a search for available environmental records. The EDR is a DataMap Area Study consisting of a boundary search of 1-mile. No other environmental reports were made available to URS.

4.0 SITE INSPECTION

4.1 CURRENT USES OF THE PROPERTY

URS conducted a site reconnaissance on February 8, 2008, and again on April 15, 2008, to visually inspect readily accessible areas of the property. According to information provided by the District, property targeted for acquisition encompasses approximately 1,118 acres which is currently used for cattle grazing only. Photographs taken during URS' site inspection are provided in **Appendix A**.

4.2 SITE OBSERVATIONS

At the time of the site reconnaissance, the subject property was utilized for cattle grazing operations. Improvements to the property are minor and include a network of drainage ditches which are associated with the improved pasture areas. These improved pasture areas were historically used for the cultivation of row crops and are identified as an area of potential environmental concern. The drainage ditches around the perimeter of the improved pasture areas are broad, 10 to 15 feet wide and 5 to 6 feet deep. Smaller ditches, that criss-cross the interior portions of the improved pastures are only 4 to 5 feet wide and 2 to 3 feet deep. The sediment in the ditches were also identified as an area of potential environmental concern. Barbed wire fencing has been utilized throughout the subject property.

A tractor was observed staged in the west central portion of the site. The tractor was reportedly used to maintain the improved pasture areas. A metal, 500-gallon aboveground storage tank (AST) mounted on a skid was observed on the main unpaved access road in the central portion of the property. This tank was used to store fuel for the tractor. The AST was identified as an area of potential environmental concern. A dilapidated wooden cattle feed stand was noted in the central portion of the property, just west of the main unpaved access road. No other improvements were observed on the subject property. No buildings, structures, foundations, staging areas, cattle dip vats or pens were observed on the property. Several wetlands areas and cypress stands are present on the property. Several small burn areas were noted in the southern portion of the property in the vicinity of the depressional/wetlands areas. These areas were reportedly used to burn the exotic vegetation that was cleared from the wetlands areas. No solid or domestic wastes were observed in the burn areas. Access to the site is from the west side of Pratt Whitney Road in the southeast portion of the subject property.

4.2.1 PCB-Containing Equipment

No electrical transformers were observed on the subject property.

4.2.2 Solid Waste

No solid waste was observed on the subject property.

4.2.3 Drains and Sumps

No other drains or sumps were observed.

4.2.4 Wastewater

No process that would generate wastewater was observed.

4.2.5 Wells

No potable water supply wells were observed. A database search of the District identified no permitted wells located on the subject property. There are however 22 permitted Irrigation Use wells within a one and a half mile radius located to the south, north, and to the east of the subject property. Hobe Saint Lucie Conservancy District, Bridge Substation/Stuart Service Center, and South Florida Grassing Inc. are listed as the permittee names for these wells. Also nine permitted Livestock Use wells are located within a two mile radius to the north and to the west of the subject property. Trailside Subdivision – Lot 10, Trailside Subdivision – Lot 29, and Calusa Creek Ranch and Tree Farm are listed as the permittee names for these wells. One Industrial Use well is located within a two mile radius of the subject property. Permit numbers and additional information for these permitted wells is located in the water use survey, performed by the District, which is included as **Appendix B**.

4.2.6 Pits, Ponds, and Lagoons

Several naturally occurring surface depressions were observed throughout the property. Most of these surface depressions contain water during much of the year. Drainage ditches have been excavated in areas of the Improved Pastures. These ditches were excavated in the 1950s and were associated with the former row crop farming operations.

4.2.7 Other Physical Evidence of Contamination

No physical evidence of contamination was observed on the property.

4.3 CURRENT USES OF THE ADJOINING PROPERTY

The property is bounded to the north by former cultivated areas which are now used as improved pastures followed by Bridge Road; to the east by Pratt Whitney Road followed by former cultivated areas which are now used as improved pastures; by undeveloped land to west and southwest and improved pasture to the northwest; and to the south by citrus groves, a tract of undeveloped land and rural, single family residences.

4.4 SURROUNDING PROPERTIES OF POTENTIAL ENVIRONMENTAL CONCERN

Based on site observations, a review of available documents, and a review of the environmental database, no potential environmental concerns were identified. The assumed groundwater flow is to the south and east.

5.0 REGULATORY AGENCY REVIEW

5.1 ENVIRONMENTAL DATABASES REVIEW

The information gathered from environmental databases through EDR was reviewed to evaluate if activities on or near the parcel could threaten the environmental quality of the subject property. The report provided by EDR is a review of databases compiled by Federal, State, and local governmental agencies within a specific radius of the project. For this project the radius is 1-mile. Facilities located beyond the specified search radii are not discussed, as they are not considered potential environmental concerns due to their relative distances from the subject property. The complete list of databases reviewed is provided in their report, included, as **Appendix C**. The EDR also included a certified Sanborn Map report, readily available historic topographic maps and aerial photographs. The Sanborn report, historic maps and aerial photographs are also included in **Appendix C**.

It should be noted that this information is reported as URS received it from EDR. It is not possible for URS to verify the accuracy or completeness of information contained in these databases. However, the use of, and reliance upon this information is a generally accepted practice in the conduct of environmental due diligence investigations. The databases searched and the information obtained within these databases are summarized below.

SUMMARY OF ENVIRONMENTAL AGENCY DATA				
AGENCY DATABASE	**SEARCH DISTANCE**	**DATE OF GOVERNMENT VERSION**	**SUBJECT PROPERTY LISTED**	**NUMBER OF SITES LISTED**
National Priority List (NPL) for Superfund Sites	1.000 miles	1/31/2008	No	0
Proposed NPL	1.000 miles	1/31/2008	No	0
Delisted NPL	1.000 miles	1/31/2008	No	0
Federal Superfund Liens (NPL LIENS)	Subject Property	10/15/1991	No	0
Comprehensive Environmental Response, Compensation and Liability Index System (CERCLIS) List	0.500 miles	1/9/2008	No	0
CERCLIS – No Further Remedial Action Planned (CERCLIS-NFRAP)	0.500 miles	12/03/2007	No	0
Resource Conservation and Recovery Act (RCRA) Corrective Action Report (CORRACTS)	1.000 miles	12/12/2007	No	0
RCRA Permitted Treatment, Storage, and Disposal (TSD) Facilities	0.500 miles	9/11/2007	No	0
RCRA Registered Large Generators of Hazardous Waste (RCRA-LQG)	0.250 miles	9/11/2007	No	0
RCRA Registered Small Generators of Hazardous Waste (RCRA-SQG)	0.250 miles	9/11/2007	No	1
Emergency Response Notification System (ERNS) List	Subject Property	12/31/2007	No	0
Hazardous Materials Information Reporting System (HMIRS)	Subject Property	10/31/2007	No	0
US Engineering Controls Site Listing (US ENG CONTROLS)	0.500 miles	1/18/2008	No	0
Brownfield Sites with Institutional Controls (US INST CONTROL)	0.500 miles	1/3/2008	No	0

SUMMARY OF ENVIRONMENTAL AGENCY DATA				
AGENCY DATABASE	**SEARCH DISTANCE**	**DATE OF GOVERNMENT VERSION**	**SUBJECT PROPERTY LISTED**	**NUMBER OF SITES LISTED**
Department of Defense Sites (DOD)	1.000 miles	12/31/2005	No	0
Formerly Used Defense Sites (FUDS)	1.000 miles	12/31/2006	No	0
Listing of Brownfield Sites (US BROWNFIELDS)	0.500 miles	1/3/2008	No	0
Superfund (CERCLA) Consent Decrees (CONSENT)	1.000 miles	9/1/2007	No	0
Records of Decision (ROD)	1.000 miles	1/14/2008	No	0
Open Dump Inventory (ODI)	0.500 miles	6/30/1985	No	0
Toxic Chemical Release Inventory System (TRIS)	Subject Property	12/31/2005	No	0
Toxic Substances Control Act (TSCA)	Subject Property	12/31/2002	No	0
FIFRA/TSCA Tracing System (FTTS)	Subject Property	1/15/2008	No	0
Section 7 Tracking Systems (SSTS)	Subject Property	12/31/2005	No	0
CERLA Lien Information (LIENS 2)	Subject Property	2/8/2008	No	0
Radiation Information Database (RADINFO)	Subject Property	1/29/2008	No	0
FIFRA/TSCA Tracking System Administrative Case Listing (HIST FTTS)	Subject Property	10/19/2006	No	0
Integrated Compliance Information System (ICIS)	Subject Property	7/27/2007	No	0
Land Use Control Information System (LUCIS)	0.500 miles	12/9/2005	No	0
Incident and Accident System (DOT OPS)	Subject Property	2/14/2008	No	0
PCB Activity Database System (PADS)	Subject Property	12/4/2007	No	0
Material Licensing Tracking System (MLTS)	Subject Property	1/15/2008	No	0
Mines Master Index File (MINES)	0.250 miles	11/20/2007	No	0
Facility Index System/Facility Registry System (FINDS)	Immediately West of Subject Property	1/4/2008	No	1
RCRA Administrative Action Tracking System (RAATS)	Subject Property	4/17/1995	No	0
State Hazardous Waste Sites (SHWS)	1.000 miles	1/22/2008	No	0
State Permitted Solid Waste Landfill, Incinerators or Transfer Stations (SWF/LF) List	0.500 miles	2/12/2008	No	0
State Leaking Underground Storage Tank (LUST) List	0.500 miles	2/5/2008	No	3
State Underground Storage Tanks (UST) List	0.250 miles	2/5/2008	No	1
State Regulated Aboveground Storage Tanks (AST)	0.250 miles	2/5/2008	No	1
Sites List (FL SITES)	1.000 miles	12/31/1989	No	0
Spills – Oil and Hazardous Material Incidents (SPILLS)	Subject Property	3/11/2008	No	0
Engineering Controls Site Listing (ENG CONTROLS)	0.500 miles	1/17/2008	No	0
Brownfield Institutional Control Site Listing (INST CONTROL)	0.500 miles	1/17/2008	No	0

SUMMARY OF ENVIRONMENTAL AGENCY DATA				
AGENCY DATABASE	**SEARCH DISTANCE**	**DATE OF GOVERNMENT VERSION**	**SUBJECT PROPERTY LISTED**	**NUMBER OF SITES LISTED**
State Voluntary Cleanup Program (VCP)	0.500 miles	3/24/2008	No	0
Drycleaner Facility Locations (DRYCLEANERS)	0.250 miles	2/5/2008	No	0
State Priority Cleaners (PRIORITYCLEANERS)	0.500 miles	3/1/2008	No	1
Ethylene Dibromide Database Results (DEDB)	0.500 miles	2/12/2008	No	0
Brownfield Sites (BROWNFIELDS)	0.500 miles	1/27/2008	No	1
Wastewater Facility Regulation Database (WASTEWATER)	Subject Property	2/6/2008	No	0
Permit and Emissions Inventory Data (AIRS)	Subject Property	2/22/2008	No	0
Cattle Dipping Vats (FL Cattle Dip. Vats)	0.500 miles	2/4/2005	No	0
Tier 2 Facility Listing (Tier 2)	Subject Property	1/18/2008	No	0
Indian Reservations (INDIAN RESERV)	1.000 miles	12/31/2005	No	0
INDIAN LUST Region 4 (R4)	0.500 miles	9/5/2007	No	0
INDIAN UST Region 4 (R4)	0.250 miles	9/5/2007	No	0
Manufactured Gas Plants	1.000 miles	N/A	No	0

The results of the database review are as follows:

5.1.1 Subject Property

The Site was not identified in the database search report.

5.1.2 Adjacent Properties

The database search did not identify any sites adjacent to the Site.

5.1.3 Orphan Sites

The EDR-supplied Orphan Sites List was reviewed which includes sites that have not been geocoded based on an absence of sufficient data regarding exact location. Based on the review of the Orphan Sites List, and area reconnaissance, none of these sites have the potential to create a Recognized Environmental Condition to the subject property.

5.2 REGULATORY AGENCY FILE REVIEW

Ms. Anita Neil of the Martin County Institute of Food and Agriculture Service for agriculture and livestock was contacted for information regarding the cattle operations at the subject property. Ms. Neil stated that IFAS does not currently maintain files on this property and that she did not have personnel knowledge of the cattle operations at the subject property. However, Ms. Neil did acknowledged that the

agrochemicals used for cattle ranching operations are not restricted in any way if the applicator follows the label issued with the agrochemical.

The FDEP Southeast District was contacted concerning environmental waste cleanup issues on the subject property. Mr. Paul Wierzibicki, supervisor of the Waste Cleanup Section indicated that the FDEP had recently opened a file on the subject property as part of the proposed acquisition by the District. The file contained administrative information and a scope of work for evaluation of the property, as well as maps of the site. This information was submitted to the FDEP from the District via electronic mail. No reports, documents or other information was in the file. Mr. Wierzibicki did not have personnel knowledge of any releases, discharges, or environmental waste cleanup issues at the subject property.

A representative of the Martin County Health Department was contacted for information regarding health issues. The representative was unaware of any human health or nuisance issues at the property.

The U.S. Fish and Wildlife Service (Service) at Vero Beach, Florida was contacted for information regarding the property. Dr. Robert Frakes, Environmental Contaminants Specialist for the Service stated that he was unaware of any fish or bird kills on the property or in the area.

Based on the regulatory information obtained on the subject property, and the area reconnaissance, no current or past environmental issues were identified which have the potential to create a Recognized Environmental Condition to the subject property.

6.0 PHASE I ESA FINDINGS

The Phase I ESA of Harmony Farms has identified three potential areas of environmental concern associated with historical and current activities. These three areas are illustrated on **Figure 3**. Based on the results of the Phase I ESA, including the review of historical aerial photographs, environmental reports, contacts with regulatory agencies, and observations made during the site reconnaissance, URS has identified the following areas of concern that required Phase II ESA intrusive investigations:

Skid mounted AST

Former Cultivated Areas / Improved Pasture – 720-acres

Interior Drainage Canal Sediment

7.0 PHASE II ENVIRONMENTAL SITE ASSESSMENT

The Phase II ESA activities were based on the preliminary results of the Phase I ESA. The objective of the Phase II ESA was to further evaluate areas of potential environmental concern for the presence of contaminants. The assessment was conducted by collecting soil samples, installing temporary groundwater monitoring wells, collecting groundwater and sediment samples and evaluating the collected field and analytical data.

The Phase II ESA included subsurface investigations of areas of potential concern identified in the Phase I ESA. The Phase II ESA scope of work included the following items:

- Evaluate soil, sediment and groundwater for the presence of contaminants originating from on-site sources;
- Develop budgetary cost estimates (if any) associated with site remediation based on results of the investigation.

The Phase I ESA identified the three areas of potential environmental concern: Skid mounted AST, Former Cultivated/Improved Pasture Areas and Interior Canal Sediment. The Former Cultivated Areas/Improved Pasture Areas make up approximately 720 acres of the 1,118 acres and are located throughout the property. The remaining 398 acres are wooded depressions and wetlands in which no improvements have been made. Therefore these depressions and wetlands areas were not sampled as part of the Phase II ESA.

7.1 CONSTITUENTS OF POTENTIAL CONCERN

There are three primary groups of Constituents of Potential Concern (COPCs) that could have impacted soil, sediment, and groundwater at the Harmony Ranch property. These COPCs include agrochemicals and metals.

7.1.1 Agrochemicals

Based on the observed site operations and review of historical aerial photographs, the Improved Pasture areas were previously used for the cultivation of row crops. Agricultural maintenance, which includes the application of agrochemicals, may have historically been performed in the former cultivated areas. Pesticide use could potentially have been limited to direct applications to the former cultivated areas as well as direct applications to livestock. Moreover, herbicides, fertilizer, and plant nutrients could have been or were used on the former cultivated /improved pasture areas and subsequently may have residual effects to the soil and groundwater quality on the property. To evaluate the soil, groundwater, and sediments on the property for the presence of residual agrochemicals, soil, sediment, and groundwater investigations were completed. During the Phase II ESA, samples were collected and analyzed for one or more of the following:

- Organochlorine Pesticides, (EPA Method 8081)
- Organophosphorus Pesticides, (EPA Method 8141)

- Chlorinated Herbicides, (EPA Method 8151)

7.1.2 Metals

To evaluate metal constituents in the soil, sediments, and groundwater on the subject property, representative soil, sediment and/or groundwater samples were collected and analyzed for the following metals:

- Eight Resource Conservation and Recovery Act (RCRA) Metals (Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver)
- Copper and Zinc (EPA Method 6010B)

7.1.3 Petroleum Hydrocarbons

A soil and groundwater sample from around the perimeter of the skid mounted AST were collected to evaluate the potential for inadvertent discharges of petroleum products from overfilling the tank. The samples were analyzed for the following constituents:

- Volatile Organic Hydrocarbons (EPA 8021)
- Polynuclear Aromatic Hydrocarbons (EPA Method 8100)
- Petroleum Hydrocarbons or Petroleum Residual Organics (FL-PRO)
- Lead (EPA Method 6010B)

URS contracted Columbia Analytical Services (CAS), a State licensed and District approved laboratory for analyzing the samples collected. This laboratory is located in Jacksonville, Florida. URS contracted Elab, Inc., located in Ormond Beach, Florida to analyze the split samples that were collected. Elab, Inc. is also a State and District approved laboratory.

7.2 GENERAL SAMPLING METHODOLOGY

The following sections detail the laboratory and general field methodology used for the collection and analysis of soil, groundwater, and sediments during the Phase II ESA at the subject property. The soil and sediment samples were collected on April 14, 15, and 16, 2008. The groundwater samples were collected on April 18, 2008.

A work plan was formulated prior to the sampling activities. The work plan focused mainly on the methodology by which the scope of work is to be completed. The plan included the personnel slated to be involved in the project and the hierarchy of review of the data, sampling and analysis methodologies, and the processes employed by which each task will be completed. Additionally, the work plan listed timetables and deliverables, and review of the scope by the Service, and the District. Included with the work plan was a site specific health and safety plan.

In order to enable future confirmation of assessed site conditions, the locations of the samples obtained from the subject property were recorded utilizing a portable Global Position System (GPS) receiver.

Sample locations were logged based on utilizing units of Latitude (north) and Longitude (west). A copy of the GPS points is provided in **Appendix D**.

7.2.1 Soil Sampling Procedure

7.2.1.1 Former Cultivated/Improved Pasture Areas

The primary objective for the collection and chemical analysis of soil samples was to evaluate the average concentrations of residual agrochemical constituents, specifically organochlorine pesticides, organophosphorus pesticides, chlorinated herbicides, the eight Resource Conservation and Recovery Act (RCRA) metals and copper and zinc.

Based on historical photographs, it appears that much of the Improved Pasture areas, approximately 720 acres, were historically used for the cultivation of row crops. These areas appear to have been cultivated during the time frame prior to 1958 and before 1970. As a conservative measure, soil samples were collected throughout the Improve Pasture area, where cultivation had occurred, in order to evaluate the potential of residual agricultural chemicals that may have been historically applied.

Based on the future intended use, soil within the subject property was evaluated for residual concentrations of pesticides and soil addendums that may have been used during historical farming operations. Considering that the natural hydrologic flow may be restored and the potential use of the subject property in the future as wetlands, in order to evaluate residual agrichemicals in the former cultivated areas, URS used the District and Service's sampling protocol as given in the document entitled *Protocol for Assessment, Remediation and Post-Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects*.

In order to characterize the nature and extent of anthropogenic contaminants, a total of 15 composite soil samples and 150 close proximity composite soil samples were collected in the former cultivated/improved pasture areas on the property. The 720 acres of improved pasture were divided into 15, 50-acre grids. Each of the 15 grids were subdivided into 10, 5-acre sub grids. Within each of the 5-acre sub grids, a five subset, close proximity composite discrete soil sample was collected at 10 locations in each of the 15, 50-acre grids. The sub set samples were collected from 0 to 6-inches below land surface. The 10 sub set samples were thoroughly mixed together to form one composite soil sample. In addition one close proximity composite discrete soil sample was collected from each of the grid's 10 sub set sample locations and analyzed separately for copper.

Since most of the area was cultivated prior to 1970, and most of the 720-acres is currently being maintained as Improved Pasture, the 15 composite soil samples were analyzed for organochlorine pesticides by EPA Method 8081, organophosphorous pesticides by EPA Method 8141 (including atrazine), for herbicides by EPA 8151, and the eight RCRA Metals: arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium. The samples were also analyzed for copper, zinc, and for total organic carbon (TOC). A detailed review of the historical aerials indicated that the former

cultivated areas were some type of row crops. Typically vegetables such as tomatoes, pepper, and melons were cultivated in this region, and copper and zinc based agrochemicals were used as pesticides and soil addendums. Based on these observations and assumptions, the 150 close proximity composite discrete samples were analyzed for copper. A copy of the soil laboratory analytical reports and chain of custody record are included in **Appendix E**.

A sample preparation area was set up centrally located away from the sampling area which consisted of sample coolers and a sample mixing and preparation area. The ground in this area was covered with visquene to minimize the potential of cross contamination. The decontamination area set-up and used sample equipment was staged separately from the sample preparation area.

The sample team consisted of two crews. Each crew had two field technicians that entered the 50-acre sampling area. While one person collected the soil samples, the second person used a portable GPS receiver to establish the sampling point location as well as mark the location with a survey flag. A 5 subset close composite sample was collected from each of the grid's 10, 5-acre sub grids, and placed in a stainless steel bowl and thoroughly mixed. A portion of this mixed soil was placed in a Teflon bag, marked with the grid identification and sample time, sealed with tape, and placed on ice prior to returning the samples to the centralized mixing area for compositing. The remaining portion of the close composite discrete samples were placed in laboratory supplied bottleware, marked with the grid identification, sub set sample location, and sample time, sealed, and placed on ice prior to returning the samples to the centralized area pending submittal to the laboratory.

Once at the sample preparation area, the composite samples were thoroughly mixed in the Teflon bag and then transferred into a stainless steel bowl and mixed with a stainless steel spoon. One composite sample was then collected from the thoroughly mixed soil and placed in laboratory supplied bottleware.

The nomenclature of the composite samples was labeled based on (1) the grid numbers from where each soil sample was collected. For example, the composite soil sample collected from Grid 1 was labeled as Grid-1. Each of the sub set locations in each grid were labeled as SS-1 through SS-10. For example if close composite discrete samples were collected from Grid 1 from soil sample locations SS-1, SS-2, SS-3 the soil samples were labeled Grid-1-SS1, Grid-1-SS2, Grid-1-SS3, etc. Since the close composite discrete soil samples were collected in each of the grids for copper, the discrete soil samples were labeled as described above.

7.2.1.2. Additional Soil Evaluation

One composite soil sample, collected from Grid 1 exhibited the organochlorine pesticide 4,4-DDD above the Sediment Quality Assessment Guideline (SQAG) Probable Effects Concentration (PEC) and 4,4-DDE and alpha and beta chlordane above the SQAG Threshold Effects Concentrations (TEC). Composite soil samples collected from four grids, Grids 2, 3, 7 and 10, exhibited one or more of the following organochlorine pesticides: alpha chlordane, beta chlordane, 4,4-DDD, and 4,4-DDE, at concentrations above their respected SQAG Threshold Effects Concentration (TEC).

After the initial analysis of the composite soil sample data, these organochlorine pesticides were identified as constituents of potential ecological concern (COPEC). A COPEC is any agrochemical that is detected in one or more composite samples at concentrations exceeding the SQAG-TEC values.

Following the Service's guidelines, to evaluate the potential of "false negatives" in the former cultivated areas, the soils in an additional four grids or 25 % were evaluated. Four "clean grids", Grids 4, 8, 12, and 15, that did not exhibit any COPECs above the SQAG-TEC values were selected for further evaluation. This evaluation consisted of collecting and analyzing the 10 close composite discrete soil samples collected from each of the grids.

For the additional soil evaluation, when collecting the initial close composite discrete soils samples used for the composite and copper analysis in the 50-acre girds, an additional amount of soil was collected from each sample location and placed on hold pending laboratory analysis. The 10 close proximity composite soil samples collected in Grid 1, which exhibited 4,4-DDD above the SQAG PEC and the 40 samples collected from the four "clean grids", Grids 4, 8, 12, and 15, were taken off hold and analyzed for the elevated agrochemicals 4,4-DDD, 4,4-DDE, and alpha and gamma chlordane as well as other organochlorine pesticide compounds by EPA Method 8081. The intent of the additional sampling in Grid 1 was to define the extent of any impacts to the extent necessary to provide reasonable cost estimates for cleanup.

The Screening Level Ecological Risk Assessment (Section 10) identified the COPECs detected in Grids 1, 2, and 3 as potentially causing risks to the future aquatic community and to the Clapper Rail, Everglades Snail Kite, Little Blue and Great Blue Herons, Osprey, and Tri-colored Heron that may utilize this area. To further evaluate the concentrations and distribution of the COPECs in these grids, on May 29, 2008, URS collected an additional 20 close composite discrete soil samples from Grids 2 and 3.

From the additional soil sample results, 4,4-DDD was identified as the most wide-spread COPEC and the compound having the most potential risk. To evaluate the lateral extent of 4,4-DDD, on May 29, 2008, URS collected 20 close composite discrete soil samples from the adjoining grids 9 and 10. The data collected from these two grids as wells from Grids 1, 2, and 3 were used to evaluate the lateral extent of 4,4-DDD impacts. URS also collected soil samples from six locations in Grid 1 at deeper horizons, specifically 6-inches to 12-inches bls, and 12-inches to 18-inches to evaluate the vertical extent of soil impacts.

7.2.1.3 Point Source Sampling

Discrete soil samples were collected from the area identified as a potential environmental point source: the skid mounted AST. A stainless steel hand auger was used to collect the soil samples. The soil samples were collected at two foot intervals and screened for petroleum vapors using an organic vapor analyzer. One representative soil sample was collected, placed in a pre-cleaned laboratory bottleware,

labeled with the appropriate sample identification, and then preserved on ice in a cooler. The auger bucket was cleaned before the initial sample was collected and between each soil boring location using a solution of Alconox and water and a final rinse of de-ionized water.

7.2.2 Temporary Monitor Well Installation and Groundwater Sampling Procedures

JAEE Environmental Services, Inc., a state certified water well contractor, installed three temporary groundwater monitor wells, TMW-1, TMW-2, and TMW-3, on the Harmony Ranch Property. The temporary monitor wells were installed on April 16, 2008, using a truck mounted Geoprobe® 6600 Drill Rig.

The wells were constructed of 10-foot, 1.5-inch diameter 0.010 slotted PVC screen, with 2 feet of solid PVC riser. The wells TMW-1 and TMW-2 were installed to a depth of 10 feet bls; TMW-3 was installed to 9 feet bls. Prior to sampling, new polyethylene tubing was inserted into the monitor wells and purged with a peristaltic pump until the groundwater was visually clear of sediment. The purged development water from each of the wells was allowed to percolate into the soil in the immediate vicinity of monitor well. A typical monitor well construction diagram is included in **Appendix F**.

Prior to sampling, the water level measurement and total well depth were recorded from each well to calculate the well volume. Field parameters including pH, temperature, conductivity, dissolved oxygen, depth to water, and turbidity measurements were also collected after one well volume was purged and continued until parameters stabilized. New, dedicated non-reusable polyethylene tubing was used for each well and properly disposed afterwards. The samples were collected from the effluent line of the peristaltic pump directly into laboratory pre-cleaned vials and bottleware. Labels were affixed to each vial and bottles depicting the job designation, monitor well number, sample number, and the required laboratory analysis. Each sample vial or bottle was then preserved on ice in a cooler for submittal to the laboratories following chain of custody procedures for analysis. The chain of custody records, groundwater analytical laboratory reports and sampling logs are included in **Appendix G**.

7.2.3 Sediment Evaluation

To evaluate the sediment quality in the interior drainage ditches in the former cultivated/improved pasture areas, URS collected five sediment samples. Using a stainless steel hand auger, the sediment samples were collected from the upper 6 inches of sediment in the drainage ditches. The samples were collected, placed in a stainless steel bowl and thoroughly mixed, and then placed into laboratory pre-cleaned sample jars. Labels were affixed to each jar depicting the job designation, monitor well number, sample number, and the required laboratory analysis. Each sample jar was then placed on ice in a cooler for submittal to the laboratories following chain of custody procedures for analysis. The chain of custody records and sediment analytical laboratory reports are included in **Appendix E**.

7.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

All field work was conducted according to the FDEP's Standard Operation Procedures for Field Activities and URS' QAM. In accordance with the Service's sampling protocol, approximately 10% of

the samples were split for analysis by a second laboratory. The split samples were be analyzed for the same constituents as the original samples.

Quality assurance procedures utilized during this assessment include compliance with the FDEP Standard Operating Procedures (SOP) for Laboratory Operation and Sample Collection Activities. Laboratory analytical parameters, procedures, and quality control was conducted in accordance with Test Methods for Evaluating Solid Waste, Physical Chemical Methods, Third Edition (EPA SW-846) methodologies; method specific quality assurance protocols and control procedures outlined in the CAS Comprehensive Quality Assurance Plan.

URS utilized the FDEP Automated Data Processing Tool (ADaPT) for data validation of each group of samples that were submitted to the laboratory, and worked with each laboratory in preparing a project-specific library. All laboratory data were verified using the ADaPT program. The ADaPT data validation summaries are included with each laboratory report in **Appendix E** (soil and sediment analytical laboratory reports) and **Appendix G** (groundwater analytical laboratory reports). The following general conclusions were drawn from the validation summaries:

7.4 QUALITY ASSURANCE/QUALITY CONTROL EVALUATION

During the field activities of the 1,118-acre Harmony Ranch property, 15 composite soil samples and 150 close composite discrete soil samples, five sediment samples, and two groundwater samples were collected from the former cultivated/improved pasture areas. One soil and one groundwater sample were collected in the vicinity of the skid mounted AST. A total of 18 duplicate soil/sediment samples were collected and 19 soil/sediment samples were split and submitted to a separate laboratory for analysis. One duplicate and one split groundwater sample were collected and analyzed.

In order to validate the field and laboratory procedures in addition to ensuring that the data reported is representative of site conditions, URS also collected equipment blanks, trip blanks, matrix spike and matrix spike duplicate samples. The following general conclusions were drawn from the validation summaries:

- Two equipment blanks were collected during grid sampling activities. Each equipment blank sample was representative of the stainless steel equipment used (hand auger, mixing bowl, and mixing spoon), and were analyzed via EPA Methods 8081, 8141, 8081, 8 RCRA Metals, Total Organic Carbon, Copper and Zinc. There were no detections or outlier data reported for EQB-1 and EQB-2.

- Two duplicates were collected from the grid composite samples. These samples were analyzed for EPA parameters 8081, 8141, 8151, RCRA 8 Metals, Total Organic Carbon, Copper and Zinc. Sample results indicated good correlation between the parent sample and the duplicate sample results.

- Four soil samples were split during the grid composite sample collection to be submitted to a separate laboratory for analysis. The parameters detected and concentrations indicated good correlation between the samples analyzed by the original laboratory and the split samples analyzed by the separate laboratory. The Field Duplicate Outlier Report provided in the ADaPT summary identifies three locations with concentrations differences between the results of the two laboratories, however URS evaluated the higher value concentrations as a conservative measure, and the higher values were below their respective GCTL.

- One duplicate was collected from the sediment samples. This sample was analyzed for EPA Method 8081, 8141, and 8151 parameters, RCRA 8 Metals, Total Organic Carbon, Copper and Zinc. A split sample was collected from the sediment sample Sed-3. There is good correlation between the parent sample and the split sample results from each of the laboratories. The largest difference in results was 2,090 mg/kg for Total Organic Carbon analysis. Metal concentrations resulted in a maximum difference of 2.8 mg/kg and EPA 8081 concentrations resulted in a maximum difference of 0.51 µg/l.

- The confirmation comparison criterion was exceeded for alpha-Chlordane in sample GRID-2 (0-6); for Aldrin and 4,4-DDD in sample GRID-6(0-6); for 4,4-DDD in samples GRID-9 (0-6), GRID-11 (0-6), and GRID-DUP-2 (0-6); and for 4,4-DDT in sample GRID-15 (0-6). In these cases the higher of the two values were reported since there was no evidence of matrix interference observed. The data is flagged to indicate this difference.

- One duplicate groundwater sample was collected from the cultivated/improved pasture land and analyzed for EPA parameters 8081, 8041, 8151, 8 RCRA Metals, Copper, and Zinc. The control criterion for Tetrachloro-m-xylene was exceeded in sample TMW-DUP-1 due to suspected matrix interferences; however this analyte was not detected in the associate field sample. Copper, Lead and Selenium had response percent differences above the established criteria however URS evaluated the highest concentrations as a conservative measure and the concentrations were below GCTLs. The split sample collected for the groundwater samples indicated a good correlation between the parent sample and split sample with the exception of arsenic with a difference in concentration of 6.91 µg/l, however the results are still below the associated GCTL.

- Fifteen duplicates were collected of the discrete soil samples and were analyzed for copper. Five of the 15 soil samples were also analyzed for EP Method 8081, 8041, 8151parameters. No errors were identified in the ADaPT summary. Nine duplicate soil samples were reported with result concentration differences identified in the Field Duplicate Outlier Report provided in the ADaPT summary for these samples. Sample results indicated a good correlation between the parent sample and the duplicate sample results with the maximum difference in copper concentrations

of 4.0 mg/kg. The maximum difference in EPA Method 8081 parameter concentrations is 7.5 µg/kg. These variations are likely due to the heterogeneity of the discrete soil samples.

- Thirteen soil samples were split during the discrete sample collection and submitted to a separate laboratory for analysis. The field duplicate outlier report generated by ADaPT reported a copper concentration difference of 1.11 mg/kg between soil sample Grid 10-SS-9 (0-6) and its split sample.

- The confirmation comparison criterion was exceeded for 4,4-DDT in sample GRID-1-SS-5 (0-6); for 4,4-DDE in sample GRID-4-SS-1 (0-6), and for gamma-Chlordane and alpha-Chlordane in sample GRID-1-SS-7 (0-6); Heptachlor Epoxide and gamma-Chlordane in sample GRID-1-SS-8 (0-6); 4,4-DDD in samples GRID-1-SS-3 (0-6), GRID-4-SS-7 (0-6), and GRID-4-SS-8 (0-6); alpha-Chlordane, 4,4-DDE and 4,4-DDD in sample GRID-12-SS-1 (0-6); Heptachlor Epoxide, gamma-Chlordane, alpha-Chlordane, and 4,4-DDD in sample GRID-12-SS-2 (0-6); 4,4-DDD in sample GRID-12-SS-3 (0-6); alpha-Chlordane and 4,4-DDD in sample GRID-12-SS-4 (0-6); alpha-Chlordane in sample GRID-12-SS-5 (0-6); gamma-Chlordane, alpha-Chlordane, and Dieldrin in sample GRID-15-SS-5 (0-6); and alpha-Chlordane in sample DUP-1 (0-6). In these cases the lower of the two values were reported because of an apparent interference on the alternate column that produced the higher value.

  The confirmation comparison criterion was exceeded for Heptachlor Epoxide in sample GRID-1-SS-2 (0-6). In this case the higher of the two values were reported since there was no evidence of matrix interference observed. The data is flagged to indicate this difference.

- Recoveries for matrix spikes and matrix spike duplicates were generally within the target ranges with regard to the project requirements. Exceptions to this include sample GRID-13 (0-6)MS which exceeded the upper control criterion for 4,4-DDT. This analyte was detected in the associated field sample but at concentrations below SQAGs, therefore the sample data is not significantly affected. Sample Grid-8-SS-5 (0-6)MS, DUP-4 (0-6)MS and GRID-4-SS-6 (0-6) exceeded the upper control criterion for Endrin Ketone. The analytes were not detected in the associated field samples therefore the data is not significantly affected. The matrix spike recoveries of Zinc for sample EQB-1 are not applicable since the sample was not spiked with Zinc due to an analyst oversight.

  Spike recoveries of several analytes tested in the Laboratory Control Samples (LCS) were outside the upper control criterion; however the analytes were not detected in the associated field samples. Therefore the data is not significantly affected.

- A trip blank sample was included with the soil and groundwater sample collected at the trailer-mounted AST area and analyzed for volatile organics via EPA method 8260. There were no

reported concentrations for the tested analytes above the laboratory detection limit. The upper control criterion was exceeded for dichlorodifluoromethane. Since the field samples did not contain this analyte this apparent problem that equates to a potential high bias has not affected the data quality.

The Method Blank contained a low level of 1,2-Dichlorobenzene above the Method Detection Limit (MDL) but less than the Method Reporting Limit (MRL). Since the analyte was not detected in the field sample, the sample data is not significantly affected.

Spike recoveries were within the control criteria with the exception of Methyl tert-Butyl Ether that exceeded the upper control criterion; however the analyte was not detected in the TMW-3 field sample.

- No errors or outliers were identified in the lab quality assurance for the soil and groundwater samples collected from the trailer-mounted AST area.

Based on URS' review of the data, QA/QC procedures, and performance of the two laboratories, the data is acceptable.

7.5 APPLICABLE REGULATORY STANDARDS

In an effort to develop appropriate cleanup target levels for the soil at the properties, URS considered the future use of the Harmony Ranch Property that includes the restoration of natural hydrologic flow and limited access by the general public. Therefore, the principal component of this assessment is to identify constituents that potentially or adversely affect the ecological environment. Since the soils at the Harmony Ranch Property, may eventually be periodically inundated and the soils become sediment, albeit temporarily, the soil contaminant concentrations were compared to consensus-based Threshold Effect Concentrations (TEC) and Probable Effect Concentrations (PEC) as described in Table 7 of *Development and Evaluation of Consensus-Based Sediment Quality Assessment Guidelines (SQAGs) for Freshwater-Ecosystems*, published by MacDonald Environmental Sciences, Ltd. for the FDEP in 2003.

An upper level interim screening value of 85 milligrams per kilogram (mg/kg) for copper has been established by the Service, which is protective of the Snail Kite. Similarly, because no SQAG value has been established for selenium, the Service utilizes a screening criteria of 1 mg/kg.

In addition to the established SQAGs, soil contaminant concentrations were also compared to the SCTL values as provided in the Florida Administrative Code (FAC) Chapter 62-777. Constituents detected in the groundwater at the properties were evaluated using the GCTLs defined in FAC Chapter 62-777.

8.0 ASSESSMENT RESULTS

The following section summarizes the results of the Phase II ESA activities as conducted in each of the areas of the potential areas of environmental concern. **Figure 3** is an aerial photograph illustrating the potential areas of concern on the Harmony Ranch Property.

8.1 SKID MOUNTED AST

8.1.1 Soil Evaluation

The primary objective for the collection and chemical analysis of soil samples in the vicinity of the skid mounted AST was to evaluate the soils for the presences of petroleum constituents, specifically volatile organic compounds by EPA 8260b, polynuclear aromatic hydrocarbons by EPA Method 8270, total recoverable hydrocarbons by FL-PRO, and lead. The skid mounted AST is located in the central portion of the property on the main access road. The AST had a hose and nozzle mounted at the bottom of the tank and was located near the back of the mobile trailer.

On April 16, 2008, four soil borings were advanced and soil samples, designated SS-1 through SS-4, were collected and screened for petroleum vapors with an OVA. Samples were collected at two foot intervals from the surface to the top of the water table which was encountered at a depth of three feet bls. Based on the OVA results, one soil sample, designated AST #1, was collected for analysis. This sample was collected from soil boring SS-1 which was advanced adjacent to the AST's nose and hose.

The OVA readings for the soil samples screened were less than 1 part per million. None of the samples appeared stained and no petroleum odors were noted. The petroleum parameters analyzed in soil sample AST # 1 were all less than the laboratory detection limits with the exception of lead, which was detected at 0.64 milligrams per kilogram (mg/kg). The lead concentration is below the SQAG TEC of 36 mg/kg, and below applicable SCTLs. **Figure 4** illustrates the OVA and soil analytical data. **Table 1** summarizes the OVA results and **Table 2** summarized the soil analytical results.

8.1.2 Groundwater Evaluation

One temporary monitor well, TMW-3, was installed on April 16, 2008. This monitor well was installed at the soil boring location SS-1 which is located near the hose and nozzle. A groundwater sample, identified as TMW-3 was collected and analyzed on April 18, 2008 for purgeable volatiles by EPA Method 8021, polynuclear aromatic hydrocarbons by EPA Method 8100, total recoverable hydrocarbons by FL-PRO, and lead.

The petroleum parameters analyzed in the groundwater sample TMW-3 were all less that the laboratory detection limits. The groundwater analytical results are illustrated on **Figure 5** and summarized in **Table 2**.

8.2 FORMER CULTIVATED/IMPROVED PASTURE AREAS

8.2.1 Soil Evaluation

The primary objective for the collection and chemical analysis of soil samples from the Former Cultivated/Improved Pasture Areas was to evaluate the soils for the presence of residual agrochemicals which may have been historically or are currently applied. On April 14 and 15, 2008 soil samples were collected throughout the Former Cultivated/Improved Pasture Areas.

The Former Cultivated/Improved Pasture Areas, approximately 720-acres, were divided into 15, 50-acre grids. Based on the Service's sampling criteria for agricultural properties, all 15 grids were sampled. The 15 grids are illustrated on **Figure 6**.

A total of 15 composite soil samples and 150 close-composite discrete soil samples were collected throughout the Former Cultivated/Improved Pasture Areas. Since the Former Cultivated/Improved Pasture Areas appears to have been cultivated prior to 1970, the 15 composite soil samples were analyzed for organochlorine pesticides by EPA Method 8081 To evaluate these composite soil samples for agrichemicals that may have recently been applied, these samples were also analyzed for organophosphorous pesticides by EPA Method 8141, herbicides by EPA 8151, and the eight RCRA Metals: arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium. The samples were also analyzed for copper, zinc, and for total organic carbon (TOC). The 150 close composite discrete soil samples were also analyzed for copper.

8.2.1.1 Composite Soil Sample Results

The composite soil sample collected from Grid-1 exhibited the organochlorine pesticide 4,4-DDD at 70 µg/kg. This concentration is above the SQAG PEC of 28 µg/kg. The composite soil samples collected from Grid-2 and Grid-3 also exhibited 4,4-DDD at concentrations of 21 µg/kg and 8.3 µg/kg, which are above the SQAG TEC of 4.9 µg/kg. The composite soil samples collected from Grids 1, 2, 3, and 7 exhibited 4,4-DDE at 9.4 µg/kg, 8.2 µg/kg, 11 µg/kg, and 3.2 µg/kg, respectively. These concentrations are at or above the SQAG TEC of 3.2 µg/kg. The composite samples collected from grids 1, 2, and 7 exhibited total chlordane concentrations of 12.9 µg/kg, 7.3 µg/kg, and 7.8 µg/kg, respectively. These concentrations are above the SQAG TEC of 3.2 µg/kg.

The other organochlorine pesticides analyzed were either below the SQAG TECs or were below laboratory detection limits in the composite samples collected. None of the organochlorine pesticide concentrations exceeded the SCTLs. No organophosphorous pesticides by EPA Method 8141, or herbicides by EPA 8151 were detected above laboratory detection limits in the composite soil samples collected.

Low concentrations of arsenic, barium, cadmium, chromium, copper, lead, mercury, silver and zinc were detected in one or more of the composite soil samples collected in Grids 1 through 15, at concentrations below the SQAG TECs and applicable SCTLs. The metal silver was below laboratory detection limits in the composite samples collected. Because the concentrations of the detected metals were relatively low,

a Synthetic Precipitation Leachate Procedure was not conducted on the samples. The total organic carbon (TOC) ranged from 720 mg/kg to 7,500 mg/kg. The average TOC at the project area is 4,472 mg/kg.

Figure 7 illustrates the composite soil EPA Methods 8081 results and **Figure 8** illustrates the EPA Methods 8141, and 8151 analytical results. **Figure 9** illustrates the composite soil metal results including copper and zinc. **Figure 10** indicates the grids with EPA Method 8081 parameters that exceeded the SQAG PEC and TECs. **Table 3** summarizes the composite soil sample analytical results. **Table 4** summarizes the total organic carbon results

8.2.1.2 Close Composite Discrete Soil Results

After the initial analysis of the composite soil sample data, the organochlorine pesticides 4,4-DDD, 4,4-DDE, alpha and gamma chlordane were identified as constituents of potential ecological concern (COPEC). These four COPECs were detected in one or more composite soil samples at concentrations that exceeded the SQAG TEC values.

The composite soil sample collected from Grid-1 exhibited an elevated 4,4-DDD concentration of 70 µg/kg. This concentration is above the SQAG PEC of 28 µg/kg. Therefore, in order to evaluate the lateral extent of impacts and according to the Service's protocol, each of the 10, close composite discrete soil samples collected from Grid-1 were analyzed by EPA Method 8081. From the lateral extent of impacts, areas where corrective actions may be needed can be identified.

Also, to evaluate the potential of "false negatives" in the former cultivated areas, the soils in an additional four grids or 25 % were further evaluated. Per the Service's guidelines, a representative percentage (25%) of clean grids that did not exhibit COPECs above the SQAG TEC values were selected for further evaluation, specifically Grids 4, 8, 12, and 15. Close proximity composite soil samples that were collected in these additional four grids were analyzed by EPA Method 8081.

In addition, review of historical aerials indicate some type of row crops were grown in the former cultivated areas. Typically vegetables were cultivated in this region of Martin County, and copper based agrochemicals were often used as pesticides and soil addendums. Based on these observations and assumptions, the 150 close proximity composite discrete samples collected for the 15 composite grid samples were analyzed for copper.

Figure 11 illustrates the close composite discrete soil EPA Methods 8081 results and **Figure 12** illustrates the EPA Method 8081 parameters (COPECs) that exceeded the PEC and TEC SQAGs. **Table 5** summarizes the close-composite soil sample EPA Method 8081 analytical results. **Figure 13** illustrates the close composite discrete soil sample locations for the copper samples. **Table 6** summarizes the close-composite soil sample copper analytical results.

The following are the results of the close composite discrete sampling.

Grid-1

The close composite discrete soil samples collected from Grid-1 exhibited the highest COPECs. Soil samples SS-2, 4, 7 – 10 and Dup-1 exhibited 4,4-DDD concentrations ranging from 37 µg/kg to 360 µg/kg. These concentrations are above the SQAG PEC of 28 µg/kg. The soil sample SS-3 exhibited 4.4-DDD and 4,4-DDE at 10 µg/kg and 7.7 µg/kg. These concentrations are above their respective SQAG TECs of 4.9 µg/kg, and 3.2 µg/kg. The soil sample SS-2 exhibited 4.4-DDE at 59 µg/kg, which is above the SQAG PEC of 31µg/kg. Soil samples SS-2, 4, and 8, exhibited alpha chlordane concentrations of 24 µg/kg, 27 µg/kg, and 18 µg/kg, respectively. These concentrations are at or above the SQAG PEC of 18 µg/kg for chlordane. The soil sample SS-8 also exhibited gamma chlordane at 19 µg/kg, which is above the SQAG PEC of 18 µg/kg. Total chlordane concentrations exceeding either the SQAG PEC or TEC were exhibited in soil samples SS-2, 4, 7 – 10 and Dup-1. The chlordane and 4,4-DDE concentrations that exceed the SQAG PECs are co-located with the 4,4-DDD concentrations that exceed the SQAG PEC in Grid 1.

Grid-4

The close composite discrete soil samples SS-8 and SS-9 collected from Grid-4 exhibited 4,4-DDD concentrations of 5.8 µg/kg, and 6.2 µg/kg, respectively, at concentrations above the SQAG TEC of 4.9 µg/kg. Soil samples SS-7 through SS-10 exhibited 4,4-DDE at concentrations ranging from 4.8 µg/kg to 8.2 µg/kg. These concentrations are above the SQAG TEC of 3.2 µg/kg. The other EPA Method 8081 parameters analyzed in these samples and the other samples collected from Grid-4 were either below the SQAG TECs or below laboratory detection limits.

Grid-8

The close composite discrete soil sample SS-6 collected from Grid-8 exhibited endrin aldehyde at 2.7 µg/kg. Currently no SQAG guidance concentration has been developed for this compound. The other EPA Method 8081 parameters analyzed in this sample and the other nine samples collected from Grid-8 were either below the SQAG TECs or below laboratory detection limits.

Grid-12

The close composite discrete soil sample SS-2 collected from Grid-12 exhibited alpha-chlordane at 12 µg/kg, and gamma chlordane at 4.6 µg/kg. The alpha-chlordane and total chlordane concentration of 16.6 µg/kg is above the SQAG TEC of 3.2 µg/kg. Total chlordane exhibited in the sample SS-5 at 3.34 µg/kg, which is also above the 3.2 µg/kg SQAG TEC. The other EPA Method 8081 parameters analyzed in these samples and the other eight samples collected from Grid-4 were either below the SQAG TECs or below laboratory detection limits.

Grid-15

The close composite discrete soil sample SS-5 collected from Grid-15 exhibited alpha and gamma chlordane at 5.1 µg/kg and 3.2 µg/kg, respectively, 4,4-DDD, 4,4-DDE, and 4,4-DDT at 27 µg/kg, 23 µg/kg, and 8.6 µg/kg, respectively and dieldrin at 3.3 µg/kg. These concentrations are above their SQAG TEC. Endrin was exhibited in soil samples SS-7, SS-10 and DUP-15 at 0.85 µg/kg, 0.72 µg/kg, and 1 µg/kg, respectively. These concentrations are below the SQAG TEC of 2.2 µg/kg. The soil sample SS-2 exhibited endosulfan I at 0.83 µg/kg. Currently no SQAG guidance concentration has been developed for this compound. The other EPA Method 8081 parameters analyzed in these samples and the other samples collected from Grid-15 were either below the SQAG TECs or below laboratory detection limits.

Copper

None of the 150 copper concentrations exhibited in the close composite discrete soil samples were above the copper TEC of 32 mg/kg

The copper concentrations ranged from less than 0.32 mg/kg to 13 mg/kg. The copper concentrations exhibited in the close composite discrete soil samples were also below the applicable SCTLs. Because the concentrations of the detected copper were relatively low, a Synthetic Precipitation Leachate Procedure was not conducted on the samples.

8.2.1.3 Delineation of 4,4-DDD

The 4,4-DDD concentrations exhibited in the composite sample as well as in the six discrete soil samples collected from Grid-1 were above the SQAG PEC. Other organochlorine pesticides, alpha and gamma chlordane, and 4,4-DDE, detected at concentrations above their respective PEC were co-located with 4,4-DDD in Grid-1. After receiving the data from the close composite discrete soil samples, URS contracted NewFields to conduct a Screening Level Ecological Risk Assessment (SLERA). The SLERA, which is summarized in Section 10.0, indicated that there are potential ecological risks due to the presence of elevated concentrations of 4,4-DDD in Grid - 1 as well as the 4,4-DDD and other organochlorine pesticides alpha and gamma chlordane, and 4,4-DDE detected in Grids 2, and 3.

To further evaluate the potential ecological risks in Grids 2 and 3, on May 29, 2008, URS mobilized to the site and collected an additional 10 close composite discrete samples from each of the two grids. According to the Service protocol, grids adjacent to grids with SQAG PEC exceedances, require that discrete samples be collected and analyzed for the COPCs. Therefore close composite discrete soil samples were also collected from the adjacent Grids 9 and 10. These samples were collected to evaluate the lateral extent of impacts.

Vertical samples were collected at the six close composite discrete soil sample locations in Grid # 1 where the concentrations of 4,4-DDD were detected above the SQAG PEC. The vertical samples were collected from 6 -12 inches bls, and 12 inches – 18 inches bls at the SS2, SS4, and SS7 through SS10 locations. The data obtained from the vertical samples collected from the depth at which impacts are

present was determined, which is then used to develop corrective action strategies and costs. Because the elevated alpha and gamma chlordane, and 4,4-DDE parameters were co-located with 4,4-DDD, these parameters were evaluated together, and not separately.

Figure 14 illustrates the close composite discrete soil analytical results for Grids 1-4, 8-10, 12 and 15. The data is summarized in **Table 5**. **Figure 15** illustrates the SQAG TEC and PEC exceedances in the close composite discrete soil samples. Discussed below are the results of the additional sampling.

Grid 2

One close composite discrete soil sample, SS6, exhibited 4,4-DDD of 130 µg/kg, and gamma chlordane of 33 µg/kg, which are above the SQAG PEC of 31 µg/kg and 18 µg/kg, respectively. Concentrations of 4,4-DDD, above the SQAG TEC of 4.9 µg/kg, were detected in soil samples SS3, SS4, SS5, SS7, and SS8 ranging for 5.9 µg/kg to 16 µg/kg. Concentrations of 4,4-DDE, above the SQAG TEC of 3.2 µg/kg, were detected in soil samples SS1, SS3, SS4, SS5, SS7, and SS8 ranging for 3.7 µg/kg to 23 µg/kg. These two parameters in the remaining samples and the other EPA Method 8081 parameters analyzed in all 10 samples collected from this grid were either below the SQAG TECs or below laboratory detection limits.

Grid 3

The close composite discrete soil samples SS2 and SS3 exhibited elevated concentrations of 4,4-DDD at 80 µg/kg and 60 µg/kg, respectively. These two samples also exhibited elevated 4,4-DDE at 46 µg/kg and 65 µg/kg, respectively. These concentrations are above their respective SQAG PECs of 28 µg/kg and 3.2 µg/kg. The two samples also exhibited alpha chlordane concentrations of 7.8 µg/kg and 16 µg/kg, both of which are above the SQAG TEC of 3.2 µg/kg. Soil samples SS1, DUP-3A, SS1 (SPLIT), SS4, SS5, SS6, SS8, and SS9 exhibited 4,4-DDD and/or 4,4-DDE at concentrations above their respective SQAG TECs. Concentrations of 4,4-DDD ranged from 5.8 µg/kg to 8.6 µg/kg, and concentrations of 4,4-DDE ranged from 3.2 µg/kg to 15 µg/kg.

The split soil sample SS1(SPLIT) exhibited a total chlordane concentration of 3.2 µg/kg, which is equal to the SQAG TEC of 3.2 µg/kg. The soil sample SS3 exhibited dieldrin at 2.0 µg/kg, which is above the SQAG TEC of 1.9 µg/kg. These parameters in the remaining samples and the other EPA Method 8081 parameters analyzed in all 10 samples collected from this grid were either below the SQAG TECs or below laboratory detection limits.

Grid 9

Concentrations of 4,4-DDD, above the SQAG TEC of 4.9 µg/kg, were detected in soil samples SS9, SS10, and DUP-9A of 5.8 µg/kg, 8.6 µg/kg, and 13 µg/kg, respectively. Concentrations of 4,4-DDE, above the SQAG TEC of 3.2 µg/kg, were also detected in soil samples SS9, SS10 and DUP-9A, at 11 µg/kg, 7.6 µg/kg, and 8.0 µg/kg, respectively. Soil samples SS3, SS8, and DUP-9A exhibited 4,4-DDT at 5.6 µg/kg, 5.5 µg/kg, and 5.8 µg/kg. These concentrations are above the 4,4-DDT SQAG TEC of 4.2 µg/kg.

These parameters in the remaining samples and the other EPA Method 8081 parameters analyzed in all 10 samples collected from this grid were either below the SQAG TECs or below laboratory detection limits.

Grid 10

Close composite discrete soil samples SS1, SS6, DUP-6A, SS6(SPLIT) and SS10 exhibited 4,4-DDE concentrations of 6.6 µg/kg, 5.3 µg/kg, 5.7 µg/kg, 3.9 µg/kg, and 7.6 µg/kg, respectively, which are above the SQAG TEC of 3.2 µg/kg. The SS1 sample also exhibited 4,4-DDT at 6.2 µg/kg, which is above the SQAG TEC of 4.2 µg/kg. These two parameters in the remaining samples and the other EPA Method 8081 parameters analyzed in all 10 samples collected from this grid were either below the SQAG TECs or below laboratory detection limits.

Vertical Samples – Grid-1

To evaluate the vertical extent of the soil impacts, additional close composite discrete soil samples were collected from depths of 6-inches to 12-inches bls and 12-inches to 18 inches bls at sample locations SS2, SS4, SS7, SS8, SS9, and SS10. Soil samples collected from these six sample locations exhibited elevated concentrations of 4,4-DDD, 4,4-DDE, alpha and gamma chlordane above the SQAG PEC. The vertical samples were analyzed for organochlorine pesticides by EPA Method 8081.

One or more of 4,4-DDD, 4,4-DDE and 4,4-DDT parameters were detected in the 6-inches to 12-inches depth samples at concentrations that exceeded their SQAG TECs. However, none of the parameters were detected above their SQAG TEC in the soil samples collected from 12-inches to 18-inches bls. Chlordane was not detected in any of the samples collected below 6-inches bls. **Figure 16** illustrates the vertical sample results. The analytical data for the vertical soil samples are summarized in **Table 5**.

8.2.2 Groundwater Evaluation

Two temporary groundwater monitor wells, TW-1 and TW-2, were installed in the central and eastern portions of the Improved Pasture area to evaluate potential impacts to groundwater from organochlorine pesticides, organophosphorus pesticides, chlorinated herbicides, and the eight RCRA metals, for copper and zinc. The groundwater laboratory analytical results indicated that organochlorine pesticides, organophosphorus pesticides, chlorinated herbicides were not detected above the laboratory detection limits.

Low concentrations of arsenic, barium, chromium, copper, lead, selenium, and zinc were in one or both of the two groundwater samples collected at levels below their respective GCTLs. Cadmium, mercury and silver were below laboratory detection limited in the two groundwater samples. The groundwater analytical results for the organochlorine and organophosphorous pesticides, and herbicides are depicted on **Figure 17** and the 8 RCRA metals and copper and zinc are illustrated on **Figure 18**. The groundwater data are summarized in **Table 7**.

8.3 INTERIOR DRAINAGE DITCHES

To evaluate potential impacts to sediment quality in the interior drainage ditches that traverse the Improved Pasture areas, five sediment samples, SED-1 through SED-5, were collected on April 15, 2008, for laboratory analysis. The sediment samples were analyzed for organochlorine pesticides by EPA Method 8081, organophosphorus pesticides including Atrazine by EPA Method 8141, chlorinated herbicides by EPA Method 8151, the RCRA 8 metals, and copper and zinc.

No EPA Method 8081, 8141, or 8151 parameters were detected above laboratory detection limits. Low levels of arsenic, barium, chromium, lead, mercury, silver, copper and zinc were detected in one or more samples at concentrations below their SGAG TECs and applicable SCTLs. Cadmium and selenium were below laboratory detection limits in the five sediment samples. The sediment analytical results for the organochlorine and organophosphorous pesticides, and herbicides are depicted on **Figure 19** and the 8 RCRA metals and copper and zinc are illustrated on **Figure 20**. The sediment analytical data are summarized in **Table 8**.

9.0 EVALUATION OF 95% UPPER CONFIDENCE LIMIT

Subsequent to the soil-sampling program implemented by URS to evaluate the soil quality in the Former Cultivated/Improved Pasture Areas, a statistical analysis was conducted to obtain the numerical mean and 95% upper confidence limit (UCL) concentrations of select constituents in the Improved Pasture. The 95% UCL equals or exceeds the true average, 95 percent of the time.

Analytical laboratory data of composite and discrete soil samples collected within the Former Cultivated/Improved Pasture Areas indicated elevated levels of residual agrochemical constituents. The mean and 95% UCL concentrations were calculated for the constituents that could potentially pose an ecological threat in the event that the Improved Pasture is inundated once the restoration is complete.

The analytical data generated from the analysis of soil samples collected in the Former Cultivated/Improved Pasture Areas, was used to complete the statistical analysis for the area as a whole. Separate statistical analyses were conducted for each compound detected above the respective TEC concentration. Given below is a summary of the 95 % UCL evaluation:

Composite Soil Samples:

COMPOSITE SOIL SAMPLES			
15 GRIDS	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	*6.92 µg/kg*	*12.44 µg/kg*
	4,4-DDE	*4.07 µg/kg*	*7.65 µg/kg*
	Alpha chlordane	1.05 µg/kg	3.16 µg/kg
	Gamma chlordane	1.01 µg/kg	2.02 µg/kg
	Total chlordane	2.06 µg/kg	*5.11 µg/kg*

Close Composite Discrete Soil Samples:

CLOSE COMPOSITE DISCRETE SOIL SAMPLES			
GRID-1	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	**84.78 µg/kg**	**224.20 µg/kg**
	4,4-DDE	*12.99 µg/kg*	**34.46 µg/kg**
	Alpha chlordane	*7.18 µg/kg*	*14.44 µg/kg*
	Gamma chlordane	*5.19 µg/kg*	*12.65 µg/kg*
	Total chlordane	*10.96 µg/kg*	**22.33 µg/kg**
GRID-2	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	*17.29 µg/kg*	**62.06 µg/kg**
	4,4-DDE	*6.54 µg/kg*	*18.59 µg/kg*
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---
GRID-3	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	*16.10 µg/kg*	**48.42 µg/kg**
	4,4-DDE	*15.31 µg/kg*	**40.17 µg/kg**
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---
GRID-4	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	2.26 µg/kg	*5.27 µg/kg*
	4,4-DDE	2.06 u/kg	*4.28 µg/kg*
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---
GRID-8	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	2.23 µg/kg	2.29 µg/kg
	4,4-DDE	1.33 u/kg	2.40 µg/kg
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---
GRID-9	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	3.37	*8.68 µg/kg*
	4,4-DDE	3.27 µg/kg	*8.02 µg/kg*
	4,4-DDT	2.38 µg/kg	*5.72 µg/kg*
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---

Close Composite Discrete Soil Samples:

CLOSE COMPOSITE DISCRETE SOIL SAMPLES			
GRID-10	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	0.63 µg/kg	1.73 µg/kg
	4,4-DDE	2.64 µg/kg	*4.36 µg/kg*
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---
GRID-12	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	1.09 µg/kg	1.93 µg/kg
	4,4-DDE	1.47 µg/kg	2.75 µg/kg
	Alpha chlordane	1.72 µg/kg	*6.34 µg/kg*
	Gamma chlordane	---	---
	Total chlordane	2.88 µg/kg	*8.97 µg/kg*
GRID-15	**COPEC**	**Mean**	**95% UCL**
	4,4-DDD	---	---
	4,4-DDE	2.73 µg/kg	11.59 µg/kg
	4,4-DDT	1.04 µg/kg	*4.35 µg/kg*
	Alpha chlordane	---	---
	Gamma chlordane	---	---
	Total chlordane	---	---

Note:
Bold – Exceeds the SQAG PEC
Italicized – Exceeds the SQAG TEC
--- - insufficient number of detects to calculate the 95%

For the 15 composite soil samples, including duplicates and split samples, the mean and 95 % UCL for 4,4-DDD was calculated to be 6.92 µg/kg, and 12.44 µg/kg. These concentrations are above the 4,4-DDD SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 4.07 µg/kg and 7.65 µg/kg. These concentrations are above the 4,4-DDE SQAG TEC of 3.2 µg/kg. The 95 % UCL for total chlordane is 5.11 µg/kg, which is above the SQAG TEC of 3.2 µg/kg.

For the close composite discrete soil samples collected from Grid-1, the mean and 95 % UCL for 4,4-DDD are 84.78 µg/kg, and 224.20 µg/kg, respectively. These concentrations are above the 4,4-DDD SQAG PEC of 28 µg/kg. The mean and 95 % UCL for 4,4-DDE are 12.99 µg/kg and 34.46 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDE SQAG PEC of 31 µg/kg and the mean concentration is above the SQAG TEC of 3.2 µg/kg. The alpha and gamma chlordane mean concentrations are 7.18 µg/kg and 5.19 µg/kg respectively, and the 95 % UCLs are 14.44 µg/kg and 12.65 µg/kg, respectively. Both the mean and 95 % UCL results are above the SQAG TEC of 3.2 µg/kg for chlordane. For total chlordane, the mean is 10.96 µg/kg and the 95 % UCL is 22.33 µg/kg. The mean concentration is above the chlordane SQAG TEC of 3.2 µg/kg and the 95 % UCL is above the SQAG PEC of 22.33 µg/kg.

For the close composite discrete soil samples collected from Grid-2, the mean and 95 % UCL for 4,4-DDD are 17.29 µg/kg, and 62.06 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDD SQAG PEC of 28 µg/kg and above the SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 6.54 µg/kg and 18.59 µg/kg, respectively. Both the 95 % UCL and mean concentrations are above the 4,4-DDE SQAG TEC of 3.2 µg/kg. The alpha, gamma and total chlordane parameters were not detected in a sufficient number of samples for the 95 % UCL and mean to be determined.

For the close composite discrete soil samples collected from Grid-3, the mean and 95 % UCL for 4,4-DDD are 16.10 µg/kg, and 48.42 µg/kg, respectively. The 95 % UCL is above the 4,4-DDD SQAG PEC of 28 µg/kg, and the mean concentration is above the SQAGT TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 15.31 µg/kg and 40.17 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDE SQAG PEC of 31 µg/kg and the mean concentration is above the SQAG TEC of 3.2 µg/kg. The alpha, gamma and total chlordane parameters were not detected in a sufficient number of samples for the 95 % UCL and mean to be determined.

In Grid-4, the mean and 95 % UCL for 4,4-DDD are 2.26 µg/kg, and 5.25 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDD SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 2.06 µg/kg and 4.28 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDE SQAG TEC of 3.2 µg/kg. The alpha, gamma and total chlordane parameters were not detected in a sufficient number of samples for the 95 % UCL and mean to be determined.

In Grid-8, the mean and 95 % UCL for 4,4-DDD are 2.23 µg/kg, and 2.29 µg/kg, respectively. Both the 95 % UCL and mean concentrations are below the 4,4-DDD SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 1.33 µg/kg and 2.40 µg/kg, respectively. Both the 95 % UCL and mean concentrations are below the 4,4-DDE SQAG TEC of 3.2 µg/kg. The alpha, gamma and total chlordane parameters were not detected in a sufficient number of samples for the mean and 95 % UCL to be determined.

For the close composite discrete soil samples collected from Grid-9, the mean and 95 % UCL for 4,4-DDD are 3.37 µg/kg, and 8.68 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDD SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 3.27 µg/kg and 8.02 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDE SQAG TEC of 3.2 µg/kg. The alpha, gamma and total chlordane parameters were not detected in a sufficient number of samples for the 95 % UCL and mean to be determined.

For the close composite discrete soil samples collected from Grid-10, the mean and 95 % UCL for 4,4-DDD are 0.63 µg/kg, and 1.73 µg/kg, respectively. Both of these concentrations are below the 4,4-DDD SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 2.44 µg/kg and 4.36 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDE SQAG TEC of 3.2. The alpha,

gamma and total chlordane parameters were not detected in a sufficient number of samples for the 95 % UCL and mean to be determined.

In Grid-12, the mean and 95 % UCL for 4,4-DDD are 1.09 µg/kg, and 1.93 µg/kg, respectively. Both the mean and 95 % UCL concentrations are below the 4,4-DDD SQAG TEC of 4.9 µg/kg. The mean and 95 % UCL for 4,4-DDE are 1.47 µg/kg and 2.75 µg/kg, respectively. Both the mean and 95 % UCL concentrations are below the 4,4-DDE SQAG TEC of 3.2 µg/kg. The alpha and total chlordane mean concentrations are 1.72 µg/kg and 2.88 µg/kg respectively, and the 95 % UCLs are 6.34 µg/kg and 8.97 µg/kg, respectively. The 95 % UCL results are above the SQAG TEC of 3.2 µg/kg for chlordane. The gamma chlordane parameters were not detected in a sufficient number of samples for the mean and 95 % UCL to be determined.

In Grid-15, the mean and 95 % UCL for 4,4-DDE are 2.73 µg/kg, and 11.59 µg/kg, respectively. Both the 95 % UCL and mean concentrations are below the 4,4-DDE SQAG TEC of 3.2 µg/kg. The organochlorine pesticide 4,4-DDT was detected in this grid and therefore the mean and 95 % UCL were calculated. The mean and 95 % UCL are 1.04 µg/kg and 4.35 µg/kg, respectively. The 95 % UCL concentration is above the 4,4-DDT SQAG of 3.2 µg/kg. The alpha, gamma and total chlordane parameters as well as 4,4-DDD were not detected in a sufficient number of samples for the mean and 95 % UCL to be determined.

The 95 % UCL calculations are included in **Appendix H**.

10.0 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

Due to elevated concentrations of agrochemicals detected in the Improved Pasture in ascendance of the SQAGs, a Screening Level Ecological Risk Assessment (SLERA) was conducted to evaluate the potential for ecological impacts to occur from these agrochemicals, should this area be inundated during a flooding event. Four chemicals of potential ecological concern (COPEC) were identified in the Former Cultivated/Improved Pasture Areas in the Phase II ESA. The four COPECs include 4,4-DDE, 4,4-DDD alpha and gamma chlordane. In general, the COPECs were selected if the maximum concentration of the chemical exceeded the SQAG TEC.

After identifying these chemicals as potential concerns a four-step analysis is used to assess potential impacts to its proposed wetland habitat and inhabitants. The results of the analysis indicate that the potential risks to the future aquatic community and to future aquatic-feeding birds, specifically the Clapper Rail, Everglades Snail Kite, Little Blue Heron, Great Blue Heron, Osprey, and Tri-colored Heron that may utilize the property are isolated to approximately 90-acres located in the northwest portion of the project area, with an estimated 46-acres, located in the northwest corner of the project as the area of greatest concern for risk.

Using the Great Blue Heron as the most sensitive reception anticipated to visit the property once the hydroflow is restored, the SLERA calculated risk-based concentrations (RBCs) of 12.7 µg/kg, 3.9 µg/kg, and 2.9 µg/kg, for 4,4-DDD, 4,4-DDE and 4,4-DDT, respectively. Using the RBCs as a cleanup goal, an estimated 90 acres of impacted soils are located in portions of Grids 1, 2, 3, 9 and 10 (see **Figure 7** – SLERA in **Appendix I**).

The remaining 1,028 acres are predicted to have a low risk potential for aquatic and aquatic-feeding wildlife exposed to the 4,4-DDE, 4,4-DDD, alpha and gamma chlordane, as well as other organochlorine pesticides detected in the soils on the property.

The Screening Level Ecological Risk Assessment report is included in **Appendix I**.

11.0 FINDINGS

URS Corporation (URS) was retained by the District to conduct a Phase I/Phase II ESA for Tract Number 100-075, totaling approximately 1,118 acres referred to as Harmony Ranch. The subject property is located adjacent on the west side of Pratt Whitney Road, and south of Bridge Road in south Martin County, Florida. It is URS' understanding that the District has developed a conceptual plan to restore the natural hydrologic flow on the property as part of the Indian River Lagoon – Palmar Complex Natural Storage and Water Quality Area.

The main use of the land is for cattle grazing operations. Improvements include a network of drainage canals, an improved pasture, and unpaved, access roads.

Mr. Thomas Kenny, president of Seabranch Management, Inc. has managed the property since 2001. The subject property has reportedly been utilized primarily for livestock grazing since at least 1995. Based on historic aerial photographs, from the 1950s up until the 1970s, a large portion of the property, approximately 720 acres, was used for agricultural purposes, specifically row crops. The remaining 400 acres are wooded depressional areas and/or wetlands and have remained undeveloped.

The property is well maintained. No stressed vegetation, stained or discolored soils, chemical odors, or evidence of impacted to soil or water was observed on the property. A farm tractor, skid mounted AST, and grass mowing equipment was observed in the central portion of the property. No cattle pens, cattle vices or cattle dip vats were identified and no structures, or historic mixing/staging area were observed. The property is not listed on any environmental databases as a regulated facility.

During the Phase I ESA field reconnaissance, and taking into consideration the District plans to restore natural hydroflow the following areas of potential concern were identified for Phase II ESA investigations:

- Skid mounted AST
- Former Cultivated Areas / Improved Pasture – 720 acres
- Interior Drainage Canals

As part of the Phase II ESA investigation soil, sediment, and groundwater sampling events were performed in the above areas of potential concern in order to evaluate the presence or absence of contamination from hazardous substances and waste due to historical or current agricultural land use.

During the sampling events, a total of 198 soil borings were advanced and 3 temporary groundwater monitoring wells were installed resulting in the collection and laboratory analyses of 15 composite soil samples, 198 close proximity discrete soil samples, five sediment samples, and three groundwater samples.

The Phase II was conducted in order to evaluate potential impacts to the soil, sediment, and groundwater associated with cattle ranching and grazing operations from historical and current land use. Based on the results of the Phase II ESA, URS has the following conclusions:

11.1 SKID MOUNTED AST

- Soil and groundwater samples collected in the vicinity of the Skid mounted AST have not been impacted with petroleum above applicable SCTLs or GCTLs.

11.2 FORMER CULTIVATED AREA/IMPROVED PASTURE AREAS

- The organochlorine pesticide 4,4-DDD was detected in the composite soil sample collected from Grid-1 in the Former Cultivated Areas/Improved Pasture Area above the SQAGs PEC. Three other COPECs, 4,4-DDE, alpha and gamma chlordane, were identified in the composite soil samples in the Former Cultivated Areas/Improved Pasture Grid-2, Grid-3 and Grid-7 at concentrations above their SQAG TECs. These four grids are located in the northwest and north central portions of the project area.
- Close composite discrete soil samples were collected from Grids 4, 8, 12, and 15 and analyzed by EPA Method 8081 to evaluate the potential of "false negatives" in the former cultivated areas. None of the samples collected exhibited elevated COPECs above their respective SQAG PECs, indicating that if "hot spots" were present, are small and are not expect to be masked by the composite sampling methodology.
- One or more COPECs - 4,4-DDD, 4,4-DDE, alpha and gamma chlordane, were detected above the SQAG PECs in six close composite discrete soil samples collected in Grid-1, and 4,4-DDD and 4,4-DDE were detected above the SQAG TECs in one additional sample.
- Additional close composite discrete soil samples were collected from Grids 2, and 3 to evaluate the lateral extend of 4,4-DDD east of Grid 1 and the potential ecological risk posed by the COPECs. Also, close composite discrete soil samples were collected from Grids 9 and 10 to evaluate the lateral extent of 4,4-DDD to the southeast and south of Grid 1.
- One close composite discrete sample collected from Grid-2 exhibited 4,4-DDD (130 µg/kg) and alpha chlordane (33 µg/kg) parameters at concentrations above the SQAG PEC. Two samples collected from Grid-3 exhibited both 4,4-DDD and 4,4-DDE at concentrations above the SQAG PEC.
- Six of the close composite discrete soil samples collected from Grid 2 exhibited 4,4-DDD and/or 4,4-DDE at concentrations above there SQAG TEC. One or more of 4,4-DDD, 4,4-DDE, alpha and total chlordane parameters were detected in six of the close composite discrete soil samples collected from Grid 3 at concentrations above the SQAG TEC. One or more of 4,4-DDD, 4,4-DDE, and 4,4-DDT parameters were detected in three of the close composite discrete soil samples collected from Grid 9 at concentrations above there SQAG TEC. 4,4-DDD and/or 4,4-DDE were detected in three of the close composite discrete soil samples collected from Grid 10 concentrations above there SQAG TEC.
- Based on the results of the discrete samples the COPECs that exceed the SQAG PECs are co-located ,with 4,4-DDD being the most prevalent.

- Vertical close composite discrete soil samples collected at the six locations in Grid 1 indicate that 4,4-DDD, 4,4-DDE and chlordane impacts do not extend past 12-inches bls.
- An estimated 46 acres or 74,213 cubic yards of soil impacted with 4,4-DDD above the SQAG PEC of 28 µg/kg are present in the Grids 1, 2, and 3.
- Organophosphorus pesticides, chlorinated herbicides, the eight RCRA metals, copper and zinc were not detected in soil or groundwater at concentrations that exceed established SQAGs, any applicable SCTL or GCTLs in the areas of potential concern.

11.3 INTERIOR DRAINAGE DITCHES

- Organochlorine and organophosphorus pesticides, chlorinated herbicides, the eight RCRA metals, copper and zinc were not detected in sediment that exceed established SQAGs, any applicable SCTL or GCTL in the areas of potential concern.

11.4 95 % UCL EVALUATION

- The composite soil sample mean and 95% UCL concentrations for 4,4-DDD were calculated to be 6.92 µg/kg and 12.44 µg/kg, respectively. These concentrations are above the 4,4-DDD SQAG TEC of 4.9 µg/kg. The composite soil sample mean and 95% UCL concentrations for 4,4-DDE were calculated to be 4.07 µg/kg and 7.65 µg/kg. These concentrations are above the 4,4-DDE SQAG TEC of 3.2 µg/kg. The composite soil sample 95% UCL for total chlordane was 5.11 µg/kg, which is above the SGAG TEC of 3.2 µg/kg.
- Based on the close composite discrete soil samples, the 95 % UCL for 4,4-DDD, 4,4-DDE and/or total chlordane exceeded their SQAG PECs in Grid 1, Grid 2, and Grid 3.

11.5 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

- The 4,4-DDD, 4,4-DDE, and 4,4-DDT impacted soils within Grids 1, 2, 3, 9 and 10 are expected to pose potential risks to the Clapper Rail, Everglades Snail Kite, Little Blue and Great Blue Herons, Osprey, and Tri-colored Heron, as well as the future aquatic community. An area of 46 acres within Grid 1 has been estimated as the area of greatest potential risk.
- Potential risks to the aquatic community and aquatic-feeding birds that are anticipated to frequent the property once the hydroflow is restored are predicted to be isolated to the approximately 90 acres situated in the northwest corner of the proposed acquisition. The remaining 1,028 acres do not contain COPCs at concentrations with the potential to cause unacceptable risks to the future aquatic communities or aquatic-feeding wildlife.
- The approximately 90 acres have 4,4-DDD, 4,4-DDE and 4,4-DDT concentrations above the SLERA RBC of 12.7 µg/kg, 3.9 µg/kg, and 2.9 µg/kg, respectively. Previous projects with COPECs above the RBC have been targeted for remediation.

12.0 RECOMMENDATIONS

Given below are URS' recommendations. **Table 9** is a summary of budgetary estimates for the corrective actions.

12.1 SKID MOUNTED AST

No petroleum impacts were identified in the area of the Skid mounted AST. Therefore no additional investigations are warranted.

12.2 FORMER CULTIVATED AREA/IMPROVED PASTURE AREAS

An estimated 90 acres containing soils that the RBC are present in the northwest portion of the project area that potentially pose an environmental risk once the natural hydroflow is restored. Included within the 90 acres are an estimated 46 acres of soils impacted with 4,4-DDD above the SQAG PEC, which pose the greatest risk to the eco-system. The impacts extend to 12 inches bls. The remaining portion of the property is suitable for the District's intention to restore the hydroflow.

URS recommends that the 90 acres with COPEC concentrations above the RBC be remediated to reduce the potential ecological risk. URS has evaluated the options to mitigate the 90 acres or 145,200 cubic yards of impacted soil which are present above the RBC. The intention of the District is to restore the hydroflow on the property. No reservoir or storm water treatment area is planned, therefore with the exception of infilling of the interior ditches, no construction activities are anticipated. Considering that no construction activities are planned, for the District to excavate and dispose/relocate the impacted soils or to cap the 90 acres with two feet of clean fill is cost prohibited. Also the interior drainage ditches do not have the capacity for the soils to be re-located in lower portions of the ditches and covered with 2 feet of clean fill. Given below are the feasible options to mitigate the impacted soils.

Option 1 – Soil Inversion – Disc Plow

This soil inversion consists of using a Disc Plow, and inverting the upper 12-inch section of the soil horizon where as the impacted soils are placed three feet below land surface, and soils that are not impacted cover the impacted soils. This methodology has been successful on several District projects in reducing or eliminating the ecological risks associated with the metals impacted soil. It is assumed that the cost of the purchase of a plow will be approximately $ 50,000 and this cost will be distributed over 10 projects at $ 5,000 per project. It is also assumed that the District will provide the tractor, with a horsepower requirement of 400 hp. Based on the soil profiles, URS does not anticipate having to de-grub the 90-acre before plowing. Also, based on the monitor well installations, the depth to cap rock is 9 to 10 feet bls. Therefore there is a sufficient amount of soil to invert.

Prior to implementing, additional soil sampling will need to be conducted to further delineate the soil impacts. Additionally, confirmation soil sampling will need to be conducted after the soil inversion to document the effectiveness of the corrective actions. In the event that the confirmation samples indicate

in inverted soils in an area or areas do not meet the RBC threshold, then the identified area (s) will be excavated and placed into the lower portions of the interior drainage/irrigation canals on the subject property and capped with two feet of clean soil. URS has estimated that up to 17,424 linear feet of interior drainage canals would be suitable to re-locate impacted soils that were not effectively abated. These canals measure 15 feet across and are at least 5 feet deep. Based on these dimensions, approximately 23,232 cubic yards of impacted soils can be placed in the canals and capped with an adequate amount of cover. This amount of soil represents 16 % of the total volume of impacted soils present in the northwest portion of the property.

The estimated cost for this option is $ 325,727. No costs for re-location of residual impacted soils are included in the cost estimate. **Figure 21** illustrates the areas of proposed corrective actions, where impacted soils exceed the RBC.

Option 2 – Exclude Areas of Impacts

The 90 acres of impacted soils above the RBC are grouped together in the northwest portion of the proposed acquisition. With Option 2, the current landscape/soils in the Improved Pasture would remain as is. That is, the interior drainage ditches would not be filled in and the hydroflow would not be restored in this area. However, it is URS' opinion that a buffer zone (area of non-impacted soils) would need to be established in the northwest portion of the property to separate the impacted soils from the restoration area. Using a 200-foot buffer zone the total amount of area that would be excluded from restoration is an estimated 197 acres. The District would need to negotiate with the Service the exact area (s) and amount of acreage required for the buffer zone that would be excluded from the restoration of the property. **Figure 21** illustrates the proposed 200-foot wide buffer zone.

12.3 INTERIOR DRAINAGE DITCHES

No impacts were indentified in the sediment samples collected from the Interior Drainage Ditches. Therefore no additional investigations are recommended.

In the event that the District leases the property, the land use for cattle grazing does not justify the development of a Best Management Practices (BMP) plan during the interim period prior to restoring the hydroflow on the property. Therefore, URS recommends that standard cattle grazing requirements following the 1999 Florida Cattlemen's Association Water Quality Best Management Practices for Cow/Calf Operations be included in the lease agreement.

As requested by the District, URS evaluated the recommended corrective actions associated with the acquisition scenarios. The first scenario consists of acquiring the land with the continued use of the land being specifically for cattle grazing operations with the remainder of the land undeveloped. The other scenario consists of the corrective actions based on restoring the hydroflow in the area.

Corrective Action Cost by Land Use

Environmental Concern	Approximate Remedial Cost	Agri, Residential & Industrial Land Use	Restored Hydroflow
Soil Inversion – Disc Plow	$ 84,108		**$ 325,727**
		TOTAL	**$ 325,727**

It is the opinion of URS that upon the completion of the above referenced actions, the site will be acceptable for its intended use.

13.0 REFERENCES

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Appendix A

Site Photographs

Appendix B

South Florida Water Management District Permitted Well Data Base Search

Appendix C

Environmental Data Resources, Inc. Report

Appendix D

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Appendix E

Soil and Sediment Analytical Laboratory Reports

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Appendix G

Groundwater Analytical Laboratory Reports, and Groundwater Sampling Logs

Appendix H

95 % Upper Confidence Limits

Appendix I

Screening Level Ecological Risk Assessment

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South Florida Water Management District
Land Stewardship Section

Hobe Sound Ranch
Interim Land Management Plan

February 2017



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Hobe Sound Ranch
Interim Land Management Plan

February 2016

Land Stewardship Section
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33416-4680

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1. Executive Summary

In June of 2015 the South Florida Water Management District (District), in partnership with Martin County, acquired lands in Martin County for water conservation purposes and future restoration as part of the Palmar Natural Water Storage and Treatment Area which is a component of the Indian River Lagoon-South CERP project. This Interim Land Management Plan addresses management for the 1,841 acres that have been acquired within the project area known as the Hobe Sound Ranch. The plan describes the historical, ecological, and managerial aspects of the area as a means to coordinate effective interim management programs prior to the future restoration project. The plan guides the District land management personnel toward ecological, beneficial, and consistent land management practices.

NATURAL SETTING

The natural character of the property is defined by three distinct soil categories as defined by the Natural Soil Landscape Positions soil classification system: flats soils, flatwood soils, and sand depression soils. These soils support nine distinct plant communities that are defined by criteria established by the Florida Natural Areas Inventory.

Wetlands comprise approximately 17% of the property, and most are within the flood plain of the St. Lucie River (South Fork) and Grove Basins. Wet prairie, dome swamp, and depression marsh surrounded by improved bahia pasture are the primary plant communities found throughout the property.

AGRICULTURAL SETTING

The property is composed of 1,841 acres and is currently leased out for cattle grazing. Eight (8) improved pastures have been established on the property with cross-fencing between each pasture. In addition, many cypress domes are located throughout the property. There is one (1) operable well on the property located west of C.R. 711 at Lat/Long 27° 2’ 10.87” N; 80° 16’ 51.14” W. A cattle pen is located east of C.R. 711 at Lat/Long 27° 2’ 35.61”N; 80° 15’ 44.17”W.

INTERIM RESOURCE MANAGEMENT

Resource management activities proposed or currently conducted on the property include:

- Cattle grazing on established pasture areas
- Prescribed fire to mimic the natural fire frequency in the fire-dependent natural communities.
- Forestry and vegetation management such as shredding or mowing overgrown understories and restoration of forested ecosystems.
- Wildlife management including surveys and habitat management.
- Exotic vegetation treatment.
- Monitoring activities to evaluate the health of the natural communities and the impact of management practices on them.

INTERIM RESTORATION PROJECTS

Prior to acquisition by the District and Martin County, clearing and past agricultural uses including the installation of drainage ditches had impacted most of the historical tree and vegetative community. Interim restoration of the site will focus on implementing the interim resource management activities described in this plan and potential hydrological restoration projects consistent with the future long term management and restoration goals for the property.

INTERIM PUBLIC USE

Recreational activities will be allowed which are compatible with the current and future restoration goals of the property. Interim activities will include nature-based recreation consistent with the interim land designation as described and allowed per the District's Public Use Rule 40E-7 Florida Administrative Code (F.A.C.). Uses may include hiking, biking, nature appreciation, fishing, equestrian use, and potential managed small game hunting in cooperation with the Florida Fish and Wildlife Conservation Commission. During the interim period, public use infrastructure would consistent primarily of parking areas and trailhead access points and signage.

2. Introduction and Interim Management Plan Purpose

This Interim Management Plan consolidates relevant information about the Hobe Sound Ranch property (**Map 1**) including interim land management goals and objectives, past and present land uses, resource data, restoration and management needs, public use programs, and administrative duties used to guide the management of the property during the interim period between acquisition and project construction.

Acquisition Purpose

The 1,841 acre Hobe Sound Ranch property was acquired in June 2015, in partnership with Martin County, as one of several parcels that will constitute the Palmar Natural Water Storage and Treatment Area (NWSTA). The Palmar NWSTA is an important component of the Indian River Lagoon South (IRL-S) Project. The IRL-S Project Implementation Report put forth a plan of restoration for the southern portion of the Indian River Lagoon that was authorized by Congress in 2007. Though the entire Palmar NWSTA includes approximately 17,143 acres that currently discharge to either the C-44 Canal (C-44 Basin) or the South Fork of the St. Lucie River (South Fork Basin), this initial acquisition drains to the South Fork. The proposed Palmar NWSTA includes lands that have been disturbed to varying degrees by current or previous land uses. As identified in the IRL-S plan, these lands are to be restored to a more natural hydrology by filling and/or plugging, the swales, ditches and canals that were constructed to drain the lands. This will increase the hydroperiods within the on-site wetland communities, increasing the duration of inundation, with the result of improving water quality and reducing discharges to the river.

Project Description

Historically, the Hobe Sound Ranch property consisted of broad areas of wet flatwoods interspersed with cypress strands and domes. Much of the area drained slowly toward the South Fork of the St. Lucie River. The property was once part of the larger Box Ranch and was ditched and drained for agricultural purposes in the mid to late 1970's. The site now consists of large expanses of improved pasture, interspersed with fallow vegetable fields and numerous cypress heads and freshwater marshes scattered throughout. Drainage and irrigation canals bisect the site and all of the wetlands have been impacted by the previous drainage activity. This has resulted in a reduction of hydroperiods within the wetlands and has modified the character of those wetlands by allowing upland and invasive exotic species to colonize these sites. Most of the wetlands are interconnected to each other by canals, ditches or swales and most within the pasture areas are vegetated with nuisance species such as primrose willow or cattail. Native and desirable species such as pickerelweed and maidencane are also present. Low berms may be necessary to prevent impacts to adjacent properties, and pass-through drainage features (those through which other properties drain) will remain. The Palmar NWSTA restoration project will consist of 'low-tech' solutions intended to restore the appropriate hydroperiods for the on-site wetlands. This will

occur through filling on-site ditches and swales, and providing protective berms and or water control structures as necessary to prevent any offsite impacts. This will result in increased storage and reduced runoff to the C-44 and South Fork basins that ultimately deliver water to the estuary. As the lands are restored and the storage capability is improved, they also will function to remove nutrients, rehydrate wetlands and effect habitat restoration, thus increasing the spatial extent of functional natural areas within the IRL-S watershed, improving habitat and functional quality, and improving native plant and animal species abundance and diversity. This provides a low-tech solution to water storage and water quality improvement needs within the basins. Additionally, the size and location of the NWSTA is in close proximity to other public lands (**Map 2**), creating greenways critical to reestablishing diverse wildlife populations of some keystone and /or threatened and endangered species.

Interim Management Plan Purpose

State statutes direct the District to provide natural resource protection and management while allowing compatible multiple uses on public lands. This directive and requirements set forth in Florida Statutes provide three primary goals for the Land Stewardship Section:

- Conserve and protect water resources
- Protect and/or restore land to its natural state and condition
- Provide appropriate public use

To accomplish these goals, the Land Stewardship Program performs six major functions:

- Strategic, project, and management planning
- The operation and maintenance of land resources
- Development of public use programs
- Development of restoration projects
- Evaluation of management activities
- Administration of land management contracts and leases

The interim plan consolidates current site information and general guidelines for management of the area. As such, it serves as a collective information source for management staff, partners, and the general public.

2.1 Interim Management Goals and Objectives

The Land Stewardship Section's primary functions and management priorities are contained in the following Goals and Objectives:

Goal 1: Manage natural communities and modified habitats during the interim to protect and enhance water, floral, and faunal resources

Objectives:

- Provide regular application of fire to maintain fire dependent plant communities through the use of a well-planned and documented prescribed burning program.
- Provide an aggressive, integrated exotic plant management program. Treatments will be documented and coordinated with other management activities. The project area will be surveyed annually and exotics treated as necessary based upon available budget.
- Monitor the results of habitat restoration.
- Provide resource protection and law enforcement services through partnership with the Florida Fish and Wildlife Conservation Commission.
- Protect sensitive cultural resources through cooperative law enforcement activities.
- Minimize adverse ecological impacts associated with feral hogs through the use of licensed trappers and potential public hunts as necessary.
- Provide annual operational and capital improvement budgets sufficient for staff, equipment, and supply resources which are necessary to attain a level of responsible interim management as outlined in the Interim Management Plan.
- Utilize volunteer and alternative work force opportunities within the property.
- Plan management activities on an annual basis to meet interim program objectives detailed in the plan for the property.
- Improve management efficiency and effectiveness of the property through cooperation with Martin County and State land management entities and interested parties.
- Utilize prescribed cattle grazing as a land management tool to manage exotic pasture grasses until hydrologic restoration activities are initiated as part of the NWSTA project.

Goal 2: Provide interim resource-based public use opportunities

Objectives:

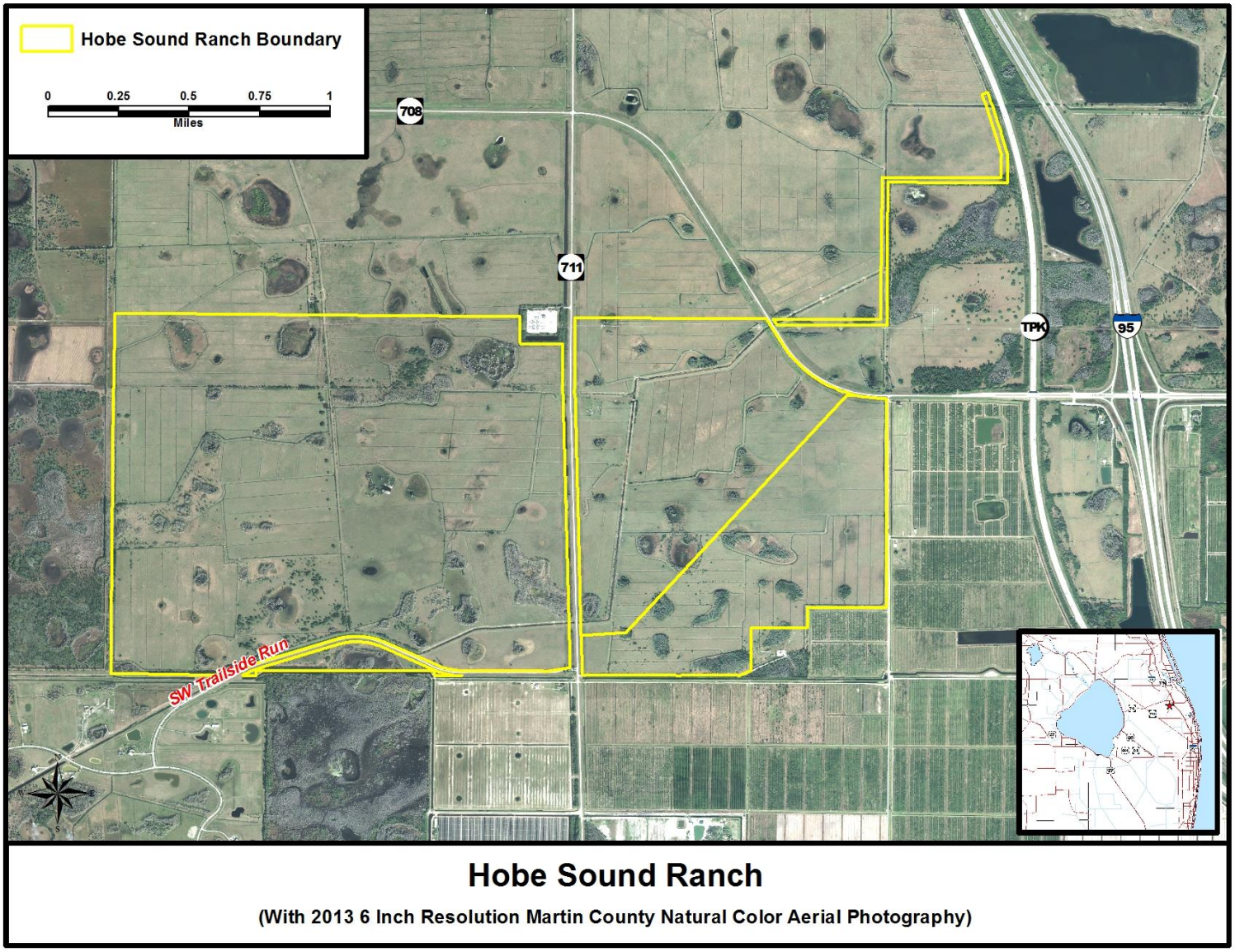
- Provide compatible uses such as:
  - Hiking
  - Wildlife viewing
  - Biking
  - Fishing
  - Equestrian
  - Nature appreciation
  - Managed hunting
- Maintain and improve the public use program and access into the property through compatible facility and infrastructure development.
- Identify potential new access points to enhance public access while improving potential road infrastructure for permitted and authorized vehicle access. Provide public use information through maintenance and installation of kiosks at public access points, and signage.
- Provide public outreach through area brochures, websites, and attending recreational user club meetings.
- Maintain public-use improvements (roads, signs, trails, entrances, and structures) using a combination of in-house maintenance, contracts, and volunteer efforts.
- Delineate boundaries of the property with appropriate signage.

Goal 3: Maintain area infrastructure during the interim

Objectives:

- Maintain and manage the property boundaries through posting, fencing, and fireline maintenance.
- Maintain public access point facilities.
- Complete annual inspection reports of recreation facilities and repair or replace amenities as needed.
- Maintain culverts and surface water drainage features necessary to prevent off-site hydrologic impacts.

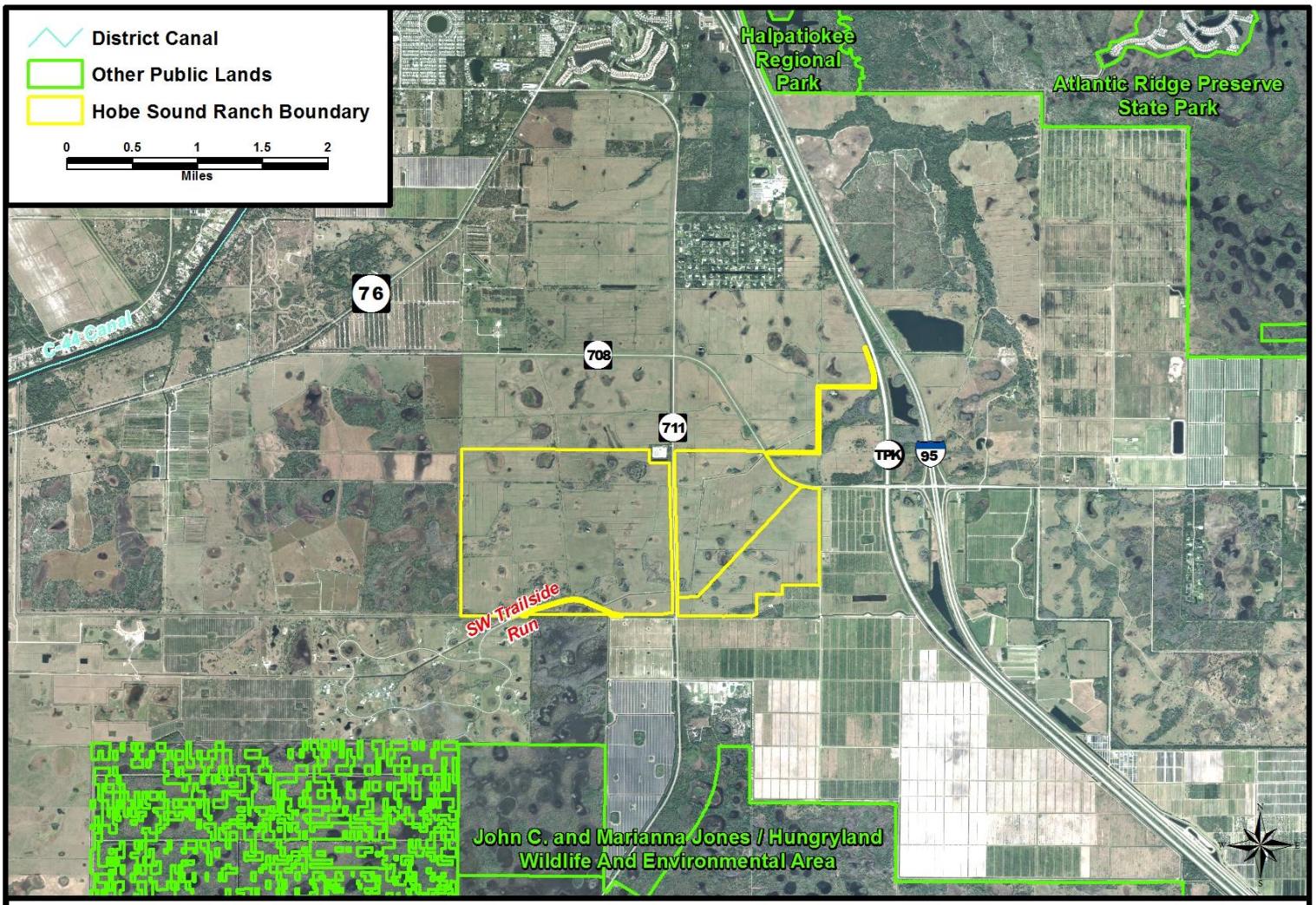
Map 1. Property Boundary



Hobe Sound Ranch

(With 2013 6 Inch Resolution Martin County Natural Color Aerial Photography)

Map 2. Property Location and other Public Lands



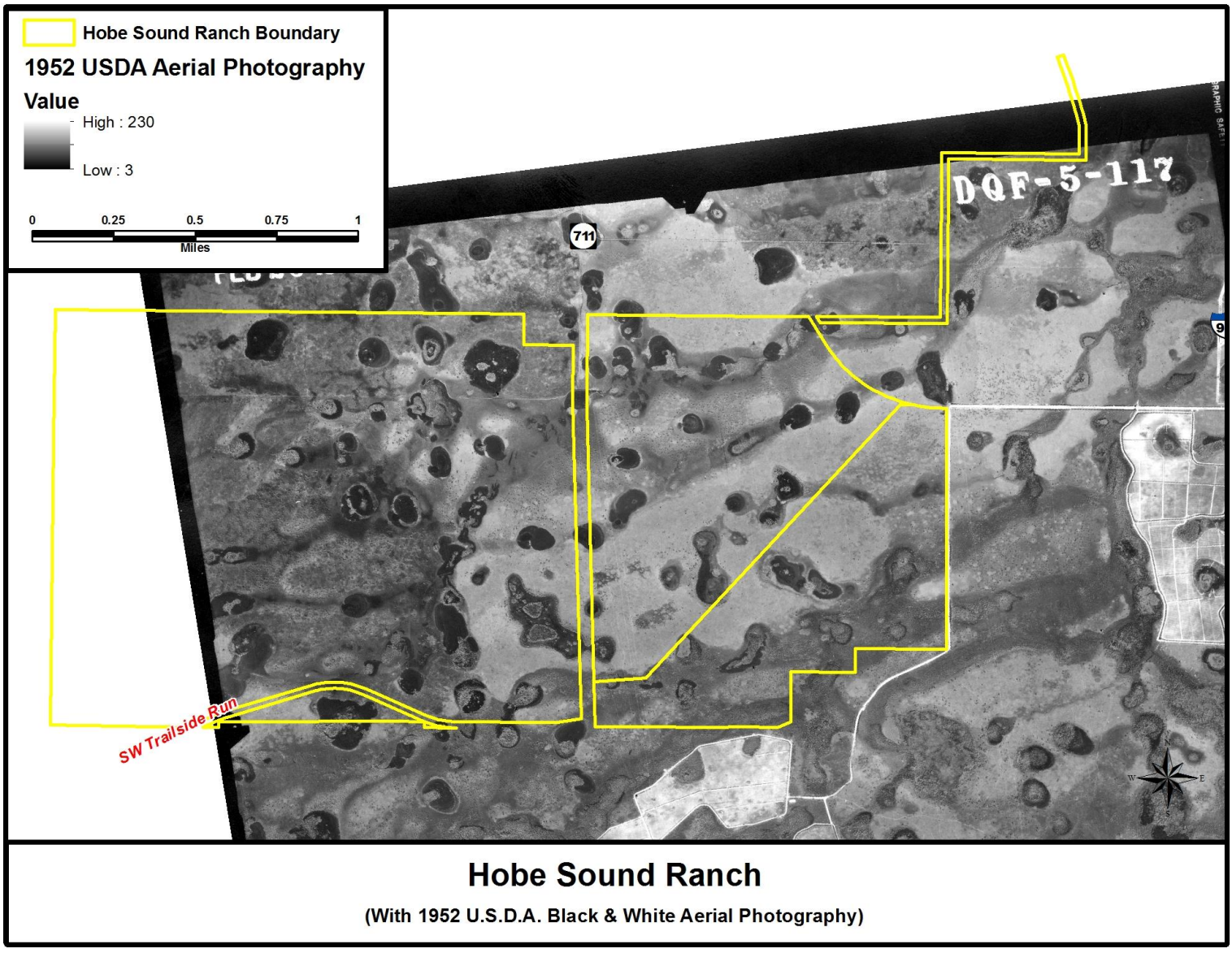
3. Site History

The District acquired the Hobe Sound Ranch in June of 2015 as part of the Palmar Complex Natural Storage and Water Quality Area in the Indian River Lagoon-South Project.

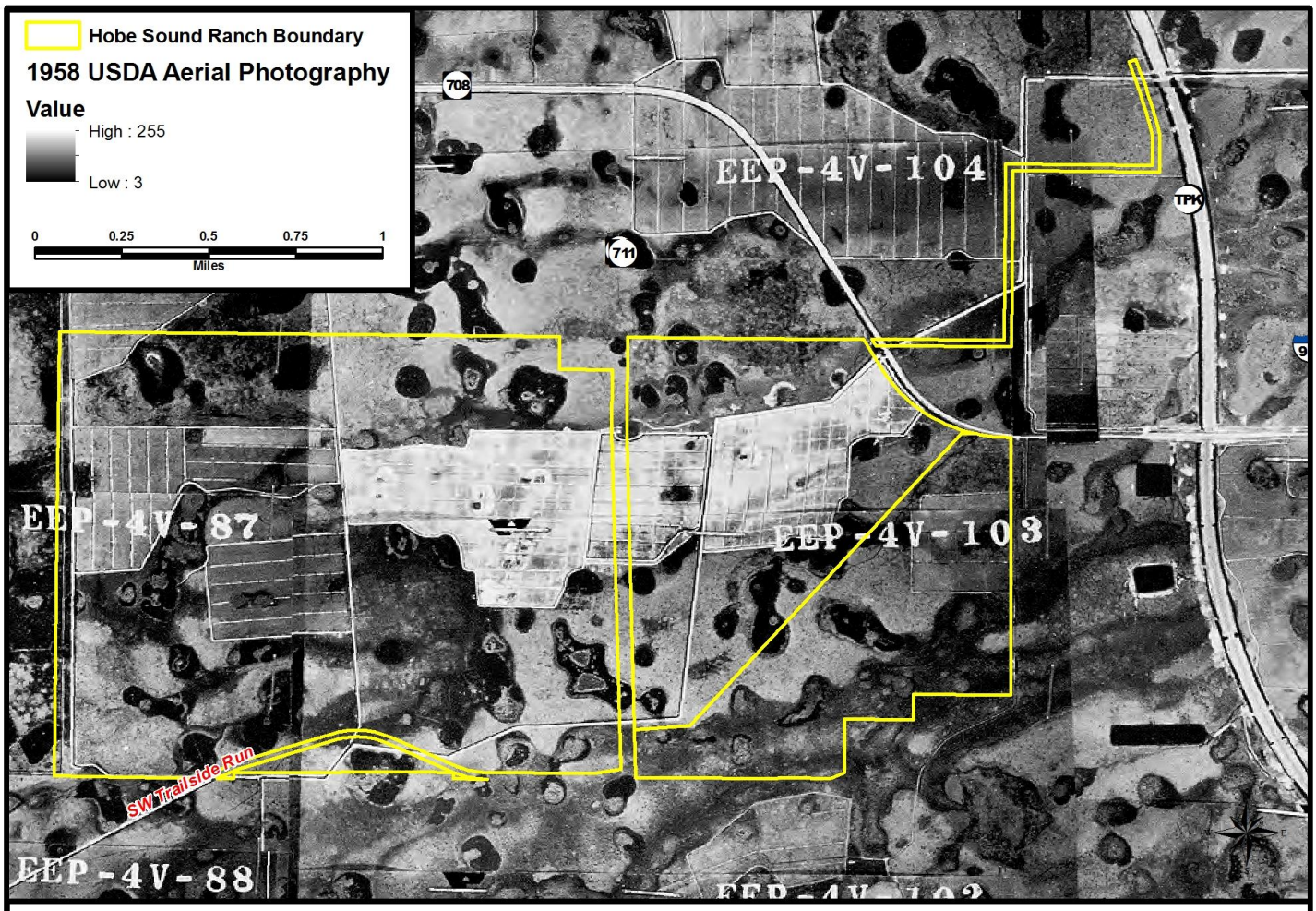
In the 100 years prior to acquisition by the District and Martin County, the property has been owned by several different individuals, families, or business interests with some form of agriculture as the primary land use. The Southern States Land and Timber Company acquired nearly 2 million acres of land from the heirs of Hamilton Disston in 1902 which included what would become the Hobe Sound Ranch. Few improvements were made to the property as historic aerial imagery from 1952 (**Map 3a**) show the property as a relatively intact natural area covered by marshes, prairies, and pine flatwoods. Cattle would have freely ranged across this landscape until 1949 when the Warren Act was passed and livestock owners were required to start fencing in their animals.

The Southern States Land and Timber Company subdivided and sold much of their land by 1945, including the future Hobe Sound Ranch property. In the years between 1952 and 1958 (**Map 3b**), land improvement practices were initiated to make the property more conducive for agricultural use. By 1970 (**Map 3c**), an internal drainage system had been completed and most of the native vegetation had been cleared for row crops or planted with pasture grasses for cattle. The property has been maintained as an active cattle ranch for the past 50+ years.

Map 3a. Historical Aerial -1952



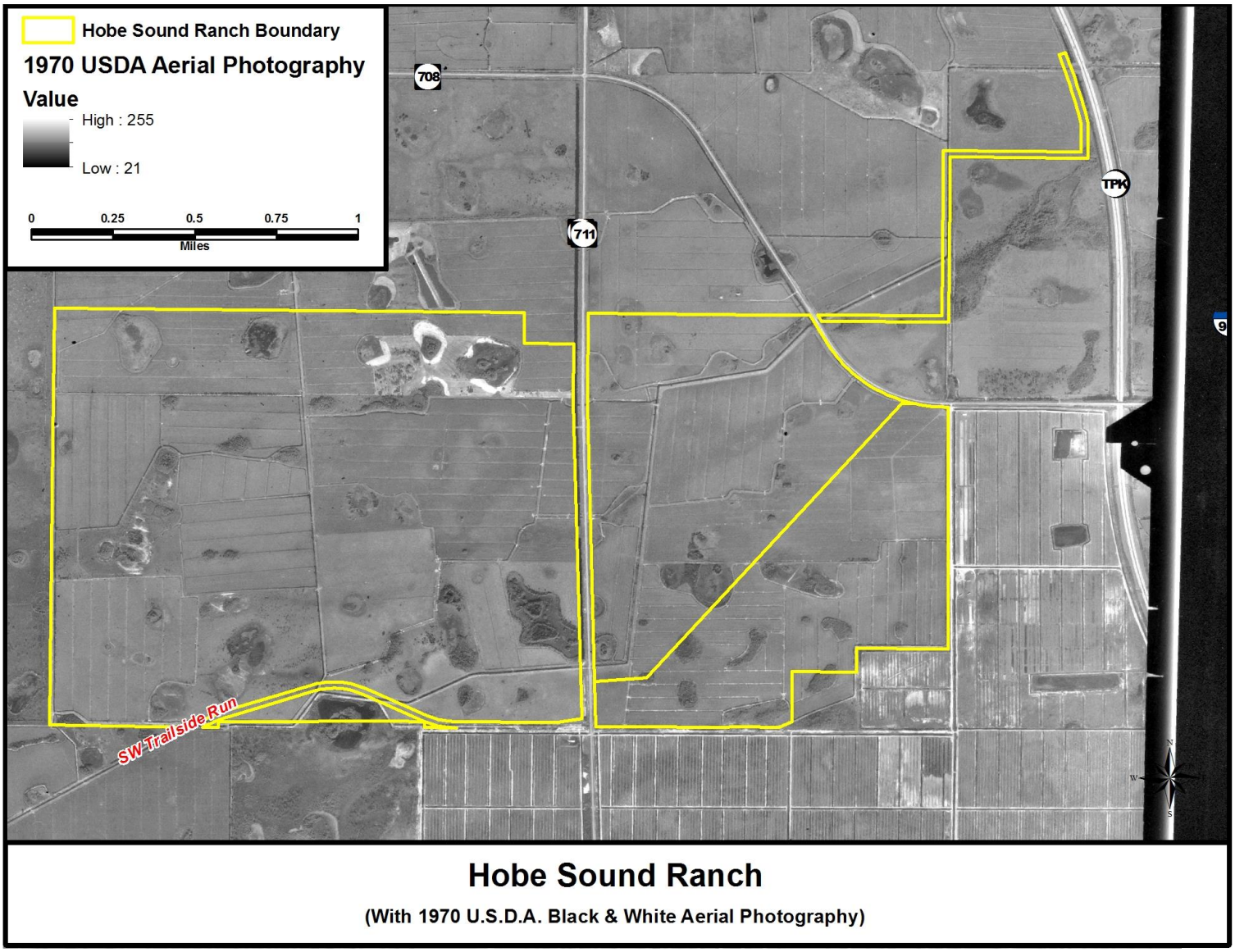
Map 3b. Historical Aerial -1958



Hobe Sound Ranch

(With 1958 U.S.D.A. Black & White Aerial Photography)

Map 3c. Historical Aerial -1970



4. Resource Inventory

Inventories of natural and historic resources are performed to provide information for effective land management planning, natural community maintenance and ecological restoration.

Floral and faunal species are inventoried, and natural communities are mapped by Land Stewardship personnel, volunteers, or private contractors. The data helps District land managers with resource management planning.

Floral and faunal inventories surveys of the property have been completed with species' lists being updated regularly by District staff. No known archaeological or historical sites exist within the property.

4.1 Hydrology

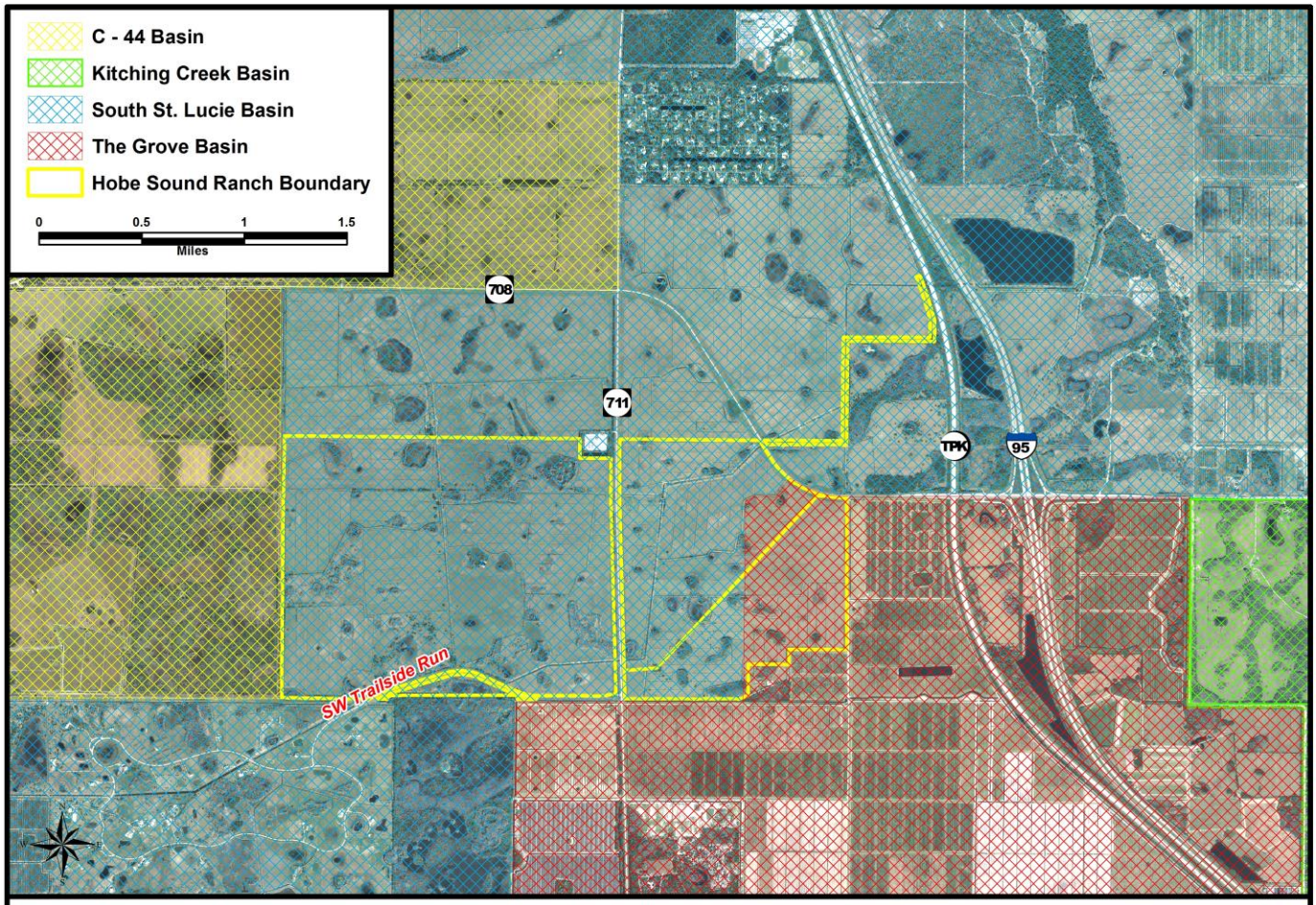
One of the primary focuses of the Land Stewardship Program is the protection and management of natural hydrologic resources on lands acquired by the District.

For management purposes, the property is located in the South St. Lucie and Grove hydrologic basins (**Map 4**). Wetlands comprise approximately 17% of the property with the majority of the property consisting of improved pasture. Surface waters within or associated with the property have been impacted by past drainage.

The acquisition included an off-site drainage ditch located along the northeast portion of the property leading to the Turnpike right of way. The purchase agreement established an easement over the drainage ditch giving Hope Sound Ranch, LTD the right to construct and maintain improvements in the area. Hope Sound Ranch secured permits from the District and has constructed the existing drainage ditch (**Map 5**).

The entire drainage ditch transverses the property from southwest to northeast. This ditch is obligated to provide conveyance and drainage for the development and agricultural lands located to the southwest of the Hobe Sound Ranch property.

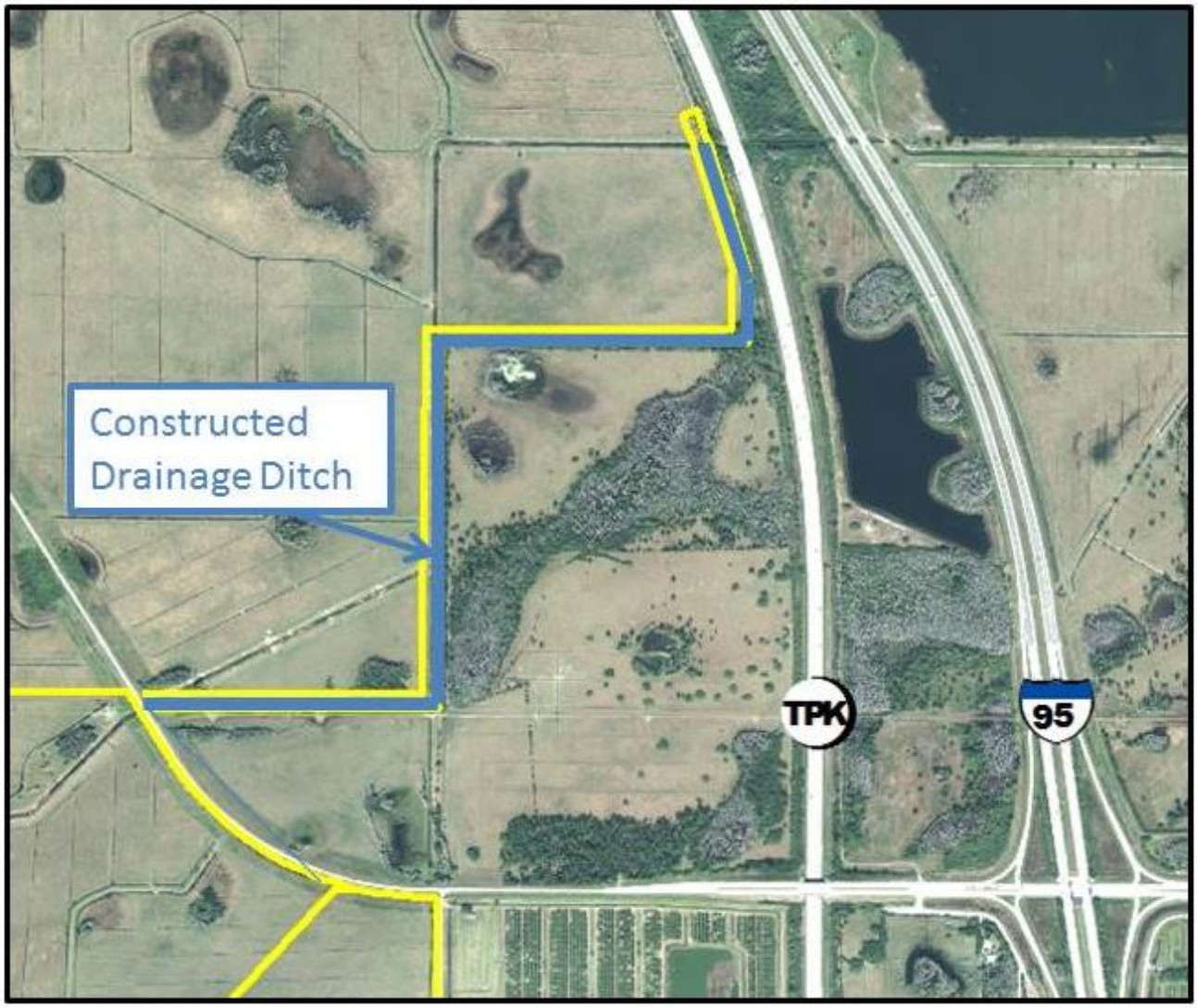
Map 4. Hydrologic Basins



Hobe Sound Ranch - Hydrologic Basins

(With 2013 6 Inch Resolution Martin County Natural Color Aerial Photography)

Map 5. Drainage

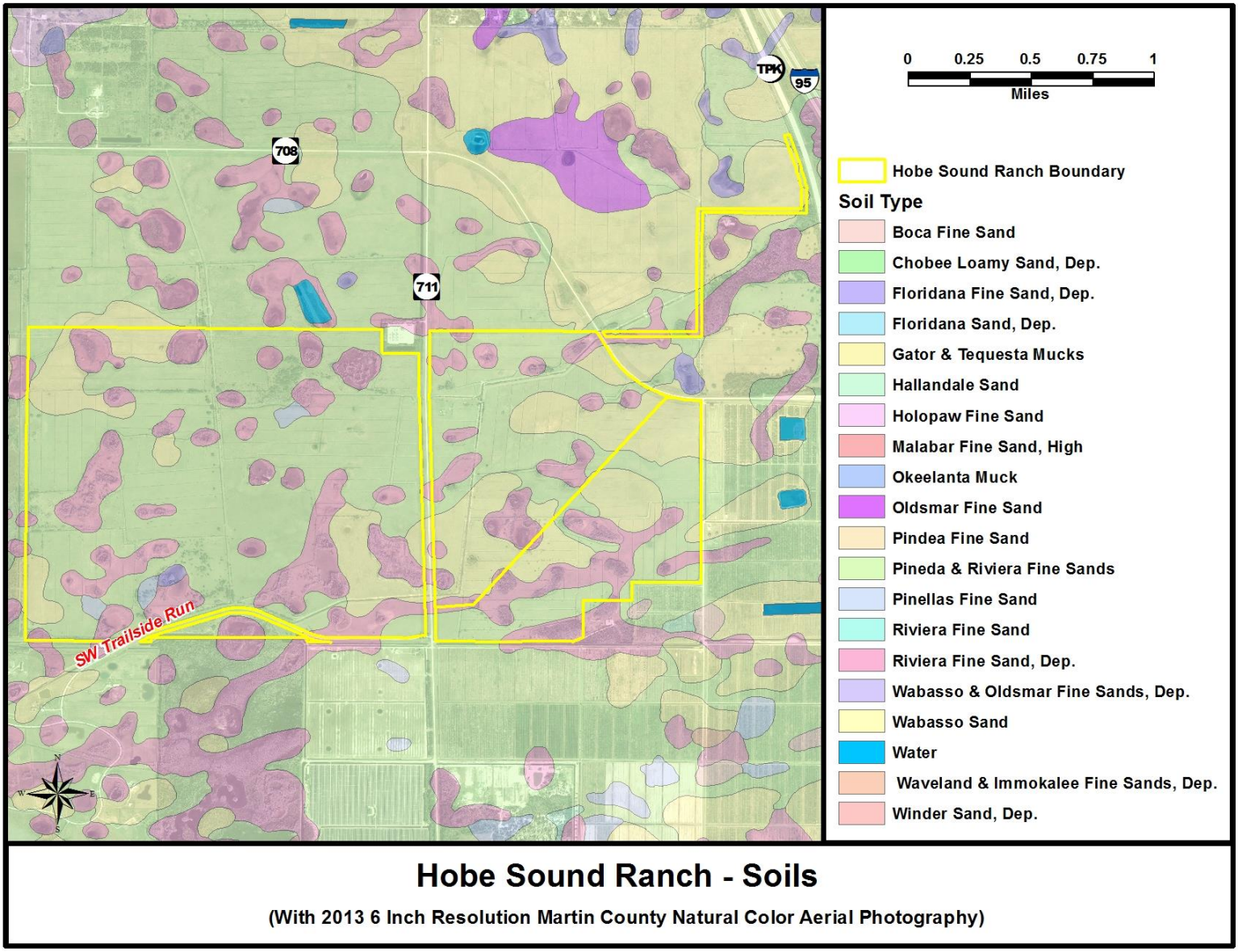


4.2 Soils

There are 3 distinct soil categories within the property as defined by the Natural Soil Landscape Positions soil classification system: flats soils, flatwood soils, and sand depression soils. The soil types on the property include Pineda & Riviera Fine Sands, Wabasso Sand, and Riviera Fine Depressional Sand (**Map 6**). This classification system groups South Florida soils into 12 categories based on hydrology and soil morphology that reflect the local relative topography, hydrology, and vegetation of the area. Classification descriptions are included as **Appendix A**.

Soil Contamination and Excavation Sites
District Environmental Assessments conducted as part of the acquisition process have revealed no known areas of soil contamination (i.e. cattle dipping vats, chemical dumping) or excavation within the property.

Map 6. Soils



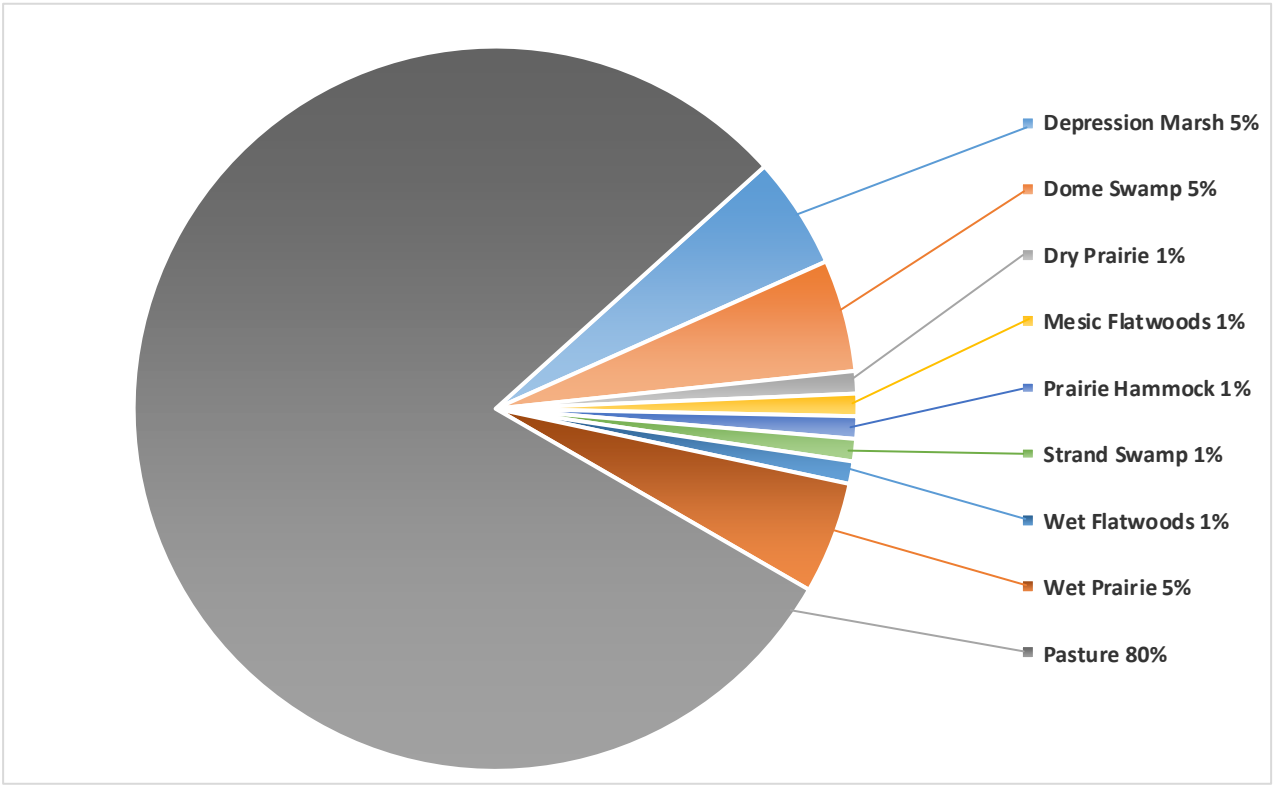
Hobe Sound Ranch - Soils

(With 2013 6 Inch Resolution Martin County Natural Color Aerial Photography)

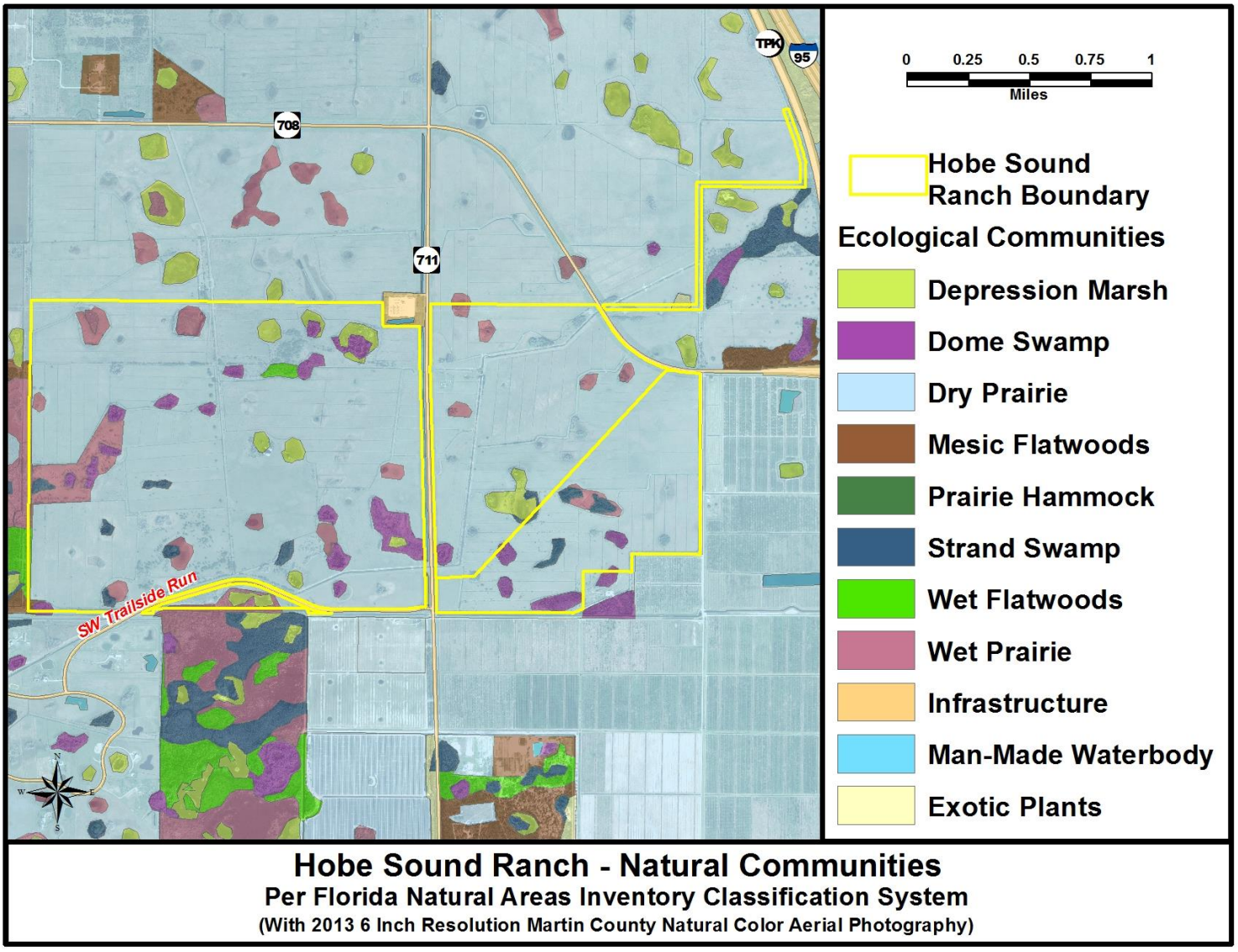
4.3 Natural Communities

Hobe Sound Ranch is a relatively disturbed expanse of improved pasture that includes some remaining natural communities including: marsh, prairie, swamp, pine flatwoods, and hammock communities (**Figure 1**). The Land Stewardship Program typically classifies natural community types by the Florida Natural Areas Inventory classification system (**Appendix B)**. Eight natural communities and one ruderal community have been identified on the property (**Map 7**). Actual community condition varies widely, depending on previous and current land use, hydrologic alteration, exotic infestation, and current management activities.

Figure 1. Current Percent Coverage of Each Community Type



Map 7. Natural Communities: Florida Natural Areas Inventory Classification



4.4 Wildlife

Auditory and visual wildlife inventory surveys documented 54 animal species within the Hobe Sound Ranch property (**Appendix C**). Wildlife species observed utilizing the property include 21 birds, one mammal, one reptile, eight amphibians and two fish. Additionally, 18 species of invertebrate have been documented within the Hobe Sound Ranch property. Six species of bird are considered rare, endangered, threatened, or of special concern have been noted. Future surveys for mammals, amphibians, reptiles, and fishes will be performed throughout the year since many animals may only utilize the property for short segments of the year. These surveys will be used to augment the current species list with new wildlife observations.

4.5 Cultural Resources

Archaeological and historic resources are protected by site identification and inter-agency coordination with the Florida Division of Historical Resources. The Florida Master Site File, maintained by the Florida Division of Historical Resources, was searched for archaeological and historical sites known to exist in the Hobe Sound Ranch property. No known sites exist within the boundaries of the property. Although most of this area has been disturbed by farming and ranching activities, land management will include efforts to identify any sites previously not documented and ensure that land management activities include steps to ensure unknown archaeological or historical sites are not disturbed.

5. Natural Resource Management

The Land Stewardship Program mission is to provide natural resource protection and management while allowing compatible multiple uses on designated public lands. Resource management includes all activities that manipulate, modify, and control natural features and aims to maintain conservation lands in an environmentally acceptable manner and, to the extent practicable, to restore these lands to their natural state and condition. Management activities include mechanical vegetation control, exotic plant control, prescribed fire, and the implementation of re-forestation activities where necessary to restore upland forest communities. Land management activities are performed in-house or by contracting out those services that can be performed in an efficient and cost-effective economical manner by outside vendors.

On Hobe Sound Ranch, the District's land management efforts are focused on protecting and enhancing the existing wetlands and the natural hydrologic storage and ground water recharge benefits of the area, while providing public recreational opportunities compatible with the resource. Management activities that achieve ecologically appropriate hydroperiods, protect water quality, systematically control invasive plants, support a prescribed fire program that mimics a natural fire regime to

properly maintain fire dependent plant communities, and manage the diversity and density of native vegetation on the area will be prioritized and implemented as funding allows. Prescribed burning is a cost-effective and efficient method of controlling woody vegetation. The District will conduct prescribed burns as resources allow. Current priorities for the District are to conduct ecological burns in the natural habitats and spring burns in pasture areas to control wax myrtle.

Prescribed grazing will also be utilized as a land management tool to control woody and herbaceous vegetation. The lessee will assist the District's efforts in securing and protecting the natural, historic and aesthetic resources on the property. This includes securing the property against unauthorized individuals through signage, fencing, and gates and ensuring illegal dumping and other unauthorized activities are reported to the District or the proper authorities in a timely manner.

Actions that do not significantly interfere with managing natural areas will be evaluated on a case-by-case basis. These may include the development of public recreation programs and agricultural practices that do not degrade native habitats. The priority of the District is to maintain high-quality habitats and hydrologic functions and improve impacted habitats and hydrologic conditions on properties that have been negatively impacted by past land use practices.

5.1 Interim Restoration Projects

One of the primary focuses of the Land Stewardship Program is the protection and management of natural hydrologic resources. Where feasible, an attempt shall be made to restore a more natural hydroperiod on tracts where the drainage patterns have been altered. The Project area has an extensive system of irrigation/drainage ditches that will be plugged or filled as funding is available. Best Management Practices (BMP's) developed by the Florida Department of Agriculture and Consumer Services will be utilized on areas with active cattle grazing for resource protection purposes. Existing cypress domes are in relatively good condition, but will benefit from future, large-scale restoration efforts related to the Indian River Lagoon projects.

5.1.1 Future Restoration and Long-Term Management

It is envisioned that the pasture drainage ditches and swales throughout the property will be filled or plugged to facilitate natural storage and wetland restoration on the property. Additionally, invasive species within the cypress domes present on the property should be aggressively managed and prescribed fire should be used to manage woody vegetation within the wetland systems. Long–term management of the Hobe Sound Ranch property will be consistent with the overall goals of the IRL-S plan. Goals include managing the natural or restored habitats to protect and enhance aquatic, floral and faunal communities. If opportunities arise to conduct restoration activities prior to the acquisition and implementation of the full IRL-S component,

these should be conducted in keeping with the goals to increase natural water storage on the property.

5.2 Vegetation Management

Mechanical equipment may be used in conjunction with prescribed burning and other management tools to control vegetation and restore habitat structure.

Vegetation management is a program component where the composition and/or structure of a vegetative community is physically altered to meet a management objective. The techniques used in vegetation management include mowing, shredding, roller-chopping, timber thinning, and planting. These techniques are applied to one or more management objectives that may include:

- Restoring a degraded vegetative community
- Improving an area's suitability as wildlife habitat
- Exotic species control or weed management
- Fuel management in relation to prescribed burning or minimizing wildfires
- Clearing for maintenance or project management purposes
- Public access and trail maintenance

Vegetation management needs are identified annually by the regional land manager. The control and maintenance of vegetation is completed by District staff or through contractual agreements.

On Hobe Sound Ranch it is anticipated that grazing and prescribed fire will be sufficient to maintain woody vegetation at an acceptable level. If this turns out to not be the case, roller chopping of myrtle will be considered. As the District places a higher priority on the control of smut grass, one of the tools useful for its control is an aeriator. This tool, similar to a rollerchopper, can be used after a fire and herbicide application to dislodge remaining clumps of smut grass. Following the removal of the agricultural ditches, and in areas with no existing ditches, pine plantings will be made to recreate the pine overstory that previously existed on areas that were historically wet flatwoods.

5.2.1 Exotic/Invasive Plants

South Florida's subtropical climate provides an excellent growth environment for the rapid spread of exotic plants that can cause extensive alterations to natural ecosystems. Hydrologic alterations, contaminated equipment and site soil disturbances are just a few factors that have influenced the expansion of exotic plants throughout the Property. The Florida Exotic Pest Plant Council's biennially updated list of Florida's Most Invasive Species (http://www.fleppc.org/) currently includes 153 species listed as plants that invade and disrupt Florida native plant communities (Category I) or plants have the potential to invade and disrupt natural successional processes (Category II). Both Category I and II exotics are considered invasive and a threat to the function and ecological stability of Florida's natural communities. Exotic plant infestations can result in partial or total displacement of native plants, loss of wildlife habitat and the degradation of public use areas.

Management practices will strive to identify existing infestations and implement appropriate control or eradication measures. Invasive plant control measures include a combination of herbicide application, biological control, prescribed fire, mowing and physical removal. Selection of control measures is dependent upon species type, environmental factors, and natural communities impacted. Most exotic plant control within the property is conducted primarily by a contracted crew of applicators. District staff also provide supplemental control treatments especially on small or sporadically distributed infestations. Areas of treatment are scheduled based on hydrologic conditions, time since last treatment, virulence of infestation, and funding. All treatments follow herbicide best management practices and use the best available science. Treatment dates, locations, and herbicide are noted and recorded in a GIS database. Plant inventories have identified Brazilian pepper, Lygodium, tropical soda apple, rosary pea, cogon grass and Mimosa pigra as the species of immediate concern on this Property.

The primary management goal is to optimize expenses for the long-term maintenance of our 30 top-priority invasive species. Treatments are scheduled to keep the greatest number of management units at maintenance level for these 30 species, with other species or units added as resources allow.

Limited resources do not currently allow for the treatment of the remaining 123 Category I & II exotic plant species, or smut grass and Bahia. The treatment of exotic pasture grasses such as Bahia or smut grass (not on the FLEPPC list) may be done by the cattle lessee with prior written District approval, and the District will provide technical assistance expertise and help facilitate this effort. As hydrologic restoration occurs on this area, efforts at treating smut grass and other exotic pasture grasses should be more cost-effective and will likely become a higher priority for the District. Land management staff plan to apply for Florida Fish and Wildlife Conservation Commission (FWC) upland exotic vegetative funding in 2017.

The United States Department of Agriculture (USDA) is currently performing exotic vegetation research on the property. They are measuring the indirect effects of biocontrol agents on habitats invaded by Old-World Climbing Fern in approximately 5 acres of cypress heads on the west side of CR711, located in the vicinity of 27°01'57.55" N; 80°15'48.96".

5.2.2 Rare, Threatened and Endangered Plant Species

Particular emphasis shall be placed on the identification, protection and management of rare, threatened and endangered plant species. Listed species are those plants considered rare within a specific geographic area by the U.S. Fish and Wildlife Service, the Florida Fish and Wildlife Conservation Commission, Florida Natural Areas Inventory, or the Florida Department of Agriculture and Consumer Services. The plant list of the property (**Appendix D**) contains several listed species (**Table 1**).

Land Stewardship establishes appropriate fire and hydrologic regimes, and controls invasive exotics in natural communities with the intent of perpetuating listed plant species. District Public Use Rules aid in the protection of native habitat and specifically prohibit destroying, defacing, or removing any natural feature or native plant on District lands. In this manner, listed plants are given lawful protection and environmental conditions suitable for their growth and reproduction.

Table 1. Listed Floral Species

Common Name	Scientific Name	State/Federal Listing
Northern Needleleaf	Tillandsia balbisiana	LT-State
Cardinal Airplant	Tillandsia fasciculata	LE-State

(LE) - Listed Endangered (LT) - Listed Threatened

5.2.3 Forest Resources

District policy designates its properties as multiple-use resources, which include timber harvesting. However, such activity must be compatible with Land Stewardship goals and objectives and meet strict environmental criteria:

- The area planned for silvicultural rotation is currently in an "improved" or disturbed state (i.e. bahia pasture, existing pine plantation)
- The site to be planted is not scheduled for future hydrologic restoration, or the site to be harvested is scheduled for hydrologic restoration and existing timber will be lost as a result of flooding
- The area does not contain any valuable resources (e.g. endangered species) that may be harmed by changes in land use

- Forest operations would not require major road construction or improvement for accessing and processing timber, particularly within or across wetlands or other sensitive plant communities
- The area to be managed currently requires maintenance (i.e., burning, mowing)
- District costs would be reduced as a result of inclusion in the forest management plan
- The area contains timber that requires salvage following fire and/or insect or disease damage, and could be subject to a sanitation harvest with minimal environmental impact
- The area provides special needs for endangered species (e.g., red-cockaded woodpecker) management that requires timber stand improvement
- Harvest or planting will not create an aesthetically unpleasant scene or an impediment to public use
- Timber harvests will return forests to a more natural structure and improve forest health

There are currently no sites within the Property that meet District criteria for an ecologically beneficial timber harvest, although it is a goal for the Land Stewardship Program to re-establish healthy slash pines on previous logged sites to encourage natural regeneration and forest sustainability.

5.2.4 Range Resources

Livestock grazing has occurred over the last century within south and central Florida and continues to be an important land use today. Prior to acquisition, the property was managed as Hobe Sound Ranch, with cattle grazing as the primary land use. Cattle grazing is employed by the District and other land management agencies as a management tool, particularly for the reduction of fuel loads and maintenance of open habitat for the benefit of native wildlife. The revenue producing lease program provides many benefits, such as:

- On-site management and security for District-owned lands at no cost to the District.
- Minimizing District expenses by generating revenue from non-governmental sources to off-set District management, maintenance and resource protection costs.
- Minimizing impacts to the local agricultural economy by keeping viable agricultural lands in active production for as long as possible.
- Minimizing fiscal impacts of public land ownership to the local government by keeping lands on the tax roll.
- Vegetation control and wildlife habitat improvement.

The District often exercises the option to lease grazing rights to the public when a property is acquired. Lease terms include a maximum stocking rate based on forage

availability and the assignment of certain management responsibilities that may include, but are not limited to infrastructure maintenance and/or fence construction or repair. The District restricts activities that could be detrimental to the environmental integrity of the area and requires all lessees to implement best management practices (BMP's) as provided by the Florida Department of Agriculture and Consumer Services. Leased lands remain on the county property tax rolls with the tax payments paid by the lessee. There is currently one active cattle lease on Hobe Sound Ranch which covers the entire 1822.13 acre property. Leasing staff plans to place a Request for Bids (RFB) for two cattle leases on the property; (1) 1141.68 acres west of CR 711 and (2) 680.45 acres east of CR 711 when the current lease expires in approximately June of 2017.

5.3 Fire

Prescribed fire will be a primary management tool on District lands and will be applied within fire-maintained communities at appropriate intervals.

The majority of natural communities on District lands rely on frequent fire to maintain their vegetative characteristics and biodiversity. Wildfires no longer occur with historical frequency or extent, and this has altered natural community structure and function. Prescribed fire attempts to mimic the benefits of natural wildfires that historically reduced fuel loads, recycled soil nutrients, and maintained natural communities by inhibiting hardwood encroachment and stimulating fire-adapted plant growth and reproduction. The Land Stewardship Program recognizes the benefits of fire and has integrated prescribed fire planning and application into its land management strategy.

5.3.1 Prescribed Fire Planning

The Land Stewardship Program bases all fire management plans on ecological research and professional experience. Fire frequency schedules for each natural community consider recommendations provided in *The Natural Communities of Florida* (Florida Natural Areas Inventory, 2010). To mimic historic fire conditions, Land Stewardship emphasizes growing season burns (April-September) where practical and when habitat conditions would benefit. Natural firebreaks are utilized where possible to promote historic fire patterns, avoid soil disturbance, and reduce hydrologic flow disruption created by fire lines. Mechanical vegetation treatments, such as mulch mowing, are sometimes used to prepare sites for prescribed fire by reducing the height of vegetation next to fire lines, to augment fire ignition in areas lacking low growing fine fuels and to manage the intensity of prescribed burns in areas with high fuel loads.

Burns are executed following the direction of the Prescribed Burning Act of 1990, Section 590.026, Florida Statutes and Florida Administrative Code Chapter 5I-2, as revised in 2014. This legislation and administrative rule outline accepted forestry burn practices and are administered through the Florida Forest Service. All Land

Stewardship staff on the fire crew have completed the state certified burn course to ensure safety and proper technique.

Fuel reduction and ecological restoration are the primary objectives for utilizing prescribed fire. Each fire-dependent natural community is burned within specific intervals as determined by Land Stewardship staff. Prescribed fire plans will emphasize yearly burn acreage to attain a minimum 4-year rotation for mesic and wet flatwoods complex; other habitats may have longer intervals (ex. Scrub) or shorter intervals (ex. urban interface pinelands, overdrained wetlands). During times when site conditions are not conducive for prescribed fire, it may be necessary to implement mechanical treatments to achieve restoration and vegetation maintenance goals.

Prescribed Fire and Carbon Sequestration

Carbon is stored on District lands in vegetation and organic soils. Each year, the amount of carbon increases as young forests grow and marshes steadily fix carbon into peat. This is also known as carbon sequestration. It is important to manage the District's land resources in a manner to maximize the amount of carbon that is sequestered, while minimizing carbon dioxide and other greenhouse gas emissions. Prescribed fire is a tool that, if used under the right conditions and with the right frequency, can increase the rate at which a fire-dependent natural community can grow and store carbon. Following a burn, there is a subsequent spike in primary productivity caused by a release of nutrients and exposure of more surface area to sunlight, as well as a post-burn swelling of both above and below ground carbon stores.

Some prescribed fire guidelines for maximizing carbon storage that the District follows include:

- Burning at a return interval of 3 to 5 years when possible.
- Keeping fuel density low to avoid the possibility of massive carbon releases in the event of a wildfire.
- Avoiding muck fires and conditions that lead to muck fires as they release large quantities of carbon and nitrous oxide.

5.3.2 Wildfire Suppression

Wildfires ignited by lightning are a common occurrence throughout Florida. The Florida Forest Service (FFS) will be notified of all wildfires on District lands, per District policy and state law. Land Stewardship will provide initial suppression when commensurate personnel and equipment are available and provide assistance to FFS in their efforts to control the fire. Possible assistance includes logistics, equipment, personnel, maps, etc. If practical, and if the fire is beneficial, FFS will be encouraged to allow the fire to burn larger acreages and to use natural fire breaks to stop it, including recent prescribed burns. It is recognized that the best wildfire mitigation for the Property is to maintain the area with frequent prescribed fire promoting a healthy open forest with light fuel loads.

5.4 Wildlife Management

A primary objective in the stewardship of the Hobe Sound Ranch property is to maintain healthy fish and wildlife populations. Wildlife management in the property is directed toward production of native species diversity consistent with the biological community types present. Land Stewardship accomplishes this in several ways:

- Continued wildlife surveys to understand what species are utilizing the area.
- Performing land management activities that maintain and/or improve native wildlife habitat.
- Conducting specific management beneficial to protected species.
- Conducting wildlife inventories through the Florida Fish and Wildlife Conservation Commission where management operations may negatively impact listed species.
- Following management guidelines for listed species protection as determined by the *Multi-species Recovery Plan for the Threatened and Endangered Species of South Florida, Volume 1,* (U.S. Fish and Wildlife Service. 1998).
- Reducing non-native wildlife species populations where appropriate.
- Maintaining a master file of confirmed and potential wildlife species.
- Cooperating with the Florida Fish and Wildlife Conservation Commission on wildlife management issues, including wildlife inventories and evaluating management actions.

Management occurs through the actions mentioned above, primarily through the application of regular prescribed fire and the control of exotic species. Additionally, the District conducts various plant and animal inventories through volunteers, staff, and private contractors to evaluate the health and dynamics of the property's natural communities.

5.4.1 Exotic/Invasive Fauna

Invasive exotic animal species are those non-native species that are harmful to native wildlife, that negatively impact native vegetation or seriously interfere with management objectives. The Land Stewardship's goal for exotic wildlife management is to reduce populations to minimize impacts to natural plant and animal communities. When population control measures are warranted, land managers consult with the Commission to determine effective and appropriate control techniques. The effects of pest population control efforts are monitored by periodic site evaluations.

The feral hog is an exotic wildlife species that occur within the Property. Disturbance caused by this species negatively impacts natural communities and interferes with land management operations. Although valued by some people as a game species, feral hogs present a serious environmental concern with their ability to quickly colonize areas due to their high fecundity, adaptability, and omnivorous diet. Their rooting behavior disrupt soil and vegetation altering natural communities and can cause long-term

damage in sensitive habitats that are slow to recover. Hog disturbance is evident throughout the property and is mostly found within the margins of wetlands but is considered minimal at the present time. Land management objectives are affected when rooting disturbance disrupts prescribed burns by preventing the spread of fire. Areas of disturbed soil are also more susceptible to exotic plant invasion. Soil rooting can create perilous conditions on hiking trails, and hog foraging can have a detrimental impact on small animal populations, ground-nesting birds, and infrastructure.

Feral hog numbers will be monitored through signs of rooting. If their numbers and impacts increase to a level of concern, the District has several options to consider. Recreational hunting can be used to stem the hog population growth. Public hog hunting will be evaluated for use on the area as a possible control measure. The District also has the ability to use no-cost hog control agents, as necessary, to manage hog populations on the area. This method will be used if it is decided that recreational hunting is inappropriate or ineffective on this site.

5.4.2 Rare, Threatened and Endangered Wildlife Species

Particular emphasis shall be placed on the identification, protection and management of rare, threatened and endangered wildlife species. Wildlife inventories have documented federal and state-listed species (endangered, threatened, and species of special concern) occurring within the Property (**Appendix C**). A summary of listed species observed on the property is contained in **Table 2**. Potential impacts and benefits to these species from land management and recreational activities are taken into account when planning and performing land management functions. District land management activities including prescribed burning, hydrologic restoration, exotic vegetation control, and vegetation management to improve natural environmental characteristics benefit listed species as well as a variety of other indigenous wildlife.

Table 2. Listed Fauna Species for Property

Species	Endangered	Threatened		State Listed Species Of Special Concern
		Fed	State	
Birds	0	2	1	2
Mammals	0	0	0	0
Amphibians	0	0	0	0
Reptiles	0	0	0	0
Fish	0	0	0	0
Invertebrate	0	0	0	0

6. Public Use

The Land Stewardship Program's mission is to provide natural resource protection and management while allowing compatible multiple uses on designated public lands. As an acquisition partner with Martin County, public use will be planned and provided for on the property consistent with Martin County Ordinance #711.

Section 373.1391(1)(a), Florida Statutes states that wherever practical, lands acquired by the District shall be open to the general public for recreational uses. The District encourages public use of properties for appropriate natural resource-based activities. All District lands are available for public use, except in rare instances where there is no legal public access or where lease restrictions or construction activities prohibit public entry.

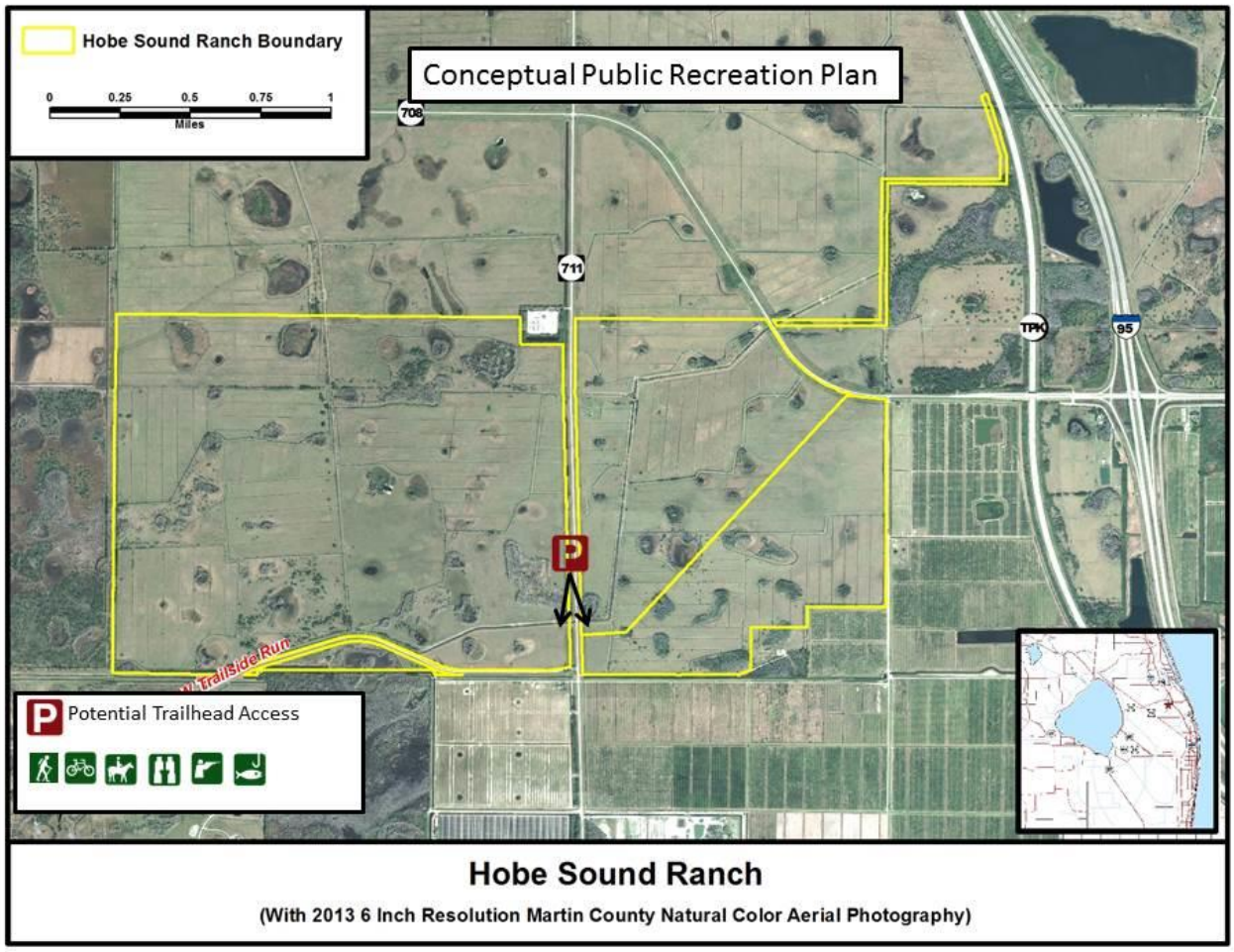
Public input into the management of the area is solicited at the District's quarterly Water Resource Advisory Commission Recreational Issues Meetings. In coordination with partnering agencies, including Martin County, adjustments to public use opportunities will be made on an ongoing basis through the Recreational Issues Meetings and by rulemaking through the 40E-7, F.A.C. Public Use Rule. This plan addresses public use matters only to describe the scope of public use opportunities available or planned as of the date of the plan, and is not intended to set public use policies for the property.

The determination of compatible public uses will be based on the following criteria:

- Consistency with the purpose the lands were acquired
- Restrictions and/or prohibitions imposed by easements, leases, reservations, adjacent land ownership, and other conditions of the purchase agreement
- Infrastructure and facility requirements, such as fences, gates, signage, entry design, stabilized off-road parking, and trails, and budgetary impacts
- Opportunities for persons with disabilities
- Limitations on use resulting from endangered species, other sensitive natural resources, archeological resources, or land management practices
- Public health, safety and welfare
- Proximity to adjacent roadways and potential impacts to adjacent landowners

It is envisioned that a variety of compatible public use activities may be allowed for the interim on the property including, but not limited to, the establishment of hiking, biking, and horseback riding trails, fishing, birding, environmental education, and nature appreciation. User groups and volunteers will be utilized for establishing trails. Potential limited hunting opportunities will be evaluated in cooperation with the Florida Fish and Wildlife Conservation Commission. Trailhead parking and pedestrian public access will be evaluated and may be initially allowed via walk-thru gates off of Pratt Whitney Road (CR 711) (**Map 8**). Additional recreational opportunities will be re-evaluated and proposed after the restoration is completed or if additional properties are acquired.

Map 8. Conceptual Public Use Access



6.1 Resource Protection

Public use shall not result in detrimental impacts to land and water resources. When a public use activity produces detrimental effects on natural resources, it shall be discontinued until an evaluation determines that such use is compatible.

Resource protection law enforcement services will be provided by state and county law enforcement officers through funded or unfunded partnership agreements to safeguard the public and protect natural and cultural resources on District-managed natural areas.

Public use regulations are set forth in Rule 40E-7, Florida Administrative Code, in order to provide and manage public recreation in accordance with Section 373.1391(1)(b), Florida Statutes. Regulations that govern activities within the Property are in the District's 40E-7 Rule. The 40E-7 Rule is available online and at agency headquarters in West Palm Beach. The District will coordinate with the Florida Fish and Wildlife Conservation Commission and the Martin County Sheriff's Office to enforce laws, rules, and regulations applicable to the property.

Resource protection is also greatly enhanced by the presence and continued maintenance of posted boundary signs. All exterior boundaries within the property will be posted and monitored at least semi-annually. On boundaries where vegetation may obscure posting or fences, the District may mow the boundary periodically.

7. Administration

Administration of Land Stewardship Program lands is directed through the Land Stewardship Section. Policy decisions, planning and budgeting, procurement of personnel and equipment, contract administration, and issues of program development are administrative tasks coordinated through the Section. Input is provided from the public and regional land managers located across the 16-county area. Regional land managers handle regular administrative duties from their field locations to assure quick response to local concerns and management issues. Administrative activities for the property are handled through the Allapattah property office and through the District's headquarters in West Palm Beach.

7.1 Budgeting

The District will secure dedicated funding sources, personnel and other resources to support program goals and objectives. Project funding needs and sources for cooperative management agreements with government and non-government entities will be identified. The principal source of funding for land management operations on the Property will be derived from lease revenue funds and ad valorem tax revenue.

Budget planning activities begin in October in order to develop a finalized budget and work plan for the following fiscal year (October-September). Overall funding availability generally determines management activities. Budget distribution among the District's five land management regions is based on a programmatic prioritization of management activities. Operational funds are distributed to most effectively accomplish the management objectives of each property.

The continued operation and maintenance of the property includes costs to cover staffing, ongoing operational and land management expenses, and capital refurbishment/replacement of aging infrastructure. Capital infrastructure needs are determined by its condition and the anticipated continued serviceability over the next

fiscal year. Priorities for capital refurbishment/replacement are made on a District-wide basis.

7.2 Infrastructure

Infrastructure and facilities are developed and maintained to provide safe access for responsible management and public use on District lands. Such infrastructure may include access points, roads, trails, signs, utilities, and minimal public facilities.

Current property infrastructure includes perimeter and interior fencing and culvert crossings, all of which require regular maintenance. Future plans include improvements to existing management roads and public access features.

7.3 Personnel and Equipment

The Land Stewardship Section is separated into five geographic regions, each assigned a Senior Scientist (Land Manager), and one to three land management technicians, and some areas based on needs, a Scientist III position. A Section Leader provides direct oversight and supervision for land management staff. Additional leadership and assistance come from the Land Stewardship Section Administrator, Wildlife and Public Use Section, and other support personnel at District headquarters in West Palm Beach, FL.

Management activities on the Hobe Sound Ranch property will be performed primarily by the Scientist III positon assigned to the Allapattah Management Area with support from other staff within the Land Stewardship Section. Stewardship of the property is the primary responsibility of the District's Land Stewardship Section with leasing administration support being provided being by the District's Real Estate Division.

7.4 Volunteers

Volunteers will be used when possible to supplement existing staff and services.

Section 373.1391(3) F.S. encourages the District to use volunteers for land stewardship and other services. The District recognizes the merits of volunteerism and welcomes participation in activities appropriate for public involvement. In Fiscal Year 2016, District lands benefited from 15,681 volunteer hours, or $346,236 worth of volunteer services (using a $22.08/hour Florida average for the value of volunteer service).

Volunteer services will be utilized, when possible, to support land management and public use activities on the Hobe Sound Ranch property.

Appendix A. Soil Descriptions

Flats soils – Flats soils are poorly drained hydric soils. Flats are located between flatwood and depressional landscapes and are generally regarded as transition areas. The seasonal high water table can typically range from the soil surface to one foot below the surface for 4-9 months during the wet season (June – September) Examples of these soils include that are present on Hobe Sound Ranch include Pineda fine sand. These soils are generally long, narrow areas that serve as drainage ways between depressional soils during periods of heavy and prolonged rainfall. A typical ecological community associated with flats soils would be the wet prairie, generally characterized by open expanses of grasses, sedges and rushes, and may include sparse pine coverage. Fire and artificial water fluctuations are major factors affecting these areas, and variations in the natural sequences of either event can change the diversity and productivity of these communities

Flatwoods soils – Flatwoods soils are poorly drained, non-hydric upland soils. Most of the soils in this series have a subsurface spodic horizon (hardpan). The seasonal high water table can range from ½ to 1 ½ feet below the soil surface for 3-6 months annually, with some areas becoming inundated for short periods during the wet season or during large storm events. Examples of these soils on Hobe Sound Ranch include Wabasso sand. Typical vegetative communities on flatwoods soils include dry prairie, wet and mesic flatwoods, and prairie hammock. The landscape position of these soils affects plant-water relationships and causes slight differences in plant composition from wetter to drier areas. Natural vegetation typically consists of scattered slash pine with an understory of saw palmetto and grasses. Some areas are dominated by wire grass and broomsedge and have few, if any trees. Other areas are characterized by gallberry, shiny blueberry, tarflower, and wax myrtle.

Sand Depression Soils – The sand depression landscape position includes hydric soils that are very poorly drained. Often these areas are depressions adjacent to and within flatwoods communities and flats landscapes. The seasonal high water table can range from one foot below to two feet or more above the soil surface for 7-10 months annually. Examples of these soils that are present on Hobe Sound Ranch include Riviera fine sand, depressional.

Appendix B. Natural Communities

Depression Marsh

Depression marsh, also known as a flatwoods pond, is characterized as a shallow, usually rounded depression in sand substrate with herbaceous vegetation often occurring in concentric bands (Florida Natural Areas Inventory, 1990). Typical plants include St. John's-wort, spikerush, yellow-eyed grass, chain fern, primrose willow, maidencane, wax myrtle, buttonbush, pickerelweed, arrowhead, and bladderwort.

Natural fire occurs in depression marshes every one to five years, depending on a combination of weather conditions and fuel build-up. Fire preserves the open canopy by limiting invasion of woody vegetation, promoting herbaceous growth, and slowing succession by deepening the marsh with an occasional peat fire. The Land Stewardship Program coordinates fire schedules to insure depression marshes burn at natural frequencies and during periods of adequate ground moisture.

Depression marsh is ranked statewide as "S", either very rare throughout its range; or found locally, even abundantly at some of its locations in a restricted range; or because of other factors making it vulnerable to extinction throughout its range. Global ranking indicates it is apparently secure, though it may be quite rare in parts of its range, especially at the periphery. Further research is required for a definitive global classification.

Dome Swamp

These hardwood swamps contain broadleaf evergreen trees that occur in shallow, stagnant drainages or depressions often found within pine flatwoods, or at the base of sandy ridges where seepage maintains constantly wet soils. The soils, which are usually covered by an abundant layer of leaf litter, are mostly acidic peat or muck that remains saturated for long periods but over which little water level fluctuation occurs. Overstory trees within bayheads are dominated by sweetbay, swamp bay, and loblolly bay. Depending on the location within the state, other species including pond pine, slash pine, blackgum, cypress, and Atlantic white cedar can occur as scattered individuals, but bay trees dominate the canopy and characterize the community. Understory and ground cover species may include dahoon holly, wax myrtle, fetterbush, greenbriar, royal fern, cinnamon fern, and sphagnum moss.

Dry Prairie

Dry prairies are large native grass and shrublands occurring on very flat terrain interspersed with scattered cypress domes and strands, bayheads, isolated freshwater marshes, and hardwood hammocks. This community is characterized by many species of grasses, sedges, herbs, and shrubs, including saw palmetto, fetterbush, staggerbush, tar flower, gallberry, blueberry, wiregrass, carpet grasses, and various bluestems. Fire frequency, intensity, and fuel build-up determines whether a pine over-story develops. Fire occurs naturally in dry prairies every one to four years, which is slightly more frequent than in mesic flatwoods.

Mesic Flatwoods

Mesic flatwoods are distinguished by the south Florida slash pine overstory and an open or dense understory, depending on degree of drainage and fire frequency. Where drainage and fire suppression has been most severe, the understory consists of dense saw palmetto and to a lesser extent live oak. Use of mechanical shrub control in conjunction with increased prescribed fire has been instrumental in enhancing native plant communities that include saw palmetto, gallberry, St. Johns-wort, shiny blueberry, beautyberry, bog buttons, yellow-eyed grass, wire grass, and numerous other native wildflowers.

This community occurs on similar soils as dry prairies and wet flatwoods, with minor changes in topography determining plant species composition. Acidic sandy soil overlays hardpan that reduces water exchange between the soil surface and subsurface. Native plants of this community have adapted to long intervals of inundation and desiccation combined with periodic fire. An important physical factor in mesic flatwoods is fire, which probably occurred every one to eight years in pre-Columbian times. Nearly all plants and animals inhabiting this community are adapted to periodic fires; several species depend on fire for their continued existence. Without relatively frequent fires, mesic flatwoods succeed into hardwood-dominated forests whose closed canopy can essentially eliminate the herbaceous ground cover.

Prairie Hammock

Prairie hammock is characterized as a clump of tall cabbage palms and live oaks in the midst of prairie or marsh communities (Florida Natural Areas Inventory, 1990). Prairie hammocks establish on elevated soils surrounded by lower topography. These islands are generally flooded only for a short duration during the highest water levels. Naturally occurring fires are rare in these hammocks, due mainly to a lack of under-story fuel.

Canopy species are live oak and cabbage palm, with occasional laurel oak in lower elevations. An abundance of epiphytes, including listed species, are found in mature canopy trees. As in most prairie hammocks, those found here have a sparse under-story due to over-story shading, but cover is also reduced by cattle grazing and trampling of shrub and ground layer vegetation. Many species common to undisturbed hammocks are sparse or lacking, replaced by disturbance species such as broomweed, tropical soda apple, and caesarweed. Typical under-story plants of pristine prairie hammocks include wax myrtle, water oak, stoppers, marlberry, beautyberry, and saw palmetto.

Florida Natural Areas Inventory ranks prairie hammocks as “G4” and “S4” both statewide and globally secure, although it may be quite rare in parts of its range, especially at the periphery. Land Stewardship management strives to minimize soil disturbance, restrict fire where appropriate and eradicate non-native invasive species within hammock areas.

Strand Swamp

Strand swamps are shallow, forested, usually elongated depressions or channels

dominated by bald cypress. They are generally situated in troughs in a flat limestone plain. Other typical plants include red maple, laurel oak, cabbage palm, pond apple, sweet bay, coastal plain willow, wax myrtle, myrsine, buttonbush, poison ivy, leather fern, swamp fern, sawgrass, swamp primrose, smartweed. Strand swamp soils are peat and sand over limestone with normal hydroperiods of 200 to 300 days per year. Periodic water flow is an integral component of strand swamps. Natural fire is infrequent in strand swamps, occurring on a cycle of 30 to 200 years. Fire, however, is essential for reduction of hardwood encroachment and reduction of peat accumulation that would convert this community to a bottomland forest. Strand swamps are extremely vulnerable to local and regional hydrologic modifications.

Wet Flatwoods

Wet flatwoods are characterized as relatively open-canopy forests of scattered pine trees or cabbage palms with either a thick shrubby under-story and very sparse ground cover, or a sparse under-story and a dense ground cover of hydrophytic herbs and shrubs, with variations between these extremes (Florida Natural Areas Inventory, 1990). Other plants associated with this habitat type in the MA include wax myrtle, saw palmetto, beakrush, St. John's-wort, and blue maidencane.

Wet flatwoods develop on poorly drained acidic, low nutrient sands underlain by hardpan. Surface water appears a minimum of one month per year. Natural fire frequency is considered to be three to 10 years. Frequent fire postpones hardwood succession and thins canopy trees, while promoting under-story growth and fire-adapted species.

State ranking is "S4", apparently secure in the state, although it may be rare in some parts of its state range. Global ranking requires further research. Most wet flatwoods are extremely vulnerable to hydrologic manipulation and exotic invasion.

Wet Prairie

Wet prairie is characterized as a treeless plain with a sparse to dense ground cover of grasses, sedges, rushes, and herbs; including wiregrass, toothache grass, maidencane, spikerush, and beakrush. Other typical plants include hatpins, marsh pinks, crownbeard, sundews, tickseed, wax myrtle, St. John's-wort, and Panicums (Florida Natural Areas Inventory, 1990).

Wet prairies occur on low, flat, poorly drained terrain and are inundated from 50 to 100 days per year. Wet prairie species have adapted to long periods of drought conditions due to rainfall seasonality. Soils typically are sands with a major organic component. Fire plays an integral role in wet prairie ecology, and with sufficient fuel build-up, burns every two to four years. If deprived of fire, these grass-dominated flatlands succumb to shrub encroachment, and are especially vulnerable to wax myrtle infestations.

Wet prairie has a state ranking of "S4", apparently secure in the state, although it may be rare in some parts of its state range. Global ranking requires further research.

Appendix C - Species List Fauna

Bald & Golden Eagle Protection Act (**BGEPA**), Federally Listed Endangered (**FE**), Federally Listed Threatened (**FT**), State Listed Threatened (**ST**), State Listed Species of Special Concern (**SSC**), & Exotic Species (**EXO**)

Birds	**Listing**
Bald eagle (*Haliaeetus leucocephalus*)	**BGEPA**
Black vulture (*Caragyps atratus*)	
Black-bellied whistling-duck (*Dendrocygna autumnalis*)	
Blue jay (*Cyanocitta cristata*)	
Cattle egret (*Bubulcus ibis*)	
Crested caracara (*Caracara cheriway*)	**FT**
Downy woodpecker (*Picoides pubescens*)	
Eastern meadowlark (*Sturnella magna*)	
Fish crow (*Corvus ossifragus*)	
Florida sandhill crane (*Grus canadensis*)	**ST**
Great egret (*Ardea alba*)	
Great horned owl (*Bubo virginianus*)	
Little blue heron (*Egretta caerulea*)	**SSC**
Loggerhead shrike (*Lanius ludovicianus*)	
Mourning dove (*Zenaida macroura*)	
Northern bobwhite (*Colinus virginianus*)	
Pileated woodpecker (*Dryocopus pileatus*)	
Red-bellied woodpecker (*Melanerpes carolinus*)	
Red-shouldered hawk (*Buteo lineatus*)	
Tricolored heron (*Egretta tricolor*)	**SSC**
Wild turkey (Meleagris gallopavo)	
Wood stork (*Mycteria americana*)	**FT**

Amphibians	
Barking tree frog (*Hyla gratiosa*)	
Cuban tree frog (*Osteopilus septentrionalis*)	**EXO**
Florida cricket frog (*Acris gryllus*)	
Green tree frog (*Hyla cinerea*)	
Greenhouse frog (*Eleuherodactylus planirostris)*	**EXO**
Pig frog (*Rana gylio*)	
Southern leopard frog (*Rana sphenocephala*)	
Squirrel tree frog (*Hyla squirrela*)	

Reptiles

American alligator (*Alligator mississippiensis*)	**FT S/A**
Brown anole (*Anolis sagrei*)	**EXO**

Mammals

Coyote (*Canis latrans*)	**EXO**
Eastern mole (*Scalopus aquaticus*)	
Opossum (*Didelphis virginiana*)	
Raccoon (*Procyon lotor*)	

Fish

Florida gar (*Lepisosteus platyrhincus*)	
Sailfin Catfish (*Pterygoplichthys multiradiatus*)	**EXO**

Invertebrates

Band-winged dragonlet *(Erythrodiplax umbrata)*	
Bella moth (*Utetheisa ornatrix*)	
Cicada (family *Cicadidae*)	
Cloudless sulfur butterfly (*Phoebis sennae*)	
Crane fly (family *Tipulidae*)	
Golden silk orb weaver spider (*Nephila clavipes*)	
Linear winged grasshopper (*Aptenopedes sphenarioides*)	
Lovebug (*Plecia nearctica*)	
Red and black mason wasp (*Pachodynerus erynnis)*	
Monarch butterfly (*Danaus plexippus*)	
Needham's Skimmer (*Libellula needhami)*	
Orb weaver (*Neoscona crucifera*)	
Psuedoscorpion (order *Pseudoscorpioninda*)	
Queen butterfly (*Danaus gilippus*)	
Scrub euchlaena moth (*Euchlaena madusaria*)	
Sri Lankan weevil (*Myllocerus undecimpustulatus undatus)*	**EXO**
White peacock butterfly (*Anartia jatrophae*)	
Yellow and black argiope spider (*Argiope aurantia)*	

Appendix D - Species List Flora

Inventoried by: South Florida Water Management District Staff 2016

Sci_Name	Common_Name	Family	Native	Edemic	EPPC1	EPPC2	StatusState	StatusUS
Acer rubrum	RED MAPLE	SAPINDACEAE	Y					
Acrostichum danaeifolium	GIANT LEATHER FERN	PTERIDACEAE	Y					
Aeschynomene indica	INDIAN JOINT VETCH	FABACEAE						
Amaranthus hybridus	SLIM AMARANTH; PIGWEED	AMARANTHACEAE						
Ambrosia artemisiifolia	COMMON RAGWEED	ASTERACEAE	Y					
Andropogon glomeratus var. pumilus	BUSHY BLUESTEM	POACEAE	Y					
Andropogon virginicus	BROOMSEDGE BLUESTEM	POACEAE	Y					
Annona glabra	POND APPLE	ANNONACEAE	Y					
Asclepias curassavica	SCARLET MILKWEED; BLOODFLOWER	APOCYNACEAE						
Axonopus furcatus	BIG CARPETGRASS	POACEAE	Y					
Baccharis halimifolia	GROUNDSEL TREE; SEA MYRTLE	ASTERACEAE	Y					
Bacopa monnieri	HERB-OF-GRACE	PLANTAGINACEAE	Y					
Bidens alba	BEGGARTICKS; ROMERILLO	ASTERACEAE	Y					
Blechnum serrulatum	TOOTHED MIDSORUS FERN; SWAMP FERN	BLECHNACEAE	Y					
Centella asiatica	SPADELEAF	APIACEAE	Y					
Cephalanthus occidentalis	COMMON BUTTONBUSH	RUBIACEAE	Y					
Ceratopteris thalictroides	WATERSPRITE	PTERIDACEAE						
Cladium jamaicense	JAMAICA SWAMP SAWGRASS	CYPERACEAE	Y					
Commelina diffusa	COMMON DAYFLOWER	COMMELINACEAE						
Conyza canadensis	CANADIAN HORSEWEED	ASTERACEAE	Y					
Crotalaria incana	SHAKESHAKE	FABACEAE						
Cyperus compressus	POORLAND FLATSEDGE	CYPERACEAE	Y					
Cyperus flavescens	YELLOW FLATSEDGE	CYPERACEAE	Y					

Cyperus haspan	HASPAN FLATSEDGE	CYPERACEAE	Y					
Cyperus odoratus	FRAGRANT FLATSEDGE	CYPERACEAE	Y					
Cyperus polystachyos	MANYSPIKE FLATSEDGE	CYPERACEAE	Y					
Cyperus surinamensis	TROPICAL FLATSEDGE	CYPERACEAE	Y					
Desmodium incanum	ZARZABACOA COMUN	FABACEAE						
Diodia teres	POOR JOE; ROUGH BUTTONWEED	RUBIACEAE	Y					
Diodia virginiana	VIRGINIA BUTTONWEED	RUBIACEAE	Y					
Diospyros virginiana	COMMON PERSIMMON	EBENACEAE	Y					
Drymaria cordata	DRYMARY; WEST INDIAN CHICKWEED	CARYOPHYLLACEAE						
Eclipta prostrata	FALSE DAISY	ASTERACEAE	Y					
Eichhornia crassipes	COMMON WATER-HYACINTH	PONTEDERIACEAE			Y			
Eleocharis baldwinii	BALDWIN'S SPIKERUSH; ROADGRASS	CYPERACEAE	Y					
Eleocharis cellulosa	GULF COAST SPIKERUSH	CYPERACEAE	Y					
Erechtites hieraciifolius	AMERICAN BURNWEED; FIREWEED	ASTERACEAE	Y					
Erigeron vernus	EARLY WHITETOP FLEABANE	ASTERACEAE	Y					
Eupatorium capillifolium	DOGFENNEL	ASTERACEAE	Y					
Ficus aurea	STRANGLER FIG; GOLDEN FIG	MORACEAE	Y					
Ficus microcarpa	INDIAN LAUREL	MORACEAE			Y			
Fimbristylis dichotoma	FORKED FIMBRY	CYPERACEAE	Y					
Fuirena pumila	DWARF UMBRELLASEDGE	CYPERACEAE	Y					
Funastrum clausum	WHITE TWINEVINE	APOCYNACEAE	Y					
Hydrocotyle umbellata	MANYFLOWER MARSHPENNYWORT	ARALIACEAE	Y					
Hypericum hypericoides	ST.ANDREW'S-CROSS	CLUSIACEAE	Y					
Ilex cassine	DAHOON	AQUIFOLIACEAE	Y					
Lepidium virginicum	VIRGINIA PEPPERWEED	BRASSICACEAE	Y					
Limnophila sessiliflora	ASIAN MARSHWEED	PLANTAGINACEAE				Y		
Lindernia crustacea	MALAYSIAN FALSE PIMPERNEL	LINDERNIACEAE						

Ludwigia leptocarpa	ANGLESTEM PRIMROSEWILLOW	ONAGRACEAE	Y					
Ludwigia octovalvis	MEXICAN PRIMROSEWILLOW	ONAGRACEAE	Y					
Ludwigia peruviana	PERUVIAN PRIMROSEWILLOW	ONAGRACEAE			Y			
Ludwigia repens	CREEPING PRIMROSEWILLOW	ONAGRACEAE	Y					
Lygodium microphyllum	SMALL-LEAF CLIMBING FERN	SCHIZAEACEAE			Y			
Melothria pendula	CREEPING CUCUMBER	CUCURBITACEAE	Y					
Micranthemum glomeratum	MANATEE MUDFLOWER	LINDERNIACEAE	Y	Y				
Micranthemum umbros	SHADE MUDFLOWER	LINDERNIACEAE	Y					
Mikania scandens	CLIMBING HEMPVINE	ASTERACEAE	Y					
Mimosa quadrivalvis var. floridana	FLORIDA SENSITIVE BRIER	FABACEAE	Y					
Momordica charantia	BALSAMPEAR	CUCURBITACEAE				Y		
Myrica cerifera	SOUTHERN BAYBERRY; WAX MYRTLE	MYRICACEAE	Y					
Nephrolepis exaltata	SWORD FERN; WILD BOSTON FERN	NEPHROLEPIDACEAE	Y					
Oxycaryum cubense	CUBAN BULRUSH	CYPERACEAE						
Panicum hemitomon	MAIDENCANE	POACEAE	Y					
Panicum repens	TORPEDOGRASS	POACEAE			Y			
Paspalum notatum var. saurae	BAHIAGRASS	POACEAE						
Phyla nodiflora	TURKEY TANGLE FOGFRUIT; CAPEWEED	VERBENACEAE	Y					
Phyllanthus abnormis	DRUMMOND'S LEAFFLOWER	PHYLLANTHACEAE	Y					
Phyllanthus tenellus	MASCARENE ISLAND LEAFFLOWER	PHYLLANTHACEAE						
Pinus elliottii	SLASH PINE	PINACEAE	Y					
Pistia stratiotes	WATER-LETTUCE	ARACEAE	Y		Y			
Pluchea odorata	SWEETSCENT	ASTERACEAE	Y					
Pontederia cordata	PICKERELWEED	PONTEDERIACEAE	Y					
Rhus copallinum	WINGED SUMAC	ANACARDIACEAE	Y					
Rhynchospora microcarpa	SOUTHERN BEAKSEDGE	CYPERACEAE	Y					

Rhynchospora nitens	SHORTBEAK BEAKSEDGE; BALDRUSH	CYPERACEAE	Y					
Richardia grandiflora	LARGEFLOWER MEXICAN CLOVER	RUBIACEAE				Y		
Richardia scabra	ROUGH MEXICAN CLOVER	RUBIACEAE						
Sabal palmetto	CABBAGE PALM	ARECACEAE	Y					
Sagittaria lancifolia	BULLTONGUE ARROWHEAD	ALISMATACEAE	Y					
Salvinia minima	WATER SPANGLES	SALVINIACEAE			Y			
Schinus terebinthifolia	BRAZILIAN PEPPER	ANACARDIACEAE			Y			
Scoparia dulcis	SWEETBROOM; LICORICEWEED	PLANTAGINACEAE	Y					
Serenoa repens	SAW PALMETTO	ARECACEAE	Y					
Sida rhombifolia	CUBAN JUTE; INDIAN HEMP	MALVACEAE	Y					
Sida ulmifolia	COMMON WIREWEED; COMMON FANPETALS	MALVACEAE	Y					
Smilax auriculata	EARLEAF GREENBRIER	SMILACACEAE	Y					
Solanum viarum	TROPICAL SODA APPLE	SOLANACEAE			Y			
Solidago fistulosa	PINEBARREN GOLDENROD	ASTERACEAE	Y					
Sonchus oleraceus	COMMON SOWTHISTLE	ASTERACEAE						
Spermacoce remota	WOODLAND FALSE BUTTONWEED	RUBIACEAE	Y					
Spermacoce verticillata	SHRUBBY FALSE BUTTONWEED	RUBIACEAE				Y		
Sporobolus indicus	SMUTGRASS	POACEAE						
Sporobolus indicus var. pyramidalis	WEST INDIAN DROPSEED	POACEAE			Y			
Taxodium distichum	BALD-CYPRESS	CUPRESSACEAE	Y					
Tillandsia balbisiana	NORTHERN NEEDLELEAF	BROMELIACEAE	Y				Threatened-State	
Tillandsia fasciculata	CARDINAL AIRPLANT; COMMON WILD PINE; STIFF-LEAVED WILD PINE	BROMELIACEAE	Y				Endangered-State	
Tillandsia setacea	SOUTHERN NEEDLELEAF	BROMELIACEAE	Y					
Tillandsia usneoides	SPANISH MOSS	BROMELIACEAE	Y					
Typha domingensis	SOUTHERN CATTAIL	TYPHACEAE	Y					

Urena lobata	CAESARWEED	MALVACEAE			Y			
Urochloa mutica	PARAGRASS	POACEAE			Y			
Vitis rotundifolia	MUSCADINE	VITACEAE	Y					
Xyris caroliniana	CAROLINA YELLOWEYED GRASS	XYRIDACEAE	Y					

FMSF USE ONLY
FMSF Survey # 19611

Form Date 5/24/04

Survey Log Sheet

Florida Master Site File
Version 2.0 9/97

Consult *Guide to the Survey Log Sheet* for detailed instructions.

Recorder of Log Sheet Jodi B. Pracht

Identification and Bibliographic Information

Survey Project (Name and project phase) Harmony Ranch

Is this a continuation of a previous project? X No ☐ Yes Previous survey#(s)

Report Title (exactly as on title page) Cultural Resource Assessment Survey of the Harmony Ranch Martin County, Florida

Report Author(s) (as on title page-individual or corporate) Archaeological Consultants, Inc.

Publication Date (month/year) 05/04 Total Number of Pages in Report (Count text, figures, tables, not site forms) 40

Publication Information (if relevant, series and no. in series, publisher, and city. For article or chapter, cite page numbers. Use the style of *American Antiquity*. See *Guide to the Survey Log Sheet.*) Archaeological Consultants, Inc. P.O. Box 5103, Sarasota, FL 34277-5103

Supervisor(s) of Fieldwork (whether or not the same as author[s]) Jodi B. Pracht and Carrie Scupholm

Affiliation of Fieldworkers (organization, city) Archaeological Consultants, Inc.

Key Words/Phrases (Don't use the county, or common words like *archaeology, structure, survey, architecture.* Put the most important first. Limit each word or phrase to 25 characters).

Survey Sponsors (corporation, government unit, or person who is directly paying for fieldwork)

Name EW Consultants, Inc.

Address/Phone 735 Colorado Avenue, Suite 1, Stuart, FL 34994 772 287-8771

Mapping

Counties (List each one in which field survey was done-do not abbreviate) Martin

USGS 1:24,000 Map(s): Names/Dates: Indiantown SW, Fla. 1953, PR 1984; Gomez, Fla. 1948, PR 1983

Remarks (Use supplementary sheet[s] if needed) No archaeological, one potentially historical sites found during survey.

Description of Survey Area

Dates for Fieldwork: Start 5/19/04 End 5/23/04 Total Area Surveyed (fill in one) ____ hectares 4573 acres

Number of Distinct Tracts or Areas Surveyed 1

If Corridor (fill in one for each) Width ____ meters ____ feet Length ____ kilometers ____ miles

Types of Survey (check all that apply) X archaeological X architectural X historical/archival ☐ underwater ☐ other: ____

Survey Log Sheet of the Florida Master Site File

Research and Field Methods

Preliminary Methods (Check as many as apply to the project as a whole. If needed write others at bottom).

- [ ] Florida Archives (Gray Building)
- [ ] Florida Photo Archives (Gray Building)
- [X] FMSF site property search
- [X] FMSF survey search
- [ ] other (describe)
- [ ] library research - *(local public)*
- [ ] library-special collection- *(non local)*
- [X] Public Lands Survey (maps at DEP)
- [ ] local informant(s)
- [ ] local property or tax records
- [ ] newspaper files
- [X] literature search
- [ ] Sanborn Insurance maps
- [X] windshield survey
- [X] aerial photography

Archaeological Methods (Describe the proportion of properties at which method was used by writing in the corresponding letter. Blanks are interpreted as "None.")

F(-ew: 0-20%, S(-ome: 20-50%); M(-ost: 50-90%); or A(-ll, Nearly all: 90-100%). If needed write others at bottom.

- [ ] Check here if NO archaeological methods were used.

- ___ surface collection, controlled
- ___ surface collection, uncontrolled
- A shovel test-1/4" screen
- ___ shovel test-1/8" screen
- ___ shovel test-1/16" screen
- ___ shovel test-unscreened
- ___ other (describe):
- ___ other screen shovel test (size: ___)
- ___ water screen (finest size: ___)
- ___ posthole tests
- ___ auger (size: ___)
- ___ coring
- ___ test excavation (at least 1x2 m)
- ___ block excavation (at least 2x2 m)
- ___ soil resistivity
- ___ magnetometer
- ___ side scan sonar
- ___ unknown

Historical/Architectural Methods (Describe the proportion of properties at which method was used by writing in the corresponding letter. Blanks are interpreted as "None.")

F(-ew: 0-20%, S(-ome: 20-50%); M(-ost: 50-90%); or A(-ll, Nearly all: 90-100%). If needed write others at bottom.

- [ ] Check here if NO historical/architectural methods were used.

- ___ building permits
- ___ commercial permits
- ___ interior documentation
- ___ other (describe):
- ___ demolition permits
- A exposed ground inspected
- ___ local property records
- ___ neighbor interview
- ___ occupant interview
- ___ occupation permits
- ___ subdivision maps
- ___ tax records
- ___ unknown

Scope/Intensity/Procedures Archaeological and historical background research conducted; 199 shovel tests (ST) dug at 50 m intervals and judgmentally; soil screened and stratigraphy recorded; STs placed on aerial; historical/architectural reconnaissance; photographs taken; report prepared.

Survey Results (cultural resources recorded)

Site Significance Evaluated? [X] Yes [ ] No If *Yes*, circle NR-eligible/significant site numbers below.

Site Counts: Previously Recorded Sites 1 Newly Recorded Sites 1

Previously Recorded Site #'s (List site #'s without "8." Attach supplementary pages if necessary) MT549

Newly Recorded Site #'s (Are you sure all are originals and not updates? Identify methods used to check for updates, ie, researched the FMSF records). List site #s without "8." Attach supplementary pages if necessary. MT994

Site Form Used: [ ] SmartForm [ ] FMSF Paper Form [X] Approved Custom Form: Attach copies of written approval from FMSF Supervisor and Supervisor-signed form.

DO NOT USE ************SITE FILE USE ONLY**************DO NOT USE**

BAR Related
- [ ] 872
- [ ] 1A32
- [ ] CARL
- [ ] UW

BHP Related
- [ ] State Historic Preservation Grant
- [X] Compliance Review CRAT # 2004-5367

ATTACH PLOT OF SURVEY AREA ON PHOTOCOPIES OF USGS 1:24,000 MAP(S)

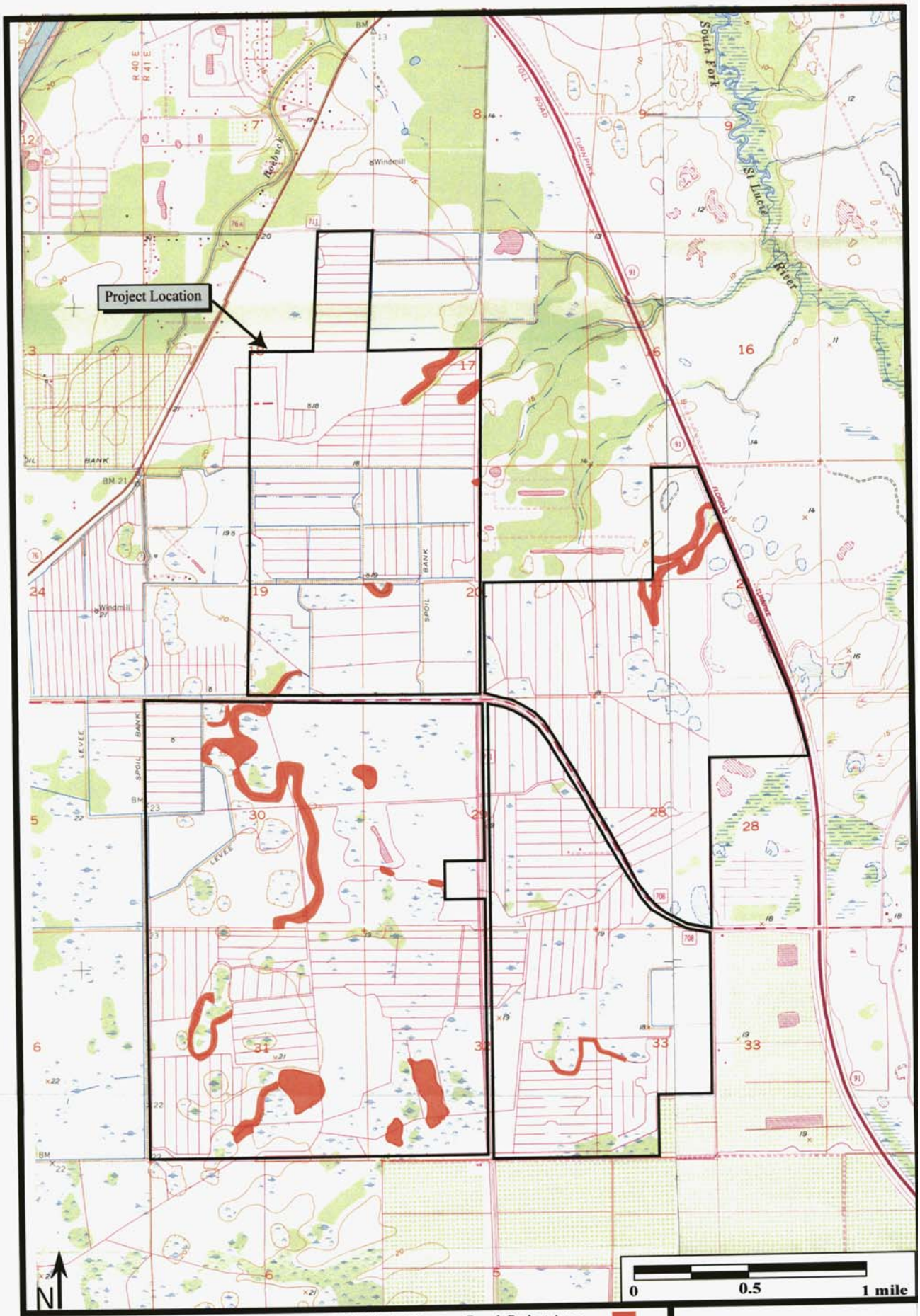


Figure 2. Zones of Archaeological Potential (ZAPs) Within the Harmony Ranch Project Area; denotes moderate ZAP, the remainder of the project is a low ZAP. Township 39 South, Range 41 East, Sections 17, 18, 19, 20, 21, 28, 29, 30, 31, 32 and 33 (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983).

FLORIDA DEPARTMENT OF STATE
Glenda E. Hood
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Ms. Marion Almy
Archaeological Consultants, Inc.
8110 Blaikie Court, Suite A
Sarasota, Florida 34240

June 25, 2004

Re: DHR Project File No. 2004-5367 (20044167) / Received by DHR: May 25, 2004
Cultural Resource Assessment Survey: Harmony Ranch, Martin County, Florida.

Dear Ms. Almy:

We note that in May 2004, Archaeological Consultants, Inc. (ACI) conducted the above referenced survey for EW Consultants, Inc., in anticipation of a request by the Florida Division of Historical Resources for a cultural resource assessment survey. Our office proceeded to review this report with the expectation that EW Consultants, Inc. will be engaging in permitting processes that will require this office to comment on possible adverse impacts to cultural resources listed or eligible for listing in the *National Register of Historic Places (NRHP)*, or otherwise of historical, architectural, or archaeological significance. We recommend at the time such actions are taken, a copy of this letter be forwarded to the permitting agency(ies) with the application. This may eliminate the permitting agency(ies) from having to submit an application to the Division of Historical Resources for review or, if applications are forwarded to the Division, would facilitate our review.

The cultural resource assessment survey consisted of an archaeological and historical investigation of moderate Zones of Archaeological Probability within the project area, in accordance with the research design previously submitted by ACI and approved by this office (DHR Project File No. 2004-4167). One previously recorded historical structure and one previously unrecorded historical structure were identified within the project area during the investigation.

The Becker Grove House (8MT549), previously identified in the center of the project tract (DHR Survey No. 4106), was a circa 1945 frame vernacular residence. 8MT549 could not be relocated during this investigation. It is the opinion of ACI that 8MT549 has been demolished since its initial recording. Based on the information provided, our office concurs with this determination. We note the submission of a Change of Status Form for 8MT549.

The Harmony Ranch Windmill and Water Trough (8MT994) is a multi-component manufactured structure consisting of an aluminum blade windmill, cement water trough, and well system located in the center of the project tract. 8MT994 represents a traditional cattle watering/agricultural system typical throughout Florida. The date of construction for 8MT994 is uncertain. It is the opinion of ACI that 8MT994 does not appear eligible for listing in the *NRHP*. Based on the information our office concurs with this determination.

It is the opinion of ACI that development of the Harmony Ranch property will have no effect on historical properties listed or eligible for listing in the *NRHP*. ACI recommends no further investigation of Harmony Ranch project area.

Based on the information provided, our office concurs with these determinations and finds the submitted report complete and sufficient in accordance with Chapter 1A-46, *Florida Administrative Code*.

If you have any questions concerning our comments, please contact Ariana Slemmens, Historic Sites Specialist, by phone at (850) 245-6333, or by electronic mail at abslemmens@dos.state.fl.us. Your continued interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura R. Kammerer, Supervisor

for Frederick Gaske, Director, and
Deputy State Historic Preservation Officer

10011

CULTURAL RESOURCE ASSESSMENT SURVEY
HARMONY RANCH
MARTIN COUNTY, FLORIDA

Prepared for:

EW Consultants, Inc.
735 Colorado Avenue, Suite 1
Stuart, Florida 34994

By:

Archaeological Consultants, Inc.
8110 Blaikie Court, Suite A
Sarasota, Florida 34240

Marion M. Almy – Project Manager
Jodi B. Pracht - Project Archaeologist
Carrie Scupholm – Architectural Historian

EXECUTIVE SUMMARY

Archaeological Consultants, Inc. (ACI) conducted a cultural resource assessment survey of the Harmony Ranch property in Martin County, Florida to locate and identify any archaeological sites and historic structures, and to assess their significance in terms of eligibility for listing in the National Register of Historic Places (NRHP). This cultural resource assessment survey was undertaken as due diligence and was not required by any Federal, State, or local agencies as a contingency of permitting. This survey and resulting report meets all requirements of Chapters 267, *Florida Statutes*, and implementing state regulations regarding possible impact to significant historic properties. All work was carried out in conformity with standards contained in the "Cultural Resource Management Standards and Operational Manual" (Florida Division of Historical Resources 2002). The resulting report meets specifications set forth in Chapter 1A-46, Florida Administrative Code. Archaeological and Historical/Architectural field survey was conducted from May 19th through May 23rd, 2004.

Background research and a review of the Florida Master Site File (FMSF) indicated that no archaeological sites, including any sites listed in or determined eligible for listing in the NRHP were recorded within or adjacent to the proposed development site. A research design for the Harmony Ranch project area identified several areas of moderate archaeological probability within the project area (ACI 2004; Appendix A). As a result of field survey, no archaeological sites were located within the property.

Background research revealed that one historic structure has been recorded within the Harmony Ranch project area. The Becker Grove House (8MT549) is not considered eligible for listing in the NRHP. The Historical/Architectural field survey found this resource to no longer be extant. No other historic buildings were identified within the Harmony Ranch project area, however the Harmony Ranch Windmill and Water Trough (8MT994) were identified during survey. This resource is not considered eligible for listing in the NRHP.

Thus, project development will have no effect on any cultural resources, including archaeological sites and historic structures, which are listed, determined eligible, or considered potentially eligible for listing in the NRHP. No further work is recommended.

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1.0 INTRODUCTION

The Harmony Ranch project area is located in northern Martin County (Figure 1.1). This ± 4573 acre property is located in multiple sections of Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983). Proposed development of the Harmony Ranch parcel includes single family homesites.

This cultural resource assessment survey of the Harmony Ranch property was undertaken as due diligence and was not required by any Federal, State, or local agencies as a contingency of permitting. This survey and resulting report meets all requirements of Chapters 267, *Florida Statute* and implementing state regulations regarding possible impact to significant historic properties. All work was carried out in conformity with standards contained in the "Cultural Resource Management Standards and Operational Manual" (Florida Division of Historical Resources 2002). The resulting report meets specifications set forth in Chapter 1A-46, Florida Administrative Code.

The purpose of this cultural resource assessment survey was to locate and identify prehistoric and historic period archaeological sites and historic structures within the project area, and to assess their significance in terms of eligibility for listing in the National Register of Historic Places (NRHP). The archaeological and historical/architectural surveys were conducted in May 2004. Field survey was preceded by background research. This served to provide an informed set of expectations concerning the kinds of cultural resources which might be anticipated to occur within the project area, as well as a basis for evaluating any new sites discovered.

In preparation for this cultural resource assessment survey, Archaeological Consultants, Inc (ACI) developed a research design for the Harmony Ranch property (ACI 2004). The research design included a review of background research, an environmental description of the project area, the delineation of Zones of Archaeological Potential (ZAPs), proposed survey methodology, laboratory procedures, and report standards (Appendix A). The research design was approved by the Florida Division of Historical Resources (FDHR) on May 18, 2004 (Appendix B).

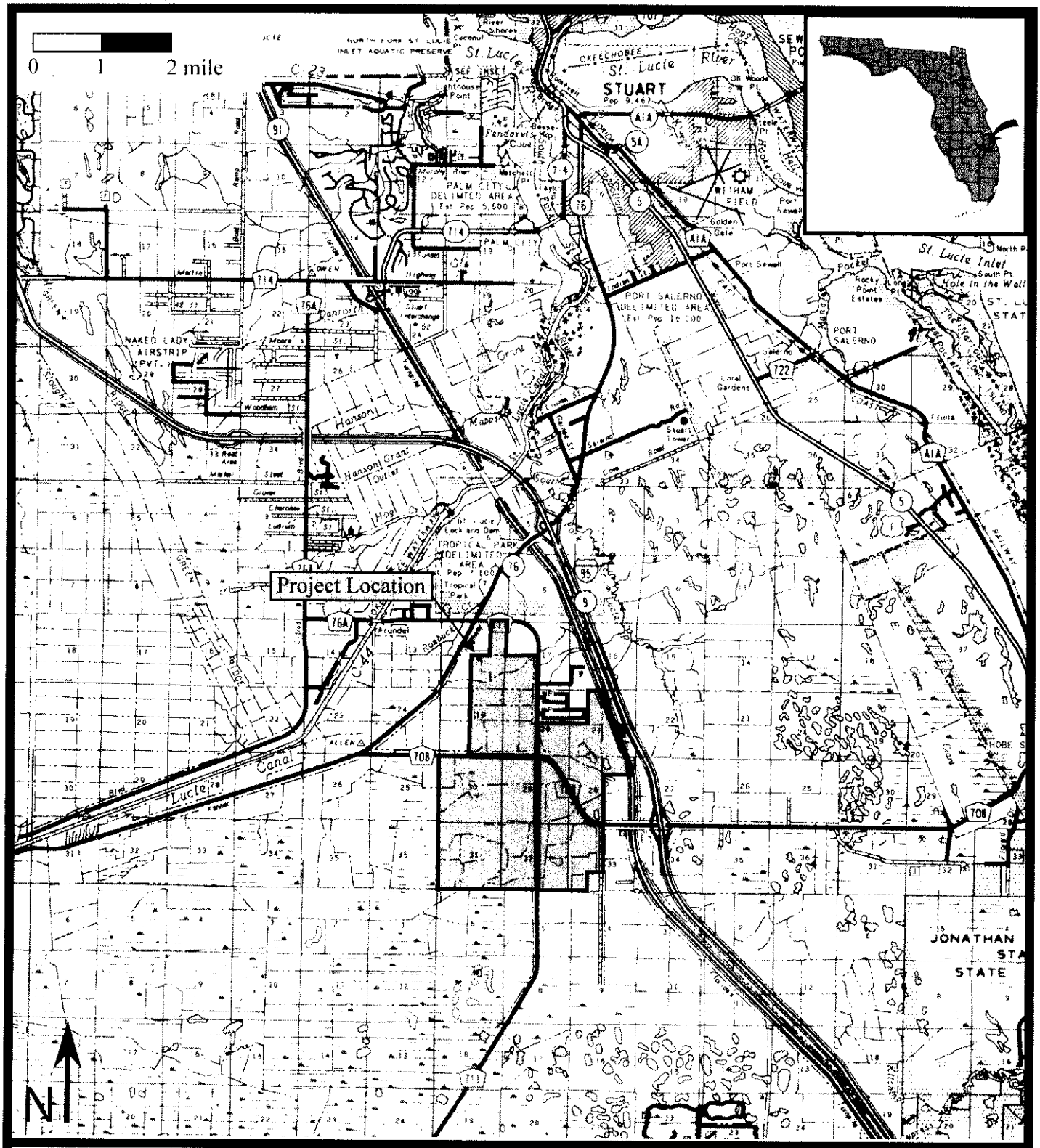


Figure 1.1. Harmony Ranch Project Area, Township 39 South, Range 41 East, Martin County (State Mapping Office 1985).

2.0 ENVIRONMENTAL SETTING

2.1 Physical Environment

The Harmony Ranch property is located in Martin County, southeast of State Road 76, west of Interstate 95, and north of the Martin/Palm Beach County line. The property is bisected north/south by County Road 711 and east/west by County Road 708 (Figure 2.1).

Martin County is underlain by Pleistocene sediments associated with the Fort Thompson and Anastasia Formations which consist of shell beds, clays, and clayey sands. These are covered with the fine to medium sized sands making up the coastal ridges (Lane et al. 1980). Physiographically, the project area is within the Atlantic Coastal Lowlands (Puri and Vernon 1964). The Lowlands are characterized by flat, low elevations and poorly drained soils.

Carr (1995), in his development of an archaeological site location predictive model for the County, defined several archaeological/geo-environmental zones. The project area is located within the Eastern Flatlands Zone:

> Eastern Flatlands Zone: For the purposes of this study, the Eastern Flatlands Zone includes all the land in Martin County north and east of the intersection of Pratt-Whitney Road (CR711) and Bridge Road (CR708) and east of the Green Ridge. Although there are some exceptions, most of this land is naturally pine flatwoods. A good deal of it has also been impacted by modern housing developments (Carr 1995:7).

Soils of the project area are part of the Wabasso-Riviera-Oldsmar and Pineda-Riviera soil associations (USDA 1981). Both associations are nearly level and poorly drained. The former is characteristic of flatwoods and the later is typical of sloughs and freshwater marshes. Table 2.1. lists the soil types specific to the Harmony Ranch project area, their relief and drainage, and environmental associations.

Currently, the project area is characterized by improved pasture with numerous ditched and scattered wetlands and cypress heads (Photos 2.1 and 2.2).

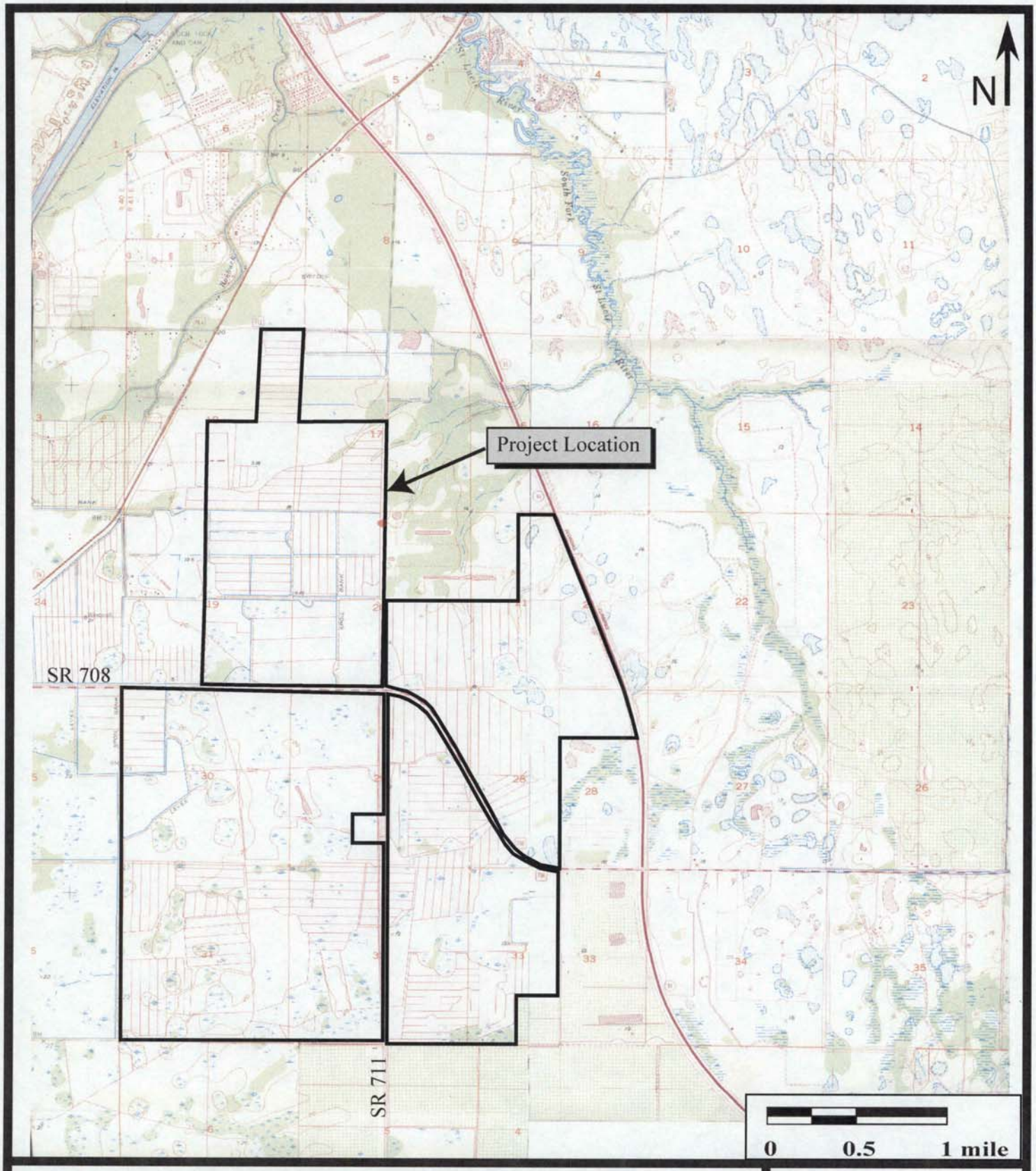


Figure 2.1. Environmental Setting of the Harmony Ranch Project Area; Township 39 South, Range 41 East, Sections 17, 18, 19, 20, 21, 28, 29, 30, 31, 32 and 33 (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983).

Table 2.1. Soil Types, Relief and Drainage, and Environmental Associations of the Harmony Ranch Project Area (USDA 1981).

Soil Type		Relief/Drainage/Environment
Boca fine sand	Nearly level, poorly drained	Flatwoods
EauGallie fine sand	Nearly level, poorly drained	Flatwoods
Floridana fine sand, depressional	Nearly level, very poorly drained	Sloughs and depressions
Holopaw fine sand	Nearly level, poorly drained	Drainageways
Malabar sand	Nearly level, poorly drained	Flatwoods and sloughs
Oldsmar fine sand	Nearly level, poorly drained	Flatwoods
Oldsmar fine sand, depressional	Nearly level, poorly drained	Depressions
Pineda sand	Nearly level, poorly drained	Grassy flats
Pinellas fine sand	Nearly level, poorly drained	Flatwoods and hammock
Rivera fine sand	Nearly level, poorly drained	Low flats and drainageways
Rivera fine sand, depressional	Nearly level, poorly drained	Depressions
Tequesta variant muck	Nearly level, poorly drained	Depressions and marshes
Wabasso sand	Nearly level, poorly drained	Flatwoods
Wabasso sand, depressional	Nearly level, poorly drained	Depressions



Photo 2.1. Looking North Toward Improved Pasture of Project Area.



Photo 2.2. Looking Northeast Along Ditch in Improved Pasture of Project Area.

2.2 Paleo-Environmental Considerations

The prehistoric environment of the project area was different from that which is seen today. Sea levels were much lower, the climate was drier, and potable water was scarce. Dunbar (1981:95) notes that due to the arid conditions during the period 16,500 to 12,500 B.P., "the perched water aquifer and potable water supplies were absent." Palynological studies conducted in Florida and Georgia suggest that between 12,000 and 5000 years ago, this area was covered with an upland vegetation community of scrub oak and prairie (Watts 1969, 1971, 1975). The rise of sea levels severely reduced xeric habitats over the next several millennia.

By 5000 years ago, the mid-Holocene hypsithermal, a climatic event marking a brief return to Pleistocene climatic conditions, induced a change toward more open vegetation. Southern pine forests replaced the oak savannahs. Extensive marshes and swamps developed along the coasts and subtropical hardwood forests became established along the southern tip of Florida (Delcourt and Delcourt 1981). Northern Florida saw an increase in oak species, grasses, and sedges (Carbone 1983). Also by this time, a forest dominated by longleaf pine, along with cypress swamps and bayheads existed in the area (Watts 1971, 1975). By about 3500 B.C., surface water was plentiful in karst terrains and the level of the Floridan aquifer rose to 1.5 m (4.9 ft) above present levels. After about 5000 years ago, modern floral, climatic, and environmental conditions were established (Watts 1975).

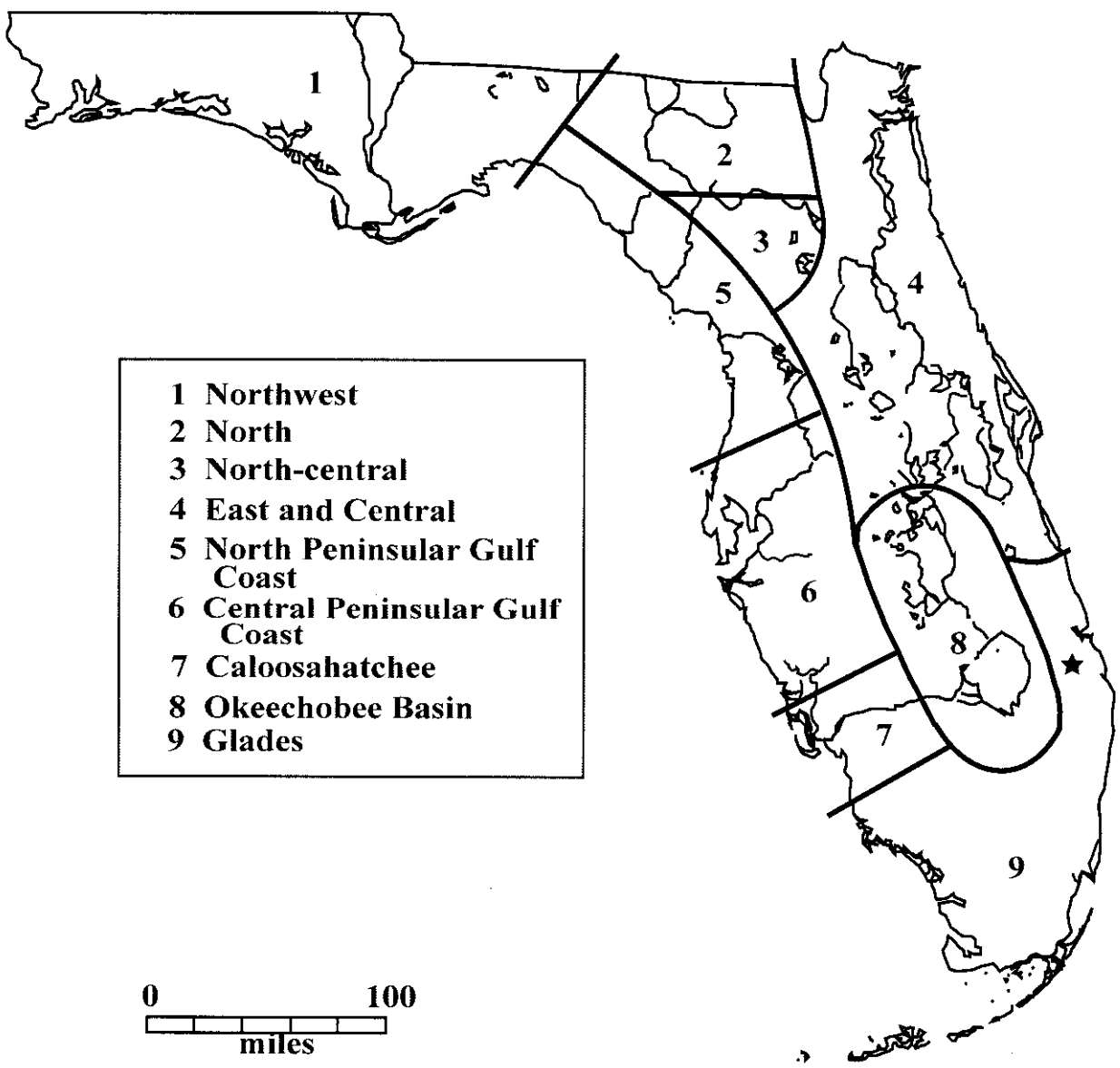
3.0 PREHISTORIC REVIEW

A discussion of the prehistory of a specific geographic region provides a general framework within which the local archaeological record can be examined. Archaeological sites are not individual entities, but are the remains of a once dynamic cultural system. As a result, they cannot be adequately examined or interpreted without reference to other sites and resources within the general area. Aboriginal populations have inhabited Florida for at least 14,000 years. The earliest cultural stages are fairly similar throughout the Southeast; cultural regionalism began to develop some 4000 years ago with the advent of fired clay pottery.

In general, archaeologists summarize the prehistory of a given area (i.e., an archaeological region) by delineating a sequence of archaeological cultures through time. Archaeological cultures are defined largely in geographical terms, but also reflect shared environmental and cultural factors. The project area is located within the Glades region (Figure 3.1) as defined by Milanich (1994). This large region, which begins along the west coast in the Ten Thousand Islands, includes the Florida Keys, and extends up the east coast to about Indian River County. This is an environmentally diverse region in which the many wetlands were key to the subsistence strategies of the aboriginal inhabitants, including the Everglades and Big Cypress Swamps, and the saltwater marshes and mangrove forests along the coasts. Carr and Beriault (1984), however, consider the coastal portions of Martin and Palm Beach Counties to be within a separate cultural region, which they refer to as "East Okeechobee", with the main cultural influences coming from the west. Griffin (1988) in his synthesis of Everglades archaeology, considered this area to be a transition zone between the Belle Glade Area to the west, and Everglades area to the south. Carr's archaeological survey of Martin County also notes the evidence of the influences present in the area from the St. Johns, Indian River, and Lake Okeechobee area (Carr 1995). Carr's (1995) synthesis of the archaeology of this area is used primarily in this overview of regional prehistory.

3.1 Paleo-Indian Stage

The earliest known cultural manifestation is the Paleo-Indian period which begins with the first human arrivals in Florida some 14,000 years ago, and persists until about 6500 B.C. (Milanich and Fairbanks 1980:38). Until quite recently, archaeologists theorized that the Paleo-Indian populations were nomadic hunters who subsisted by hunting the now extinct Pleistocene mammals and gathering wild plants. Today, however, scientists know that these people engaged in a variety of settlement and subsistence strategies, including the well-known "big game hunting" strategy. A widely-accepted subsistence model, the Oasis model, suggests that watering holes (oases) were critical to game animals and humans who depended on them to secure drinking water in the arid Florida environment 10,000 to 14,000 years ago (Milanich 1994:40-41). Support



Post- 500 B.C. regions of precolumbian Florida

Figure 3.1. Florida Archaeological Regions (Milanich 1994:xix). The project area (★) is located in the Glades Region.

for the model is found in the distribution of Paleo-Indian camps at former water holes and other perched water sources in the karstic, Tertiary limestone regions of Florida (Dunbar 1991; Milanich 1994). During this time the climate was cooler and drier. Since sea levels were as much as 115 feet below present levels, and the coastal regions extended miles beyond present day shorelines (Milliman and Emery 1969), it is probable that many sites dating to this time have been inundated (Clausen et al. 1979; Ruppé 1980; Scholl et al. 1969). The presence of extensive grasslands in southern Florida is indicated by the large variety of grazing undulates and sloths (Martin and Webb 1974).

Sites of the Paleo-Indian period, most readily identified by distinctive, lanceolate shaped stone projectile points, are not well known in this region. However, fossil beds in the Vero Beach and Melbourne area have produced human remains in context with Pleistocene fauna (Murphy 1990). Farther south on the east coast, discoveries at the Cutler Fossil Site, south of Miami and near Biscayne Bay, provide more data (Carr 1986). Here, a solution feature containing the bones of many fossil animals was found with two early projectile points. Carbon-14 dates indicate the site was inhabited some 9,700 years ago during the very late Paleo-Indian or Early Archaic Period.

3.2 Archaic Stage

Following the Paleo-Indian period is the Archaic stage which has been divided into three periods: Early Archaic (7500-5000 B.C.), Middle Archaic (5000-3000 B.C.), and Late Archaic (3000-500 B.C.) (Milanich 1994). The beginning of the Archaic is denoted by interrelated environmental and cultural changes. The environmental changes associated with the end of the Pleistocene necessitated modification of the extant prehistoric settlement patterns and subsistence strategies. Whereas the Paleo-Indians depended more heavily upon the Pleistocene megafauna and the few watering holes, Archaic populations hunted smaller game and learned to exploit a broader range of resources such as shellfish. These adaptive changes resulted in an increased number and types of archeological sites. The effects of the changing environment are evidenced in site location variation. Though Early Archaic artifacts are often found in association with Paleo-Indian deposits, especially around water sources, other Early Archaic sites are located in areas devoid of Paleo-Indian components. The only known Early Archaic sites in southern Florida are the previously mentioned Cutler Ridge Site (Carr 1986) and the Little Salt and Warm Mineral Springs sites in Sarasota County (Clausen et al. 1979; Royal and Clark 1960).

During the Middle Archaic wetter conditions prevailed. Sea levels continued to rise and pine forests and swamps emerged. The climate changed to one of more pronounced seasonality. Present-day vegetation patterns became established; hammocks of broad-leafed mesic trees, upland pine forests, and bayheads and cypress swamps became significant plant communities (Watts 1971). Settlement in southern Florida continued to be focused on the hydric sinkholes and other similar wetland features (Carr 1995). Subsistence was based on hunting, fishing, shellfish collecting, and plant gathering.

Throughout much of south Florida, continually rising sea levels and increased ground water produced mesic conditions. Several muck or wet burial sites of this period have been investigated. For example, a Middle Archaic muck pond burial was found at the Bay West Nursery in Collier County (Beriault et al. 1981). On the east coast, just north of the Glades region, two mortuary sites, the Gauthier Site and the Windover Site, have been recorded in Brevard County (Carr 1981; Doran and Dickel 1988); to the south in Dade County at the Cheetum Site, located on what would have been the eastern edge of the still incompletely formed Everglades, Middle to Late Archaic period burials were found (Newman 1986). Village middens were located along the periphery of these mortuary ponds. In addition to these sites, small campsites, evidenced by lithic tools and debitage, are common though not well represented in southern Florida, most likely due to the lack of suitable lithic raw materials.

By about 2000 B.C., the first pottery was manufactured in Florida. This marked the beginning of the Ceramic (Late) Archaic, which is sometimes referred to as the Orange period in much of peninsular Florida. Carr (1995) indicates that there are two variations of the Late Archaic culture in this area. The Orange culture is a coastal manifestation known primarily from the St. Johns River Valley and Atlantic coasts further to the north, whereas the Glades Archaic peoples were located inland on the numerous tree islands throughout the Everglades and wetlands, including the Allapatah Flats and the Loxahatchee Marsh. Further west, in the Glades region, fiber-tempered ceramics are best represented at the coastal sites such as Useppa Island (Griffin 1989) and Key Marco (Cockrell 1970). Although a number of sites along the Atlantic coast have provided evidence of fiber-tempered and semi-fiber-tempered wares, including Markham Mound in Broward County (Mowers and Williams 1972), Griffin (1988:193) notes that "nowhere in South Florida have sites of this period yet been discovered which can approach the size, and apparently the population density, of those in the valley of the St. Johns River and the adjacent coastal lagoons." Two sites in Martin County that have a Late Archaic component include 8MT37, the Hutchinson Island Burial Mound, and 8MT377, the Port Seawall Site, a shell midden.

3.3 Transitional

The Transitional period follows the Late Archaic and dates from about 1000 to 750 B.C. In general, this time was characterized by increased regionalism, population growth, and socio-cultural complexity (Bullen 1959, 1970). The movement toward a sedentary life continued. Fiber-tempered pottery was slowly replaced by sand-tempered ceramics (Glades Ware) in the Glades area (Milanich and Fairbanks 1980). Griffin notes that in south Florida (including the Circum-Glades region) during this time frame ". . . the emergence of the three ceramic areas, or ceramic trajectories . . ." developed (Griffin 1989:194). Several east coast sites can be dated to this period. Semi-fiber tempered ceramics were recovered from the coastal Mt. Elizabeth Site (8MT30) (Carr 1995).

3.4 Formative: East Okeechobee I - IV

The East Okeechobee I period (750 B.C. - A.D. 800) is characterized by the use of sand-tempered plain ceramics with Belle Glade Plain being relatively uncommon in the Jupiter area. However, in the Boca Raton area, the ceramic distribution is reversed, with little sand-tempered ceramics and the dominance of Belle Glade Plain (Carr 1995; Furey 1972). It is suggested that this is the result of different areas of influence. The lack of St. Johns Plain ceramics is hypothesized as being the result of a direct transition from the Glades Archaic (Carr 1995:28).

As with the preceding Glades Archaic, sites tend to be located in the interior wetlands rather than on the coast. There appears to have been an expansion of the areas utilized to include the upper reaches of streams and rivers (Kennedy et al. 1994a, 1994b). Carr (1995:29) suggests that those sites represent short term seasonal encampments that are not repeatedly occupied. The coastal sites, such as the Jupiter Inlet I site (8PB34) (Kennedy et al. 1993), were also most likely used on a seasonal basis.

The East Okeechobee II period (A.D. 800 - 1000) is denoted by the more extensive occupation of the coastal areas and the appearance of St. Johns Plain ceramics. Carr (1995:29) suggests that the lack of the St. Johns ceramics at the interior sites demonstrates a change in settlement patterns. In the southern portion of the area, there is a slight decrease in the use of Belle Glade Plain and an increased use of sand-tempered plain ceramics. Within the Boca Raton area, Carr indicates a slightly later occurrence of this period, ca. A.D. 950-1200.

St. Johns Check Stamped ceramics mark the beginning of the East Okeechobee III period. Radio-carbon dates from the Jupiter Inlet I site indicate a beginning date of roughly A.D. 1000. There is a substantial increase in the use of St. Johns ceramics (Plain and Check-stamped) until this ware becomes the main type used. The Riviera complex in Palm Beach County is a settlement dating from this period (Wheeler 1992). In the Boca Raton area, both the sand-tempered plain and St. Johns ceramics increased together while the prevalence of Belle Glade ceramics decreased (Carr 1995). This period ends with the arrival of Europeans to the New World around A.D. 1500.

The Okeechobee IV period is marked by the arrival of European goods into the aboriginal sites. The ceramic assemblages remained virtually the same, with a possible increase in the amount of St. Johns Check-stamped ceramics. Several different tribes were located along the southeast coast of Florida, including the Jaega in Palm Beach County, the Hobe in Martin County, and the Ais located further north in Indian River and Brevard Counties (Milanich 1995). They are known almost entirely from the narrative of Jonathan Dickinson, a Quaker, who was shipwrecked in 1696 (Andrews and Andrews 1985). The Hobe subsisted primary on a marine diet and coastal plants though deer were also hunted. Agricultural pursuits were not undertaken. By 1700, the Hobe, Ais, and Jaega were in decline. The population of the south Florida Indians in the early sixteenth century was estimated at 20,000; however, by the eighteenth century, the number had declined to several hundred (Milanich and Fairbanks1980).

4.0 HISTORICAL OVERVIEW

The cultural traditions of the native Floridians ended with the advent of European expeditions to the New World. The initial events, authorized by the Spanish crown in the 1500s, ushered in devastating European contact. After Ponce de Leon's landing near St. Augustine in 1513, Spanish explorations were confined to the West Coast of Florida (Narvaéz in 1528; DeSoto in 1539) and European contact along the east coast was left to a few shipwrecked sailors from treasure ships which, by 1551, sailed through the Straits of Florida on their way to Spain. The need to protect the treasure galleons led Spain to destroy Fort Caroline on the St. Johns River near today's Jacksonville. After the Spanish Admiral, Pedro Menéndez de Avilés, had taken the French fort and a hurricane had destroyed the French fleet on the coast north of Cape Canaveral, the threat to Spain was greatly reduced and the few Huguenots who did not surrender withdrew to the vicinity of the wrecked fleet near Cape Canaveral. Native Americans, friendly to the Spanish, relayed this information to Menéndez, who captured all but one French captain and a few soldiers who decided to risk their fortunes with the Native Americans rather than the Spanish Catholics.

Shipwrecks were occurring as early as 1530 on the eastern shores of Florida around settlements of the Ais tribe, near the Indian River Inlet. Upon a shipwreck in 1545, Hernando d'Escanlante Fontenada lived amongst the Calusa tribes, until he was given over to Menédez twenty years later. He documented his experiences and noted several ships grounded on the coast near the Ais, who would recover the gold and silver, and trade with the Calusa (Milanich 1995:39-42).

Menéndez proceeded southward, passing a number of villages from which the Native American inhabitants had fled. He left mirrors, knives, scissors, and bells as a sign of good will and received hospitality and food in return from the Ais who lived near the Indian River Inlet (Barcia 1723:91 in Rouse 1951). Menéndez remained four days arranging for 200 of his men, under Juan Velez de Medrano, to settle nearby. Then Menéndez continued on to Havana for supplies and to turn over the French prisoners. However, upon his departure, the Ais attacked the soldiers, and Velez moved the survivors to the southern end of the Indian River where the more friendly Guacata Native Americans, and a better supply of food, could be found. Velez relocated south of the Ais settlement, establishing the new settlement Santa Lucia, or St. Lucie, near the St. Lucie River (Barrientos 1902:96-97 in Rouse 1951; Lyon 1983:140; Menendez 1893:111 in Rouse 1951).

During Spain's first period of occupancy (1565-1763), it failed to establish permanent settlements in the project area. Located on the fringe of Spanish activity centered in St. Augustine, Martin County was too far removed for Spain to exert political control (Milanich and Fairbanks 1980). From the 1570s into the 1700s, there are references to Spanish contact with the Ais and Hobe tribes (Rouse 1951:50-56; Milanich 1995:56). Other groups are also noted such as the Viscaynos, from whom Biscayne Bay

probably received its name, and the Sanaluces, who probably resided near the Spanish fortified settlement of Santa Lucia (Milanich 1995:56). Contact with the Ais tribes however, reveals the most information. The most significant description of the Ais in the 17th century was recorded by Jonathan Dickinson who, with his family and other members of his party, was shipwrecked in September 1696 while en route from Port Royal, Jamaica to Philadelphia. The group walked from the coast of the Jaega and Hobe territories, thought to be located to the south of the Ais, northward to St. Augustine. Although the party spent only a brief time among the natives, Dickinson provided a vivid account of Ais appearance, dress, subsistence, ceremonies, and other customs (Andrews and Andrews 1985).

By the early 1700s, the native populations were largely decimated - ravaged by conquest, disease, the typical effects of European contact. European exploration and settlement was not as rampant during this period. Temporary fish camps near the coast of present-day Martin County were their primary settlements (Archaeological and Historical Conservancy, Inc. 1998:16). The area which now constitutes the State of Florida was ceded to England in 1763 after two centuries of Spanish possession. England governed Florida until 1783 when the Treaty of Paris returned Florida to Spain; however, Spanish influence was nominal during this second period of ownership (1783-1821).

Prior to the American colonial settlement of Florida, portions of the Creek Nation and remnants of other Indian groups from Alabama, Georgia, and South Carolina moved into Florida and began to repopulate the vacuum created by the dissemination of the aboriginal inhabitants. The Seminoles, as these migrating groups of Indians became known, formed, at various times, loose confederacies for mutual protection against the new American Nation to the north (Tebeau 1971:72). One such attack in 1703 extended as far south as the Ais territory in the headwaters of the St. Johns River (Fairbanks 1871:179 in Rouse 1951:58). Adair (1930:489 in Rouse 1951:58) records a band of Creek Indians on a raid into south Florida who traveled up the St. Johns River to its headwaters and portaged through Ais territory to the Indian River, north of the project area.

The influx of white settlers and interference with native traditions began causing troubles for both groups. In order to pacify these hostilities and assimilate Americans from the north into Florida, the Spanish colonial government began providing large land grants. The large grants were awarded to those who would establish large plantations, in hopes that this would stabilize the hostile environment and stimulate economic growth. James Hutchinson received the first Spanish land grant within present-day Martin County in 1807, which consisted of 2,000 acres along the Indian River. By 1817, two additional land grants were awarded in Martin County. One of these was a 16,000 acre grant, which became known as the Hanson Grant, north of the Harmony Ranch project. The property owners, John M. Hanson, Samuel Miles, John I. Hedrick, and Bernardo Sequi, acquired the land in order to build a sawmill at the mouth of the St. Lucie River. The grant included the future settlements of Stuart, Salerno, Sewall's Point, and St. Lucie Farms (Archaeological and Historical Conservancy, Inc. 1998:19). The other grant was awarded in 1815 to Don Eusebio Maria Gomez of St. Augustine (Historical Records

Survey 1941; Archaeological and Historical Conservancy, Inc. 1998:19). The Gomez Grant covered 12,000 acres east of the Harmony Ranch project area. Fryman and colleagues report that Gomez was awarded this grant in 1815 in return for his military service and for transporting military supplies from Havana to St. Augustine (Fryman et al. 1980:24; Archaeological and Historical Conservancy, Inc. 1998:19). Supposedly, he established a plantation for growing sugarcane, coconuts and some citrus (Hutchinson 1987:24). He sold this grant in the 1820s (Fryman et al. 1980), though apparently his son, Emanuel, remained in the area until at least 1844 (Hutchinson 1987:25). According to the grant application, English settlements were present within the grant area, though no additional information was available on them (Historical Records Survey 1941:187).

The bloody conflict between the Americans and the Seminoles over Florida first came to a head in 1818, and was subsequently known as the First Seminole War. As a result of the war and the Adams-Onis Treaty of 1819, Florida became a United States Territory in 1821. Andrew Jackson, named provisional governor, divided the territory into St. Johns and Escambia Counties. At that time, St. Johns County encompassed all of Florida lying east of the Suwannee River (including present-day Martin County), and Escambia County included the land lying to the west. In an 1825 census, some 317 persons were reported living in south Florida (Hutchinson 1987:26).

Even though the First Seminole War was fought in north Florida, the Treaty of Moultrie Creek in 1823, at the end of the War, was to affect the settlement of all of south Florida. The Seminoles relinquished their claim to the whole peninsula in return for occupancy of approximately four million acres of reservation south of Ocala and north of Charlotte Harbor (Mahon 1967:46-50). The treaty never satisfied the Indians or the Anglo-American settlers. The inadequacy of the reservation and the desperate situation of the Seminoles living there, plus the mounting demand of the settlers for their removal, soon produced another conflict.

By 1835, the Second Seminole War was underway. The largest and bloodiest battle of the war occurred to the south near the present town of Okeechobee. The Battle of Lake Okeechobee, as it was known, took place on December 26, 1837. Following this event, the U.S. military established a strong presence in present-day Martin County. Fort McRae was constructed in present-day southeast Martin County. Although the exact site of this fort is not known, there is evidence that it existed where the St. Lucie Canal enters Port Myaca (8MT38) (Archaeological and Historical Conservancy, Inc. 1998: 21). In January 1838, a military camp was established along the St. Lucie River near Sewall's Point. Established by naval Lieutenant Levin M. Powell, the supply camp did not last long and was soon abandoned. Also in 1838, Fort Jupiter was established on a point of land overlooking Jupiter Inlet. It was here that the largest capture of Seminoles was made during the war. General Jessup had requested a truce with the Seminoles as he was trying to gain permission from the federal government to terminate the war by negotiating with the Indians to remain in the southern part of the peninsula. Tuskeegee and Hallec-Hojo agreed to the truce and arranged for their families to camp nearby and await the decision from the government. Washington rejected Jessup's proposal, and he felt that allowing the Indians return to the swamps would result in many lives being lost

in the attempts to recapture them. Thus, he commanded Colonel Twiggs and his Second Regiment of Dragoons to surround the Indian camp and take them all into custody (Hutchinson 1987).

The Second Seminole War lasted until 1842 when the federal government decided to end the conflict by withdrawing troops from Florida. Some of the battle-weary Seminoles were persuaded to migrate west where the federal government had set aside land for Native American inhabitation. However, those who were adamant about remaining were allowed to do so, but were pushed further south into the Everglades and Big Cypress Swamp. This area became the last stronghold for the Seminoles (Mahon 1967:321).

In 1842 Mosquito County, which included present-day Martin County, was formed from portions of St. Johns County. Encouraged by the passage of the Armed Occupation Act in this same year, designed to promote settlement and protect the Florida frontier, Anglo-American pioneers and their families moved south through Florida. The Act made available 200,000 acres outside the already developed regions south of Gainesville to the Peace River, barring coastal lands and those within a two mile radius of a fort. The Armed Occupation Act stipulated that any family or single man over 18 years of age able to bear arms could earn title to 160 acres by erecting a habitable dwelling, cultivating at least five acres of land, and living on it for five years. During the nine month period the law was in effect, 1184 permits were issued totaling some 189,440 acres (Covington 1961:48; Dunn 1989:24-25). In this part of the state, four settlement areas were occupied - Indian River colony (extending from the St. Lucie River north to the Sebastian River), Jupiter, Lake Worth, and Biscayne Bay areas. The Indian River colony was the largest (Hutchinson 1987:34-38). Between March and August 1843, permits documented 25 settlers and their families in present-day Martin County, a majority of whom resided near the St. Lucie River (Archaeological and Historical Conservancy, Inc. 1998:22-23).

In 1845, the Union admitted the State of Florida with Tallahassee as the state capitol. Santa Lucia County, which included present-day Martin County, was formed from portions of Mosquito County. It was during this time that the U. S. Government began land surveys in the project area. The exterior lines of Township 39 South, Range 41 East were surveyed in 1845 by George Houston (State of Florida 1845). The interior (Section) lines were surveyed by M.A. Williams in 1853 (State of Florida 1853). Williams described the area of the Harmony Ranch project area as third rate pinelands and ponds (State of Florida 1853:366). The resulting plat depicts no manmade features including roads, trail, forts, or villages within the project area (State of Florida 1854).

In December of 1855, the Third Seminole War, or Billy Bowlegs War, began as the result of pressure placed on Native Americans remaining in Florida to move west (Covington 1982). The War started in present-day Collier County when Seminole Chief Holatter-Micco, Billy Bowlegs, and 30 warriors attacked an army camp killing four soldiers and wounding four others. The attack was in retaliation for damage done by several artillerymen to property belonging to Billy Bowlegs. This hostile action renewed

state and federal interest in the final elimination of the Seminoles from Florida. As a result, several regional military posts were established (Tebeau 1966). In the early part of 1857, Captain W. Stevens attacked a group of Seminoles just south of Fort McRae. This skirmish became known as Steven's Ambuscade (Archaeological and Historical Conservancy, Inc. 1998:26).

Military action was not decisive during the war; therefore, in 1858 the U.S. Government resorted to monetary persuasion to induce the remaining Seminoles to migrate west. Chief Billy Bowlegs accepted $5,000 for himself, and $2,500 for his lost cattle; each warrior received $500, and $100 was given to each woman and child. On May 4, 1858, the ship *Grey Cloud* set sail from Fort Myers with 38 Seminole warriors and 85 Seminole women and children. Stopping at Egmont Key, 41 captives and a Seminole woman guide were added to the group. This made a total of 165 Seminoles migrating west. On May 8, 1858, the Third Seminole War was declared officially over (Covington 1982:78-80).

In 1861, Florida followed South Carolina's lead and seceded from the Union in a prelude to the American Civil War. Florida had much at stake in this war as evidenced in a report released from Tallahassee in June of 1861. It listed the value of land in Florida's 35 counties as $35,127,721 and the value of the slaves in the state at $29,024,513 (Dunn 1989:59). Blockade running became the primary industry on the east coast of Florida, especially in the inlets along the Indian River, which were outside the main transportation routes. Even though the coast of Florida experienced a naval blockade during the war, the interior of the state saw very little military action. One of the major contributions of the state to the war effort was in the supplying of beef to the Confederate Government. The war lasted until 1865, when General Robert E. Lee surrendered to General U.S. Grant at Appomattox Courthouse in Virginia.

Immediately following the war, the South underwent a period of "Reconstruction" to prepare the Confederate States for readmission to the Union. The program was administered by the U.S. Congress, and on July 25, 1868, Florida officially returned to the Union (Tebeau 1971:251). Expeditions to present-day Martin County began occurring at this time, and the area soon became known for its fishing, hunting, and camping. During this Reconstruction period, Florida's financial crisis, born of pre-war railroad bonded indebtedness, led Governor William Bloxham to search for a buyer for an immense amount of state lands. Bloxham's task was to raise adequate capital in one sale to free from litigation the remainder of state lands for desperately needed revenue. In 1881, Hamilton Disston, a Philadelphia investor and friend of Governor Bloxham, purchased four million acres from the State of Florida in order to clear the state's debt. This transaction, which became known as the Disston Purchase, enabled the distribution of large land subsidies to railroad companies, inducing them to begin extensive construction programs for new lines throughout the state. Hamilton Disston and the railroad companies in turn sold smaller parcels of land to developers and private investors.

When settlers first arrived in the general project area, it was part of Dade County. A lighthouse was built at Jupiter Inlet in 1859 (Hutchinson 1987:41). The Gilbert's Bar House of Refuge was built in 1876, and homesteaders soon began to settle in the area. Many came to grow pineapples or enjoy the excellent fishing (USDA 1981). However, the 1880 federal census only shows four residents in present-day Martin County; it was during the late 1880s that the earliest settlements were established (Archaeological and Historical Conservancy, Inc. 1998:29).

Henry M. Flagler, a partner with John D. Rockefeller in Standard Oil, visited Florida in 1878, and decided to build a hotel in St. Augustine and a railroad to reach it from Jacksonville. Eventually, this developed into a string of hotels and a railroad which stretched the length of the east coast of Florida. One of the flag stops along the way was "Alicia", the future site of Salerno. Flagler named this stop after his second wife (Hutchinson 1987:187). At that time, the village consisted mostly of fishermen. By the turn of the century, there were stations at Stuart (at that time known as Potsdam), Jensen, Rio (where the water tower was located [St. Lucie]), Salerno, Fruita, Gomez, and Hobe Sound (Hutchinson 1987:198).

Although the State of Florida initially was very generous with the sale of public lands to Flagler, when the federal government learned of the "sweetheart deals", the transactions were terminated. Undaunted, Flagler simply acquired the land necessary for his railroad from third party corporations (Brown and Hudson 1993). One such company was the Florida Coast Line Canal and Transportation Company which purchased all of the property within the Harmony Ranch study area on December 1, 1900 (State of Florida n.d.:187).

In 1905, the lands north of the St. Lucie River became part of St. Lucie County, which had been carved from southern Brevard County. In 1909, the state legislature created Palm Beach County from a portion of Dade County (Curl 1986:57). In order to make more land available for agricultural development in the area and provide adequate water transportation, the Everglades Drainage District was established around this time. The St. Lucie Canal (8MT1316) was constructed from 1911 to 1917, as one of six primary canals in the drainage district. The canal stretches from Lake Okeechobee to the St. Lucie River in present-day Martin County. The area continued to develop and some 500 people resided in Stuart by 1916 when electric service came to town. Due to the increase in population and development in the area, the canal began being used to control flooding in the area for residential developments rather than for agricultural development. In 1925, Martin County was formed from the northern portion of Palm Beach County and a small portion of southern St. Lucie County, with Stuart as the county seat.

A land boom occurred in Florida from the early to mid-1920s. Several incidents prompted the boom, including the mild winters, growing number of tourists, the larger use of the automobile, completion of roads, prosperity of the 1920s, and the promise by the state legislature never to pass state income or inheritance taxes. The Dixie Highway (now U.S. 1) network of roads, completed at this time, connected south Florida to the rest

of the nation. In addition, pineapple plantations and citrus groves were transformed into subdivisions with Spanish-influenced architecture (Hutchinson 1987:215).

By 1926-27, the bottom fell out of the Florida real estate market. Massive freight car congestion from hundreds of loaded cars sitting in railroad yards caused the Florida East Coast Railway to embargo all but perishable goods in August of 1925. The embargo spread to other railroads throughout the state and, as a result, most construction halted. By October, rumors were rampant in northern newspapers. To counteract the reports, T. Coleman du Pont, chairman of the Mizner Development Corporation, held a public meeting to try to convince the public that the increase in property values represented real worth. However, the next week du Pont and several other board members resigned in a public letter to the *New York Times*. Du Pont brought stability to the Corporation, which was undertaking the development of Boca Raton. After the public letter, confidence in the Florida real estate market quickly diminished, investors could not sell lots, and the Great Depression hit Florida earlier than the rest of the nation (Curl 1986:84-84).

To make the situation even worse, two hurricanes hit the area in 1926 and 1928. Soon after the collapse of the Florida Land Boom, the October 1929 stock market crash and the onset of the Great Depression left residents with damaged houses and little money or business to rebuild. Residents survived on the fish and fruits, which were plentiful in the area. By the mid-1930s, federal programs, implemented by the Roosevelt administration, started employing large numbers of construction workers, helping to revive the economy of the state. The programs were instrumental in the construction of parks, bridges, and public buildings. A bridge over the St. Lucie River was constructed in 1933, resulting in hundreds of worker applications for only a few jobs (Hutchinson 1987:216).

At this time, commercial fishing became economically important. The arrival of the railroad and the availability of ice made the shipment of fish possible. Most folks who had access to the water hung out nets to supplement their incomes. The shark industry also became important in the 1940s. All parts of the shark were used for some purpose, ranging from vitamin capsules to hog feed. Also during this time, flower production became important economically. According to Hutchinson (1987:286), chrysanthemums and pompons were forced to bloom all year through the use of artificial lights and shades.

The growth of tourism in the late 1930s and early 1940s prompted the recovery of the state from the Depression. Although the Depression virtually destroyed the hotel business, motels continued to thrive because vacationers continued to travel by automobile. After the war, car ownership increased, making the American public more mobile. Many who had served at Florida's military bases during the war also returned with their families to live. Florida's population increased from 873,891 to 2,771,305 from 1940 to 1950 (Dunn 1989).

Largely, the post-World War II development of Martin County is similar to that of the rest of America: increasing numbers of automobiles and asphalt, an interstate

highway system, suburban sprawl, and strip development along major state highways. The United States Census reported the 2000 population of Martin County to be 126,731 (United States Census Bureau 2000).

5.0 RESEARCH CONSIDERATIONS AND METHODS

5.1 Background Research and Literature Review

A comprehensive review of archaeological and historical literature, records and other documents and data pertaining to the project area was conducted. The focus of this research was to ascertain the types of cultural resources known in the project area and vicinity, their temporal/cultural affiliations, site location information, and other relevant data. This included a review of sites listed in the NRHP, the Florida Master Site File (FMSF), cultural resource survey reports, published books and articles, unpublished manuscripts, and maps. No informant interviews were conducted during this survey. FMSF digital data used in this report were obtained on March 4, 2004.

5.1.1 Archaeological Considerations

For archaeological survey projects of this kind, specific research designs are formulated prior to initiating fieldwork in order to delineate project goals and strategies. Of primary importance is an attempt to understand, on the basis of prior investigations, the spatial distribution of known resources. Such knowledge serves not only to generate an informed set of expectations concerning the kinds of sites which might be anticipated to occur within the project area, but also provides a valuable regional perspective and, thus, a basis for evaluating any new sites discovered.

A review of the FMSF indicated that no archaeological sites were recorded previously within the project area, however, two sites are located within two mile of the Harmony Ranch project area (Figure 5.1). The Phipps Park Site (8MT386) consists of a single Sand-tempered plain pottery sherd. This artifact is not diagnostic and no cultural affiliation can be identified for the site. By today's standards, this site would be considered as an archaeological occurrence rather than an archaeological site.[1] The St. Lucie Canal Site (8MT1316) was recorded during the cultural resource assessment survey of the Gulfstream Natural Gas Pipeline (Janus Research 2000). This historic canal was excavated to assist in flood control. Other cultural resource research conducted in the Harmony Ranch project vicinity includes the survey of the Cane-Bridge-Plumosus 230 kV Transmission Line (Fuhrmeister and Hardin 1991) and the investigation of a Florida Gas Transmission Company expansion project (Athens et al. 1993). In 1995, Robert Carr conducted an archaeological survey of Martin County during which many archaeological sites were recorded (Carr 1995). However, none of the sites discovered during this survey is located in the vicinity of the project area.

[1] The FMSF defines an "archaeological occurrence" as one or two non-diagnostic artifacts not known to be distant from their original context which fit within a hypothetical cylinder of thirty meters regardless of depth below surface (FMSF 1999).

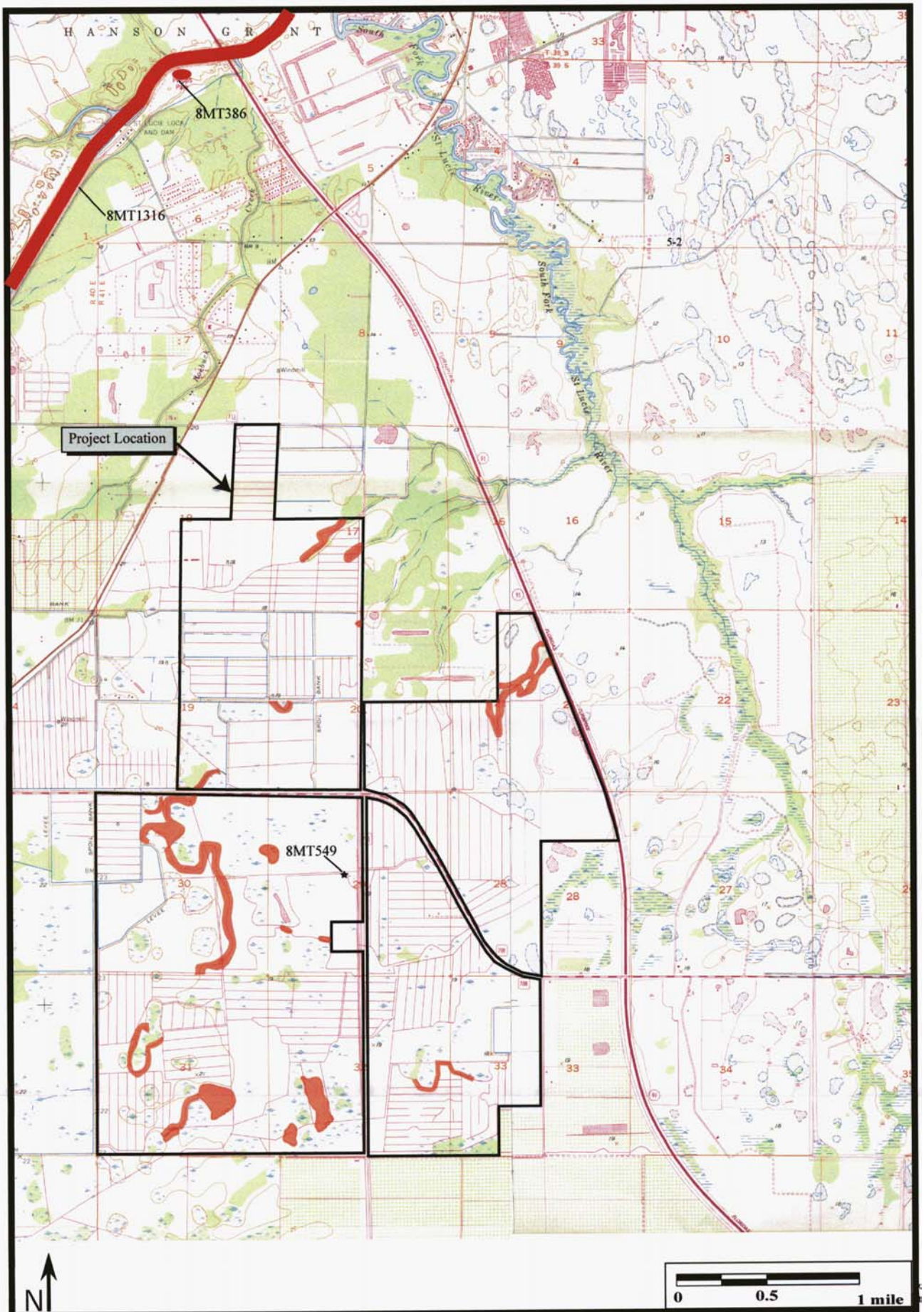


Figure 5.1. Zones of Archaeological Potential (ZAPs) and Previously Recorded Cultural Resources. (■) denotes moderate ZAP, the remainder of the project is a low ZAP. Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983).

On the basis of these and other data from survey and excavations in the region (Carr 1995), informed expectations concerning the types of prehistoric sites and the probability for their occurrence within the project area were generated. As archaeologists have long realized, aboriginal populations did not select their habitation sites and special activity areas in a random fashion. Rather, many environmental factors had a direct influence upon site location selection. Among these variables are soil drainage, distance to freshwater, relative topography, and proximity to food and other resources including stone and clay. On the basis of the aforementioned projects, comparative site locational data for Martin and surrounding counties indicate a pattern of site distribution favoring the relatively better drained terrain like ridges and knolls proximate to rivers, lakes, and other freshwater sources.

Utilizing background research and known patterns of aboriginal settlement, a research design for the Harmony Ranch project was prepared (ACI 2004; Appendix A). Zones of Archaeological Potential (ZAPs) were identified in the research design and are reproduced in Figure 5.1. ACI's research design was approved by the Florida Division of Historical Resources in May of 2004 (Appendix B). Archaeological sites, if found, were expected to be shell and/or black dirt middens and possibly small artifact scatters containing lithic or ceramics. Based on the results of the historic research, as detailed in the Historical Overview, no nineteenth century homesteads, forts, military trails, or Indian encampments were expected within the project area.

5.1.2 Historical/Architectural Considerations

A review of the FMSF revealed that one historic resource had been recorded previously within the project area. The Becker Grove Site (8MT549) was located in the central portion of the Harmony Ranch property in the northwest quarter of Section 29, Township 39 South, Range 41 East (Figure 5.1.). This ca. 1945 Frame Vernacular style residence, recorded during the Historical and Architectural Survey of Martin County (Stevensons Architects, Inc. 1995), was located at 1765 State Road 711, within the project area. This altered structure was considered locally but not eligible for listing in the NRHP (Appendix C).

A review of the USGS Indiantown SE, (1953, PR 1983) and Gomez, Fla. (1948, PR 1983) did not indicate the presence of any other buildings 50 years of age or older. However, USGS quadrangle maps do not typically depict outbuildings and secondary features. Therefore, in consideration of the extensive agricultural land use history of the parcel (including citrus grove and cattle ranching), the potential presence of farm structures such as cattle dip vats, windmills, and silos was recognized.

5.2 Field Methodology

Archaeological field methods consisted of a visual reconnaissance survey of the project area. Following ground surface inspection, subsurface shovel testing was carried out to test for the presence of buried cultural deposits. Subsurface testing was conducted at 50 m (164 ft) intervals, as well as judgmentally. Shovel tests were circular, and

measured approximately 0.5 m (20 in) in diameter by at least 1 m (3.3 ft) in depth. All soil removed from the test pits was screened through 6.4 mm (0.25 in) mesh hardware cloth to maximize the recovery of artifacts. The locations of all shovel tests were plotted on the aerial photographs and, following the recording of relevant data such as stratigraphic profile, all test pits were refilled.

The historical/architectural field methods focused on reevaluation of the Becker Grove House (8MT549) and the identification of any additional historic structures believed to be 50 years of age or older within the project area. If found, an in-depth study of each identified historic resource will be undertaken. Photographs and information required for the completion of FMSF forms will be gathered. Each resource will be evaluated for its NRHP eligibility in addition to its possible contribution to a historic district.

5.3 Laboratory Methods/Curation

If found, all cultural materials were to be initially cleaned and sorted by artifact class. Lithic debitage was to be subjected to a limited technological analysis focusing on the stages of stone tool production. Recovered flakes and non-flake production debris (i.e., cores, blanks, preforms) were to be measured, and examined for raw material type and absence or presence of thermal alteration. Flakes, if found, would be classified into four types (primary decortication, secondary decortication, non-decortication, and shatter) on the basis of the amount of dorsal surface cortex (White 1963). Discovered ceramics were to be classified by standard typology (Griffin 1988; Willey 1949).

All project related record (site maps, field forms, etc.) are being curated at Archaeological Consultants, Inc., unless the client requests otherwise.

5.4 Unexpected Discoveries

It was anticipated that if human burial sites such as Indian mounds, lost historic and prehistoric cemeteries, or other unmarked burials or associated artifacts were found, then the provisions and guidelines set forth in Chapter 872 F.S. (Florida's Burial Law) would be followed. However, it was not anticipated that such sites would be found during this survey.

6.0 SURVEY RESULTS AND CONCLUSIONS

6.1 Archaeological Survey Results

Archaeological field survey included both ground surface reconnaissance and the excavation of 199 shovel tests within the Harmony Ranch project area (Figures 6.1 to 6.4). Shovel tests were excavated systematically at 50 m (164 ft) intervals as well as judgmentally. As a result of the archaeological survey, no archaeological sites were discovered. Typical stratigraphy of the Harmony Ranch project area consisted of an upper 20 cm of black topsoil, underlain by 70 cm of brown sand, beneath which is 10 cm of gray sand.

6.2 Historical/Architectural Survey Results

The Historical/Architectural survey focused on the reevaluation of the Becker Grove House (8MT549). This ca. 1945 Frame Vernacular style residence was centrally located within the Harmony Ranch property (Section 29, Township 39 South, Range 41 East; Figure 6.3). Recorded during the Historical and Architectural Survey of Martin County (Stevensons Architects, Inc. 1995), this residence which had been altered, was considered locally significant, but was not considered eligible for listing in the NRHP (Appendix C).

The Historical/Architectural survey of the Harmony Ranch project area determined that the Becker Grove House (8MT549) is no longer extant. The area where the house was originally located is now pasture and no evidence remains of this structure. The original FMSF form for this resource has been updated to reflect the change in status of this building (Appendix D).

In addition to the reevaluation of the Becker Grove House, the Historical/Architectural survey identified a potentially historic windmill within the Harmony Ranch project area. The site description follows and the FMSF form for this resource is located in Appendix E:

The Harmony Ranch Windmill and Water Trough (8MT994) is located in the northwest quarter of Section 29, Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983; Figure 6.3.). The Aermotor manufactured windmill stands 12 ft in height with four steel legs (Photo 6.1). The 18 aluminum blade windmill rests on a concrete slab and is used to pump water for cattle. The well is located beneath the windmill and a concrete water trough is located on the west side of the windmill. The trough measures some 5 ft in length, 3 ft in width, and 2.5 ft in depth. Signage on the windmill motor reads "Aermotor Company, Chicago" and the name "Geo. Oliver of Stuart" is stenciled on the gearbox. A partially legible stamp on the bottom of the

gearbox reads "702" indicating a manufacture date of 1934 or later (Dockal 2004). It is unclear if this structure is 50 years of age or older.

The Harmony Ranch Windmill and Water trough is typical of agricultural construction found throughout Florida and available historic information does not suggest any significant historical associations with this site. 8MT994 is not considered locally significant and is not considered eligible for listing in the NRHP.

6.3 Conclusions

In conclusion, no significant cultural resources, including archaeological sites and historic structures which are listed, determined eligible, or considered eligible for listing in the NRHP are contained within the proposed Harmony Ranch property. Thus, no further work is recommended.

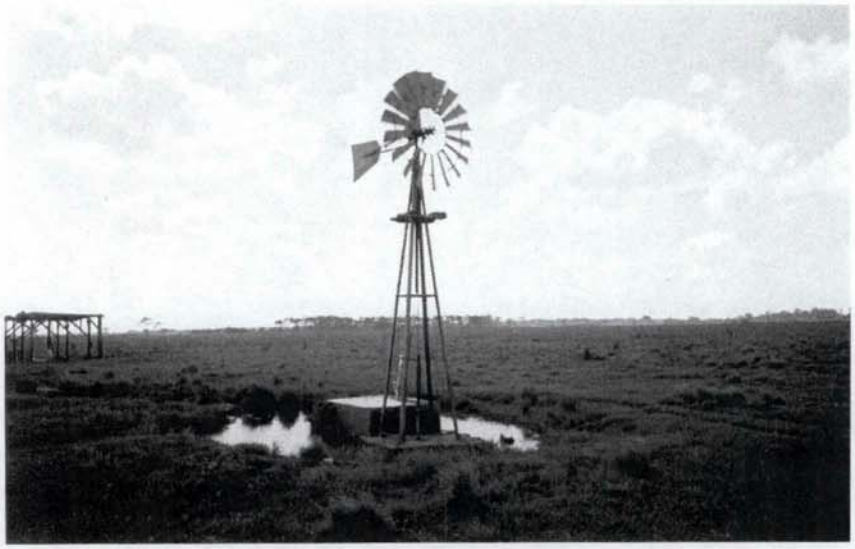


Photo 6.1. Looking Northwest Toward Potentially-Historic Harmony Ranch Windmill and Water Trough (8MT994).

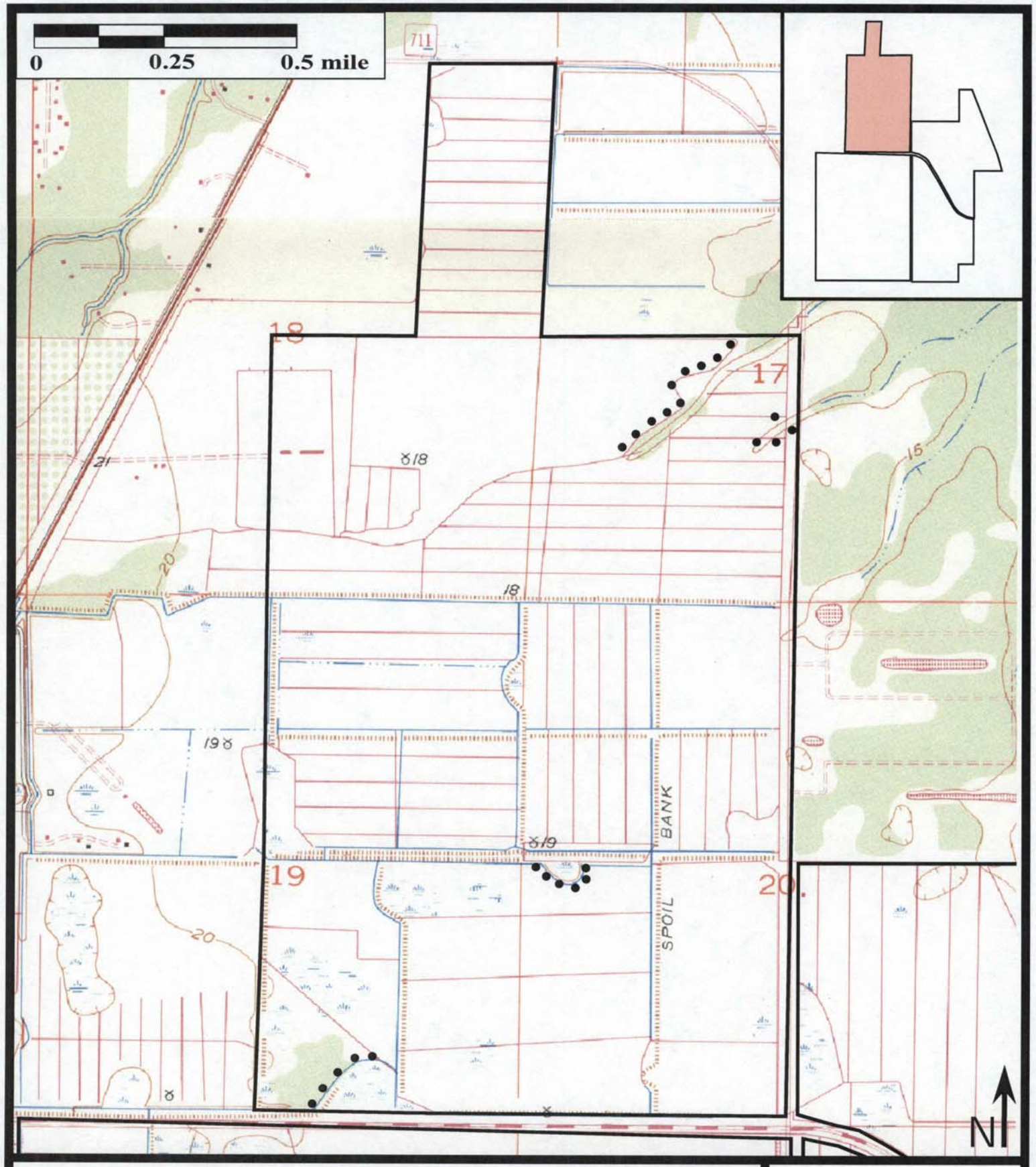


Figure 6.1. Approximate Location of Shovel Tests Within the Harmony Ranch Project Area; Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983). Testing based on approved research design, Appendix F.

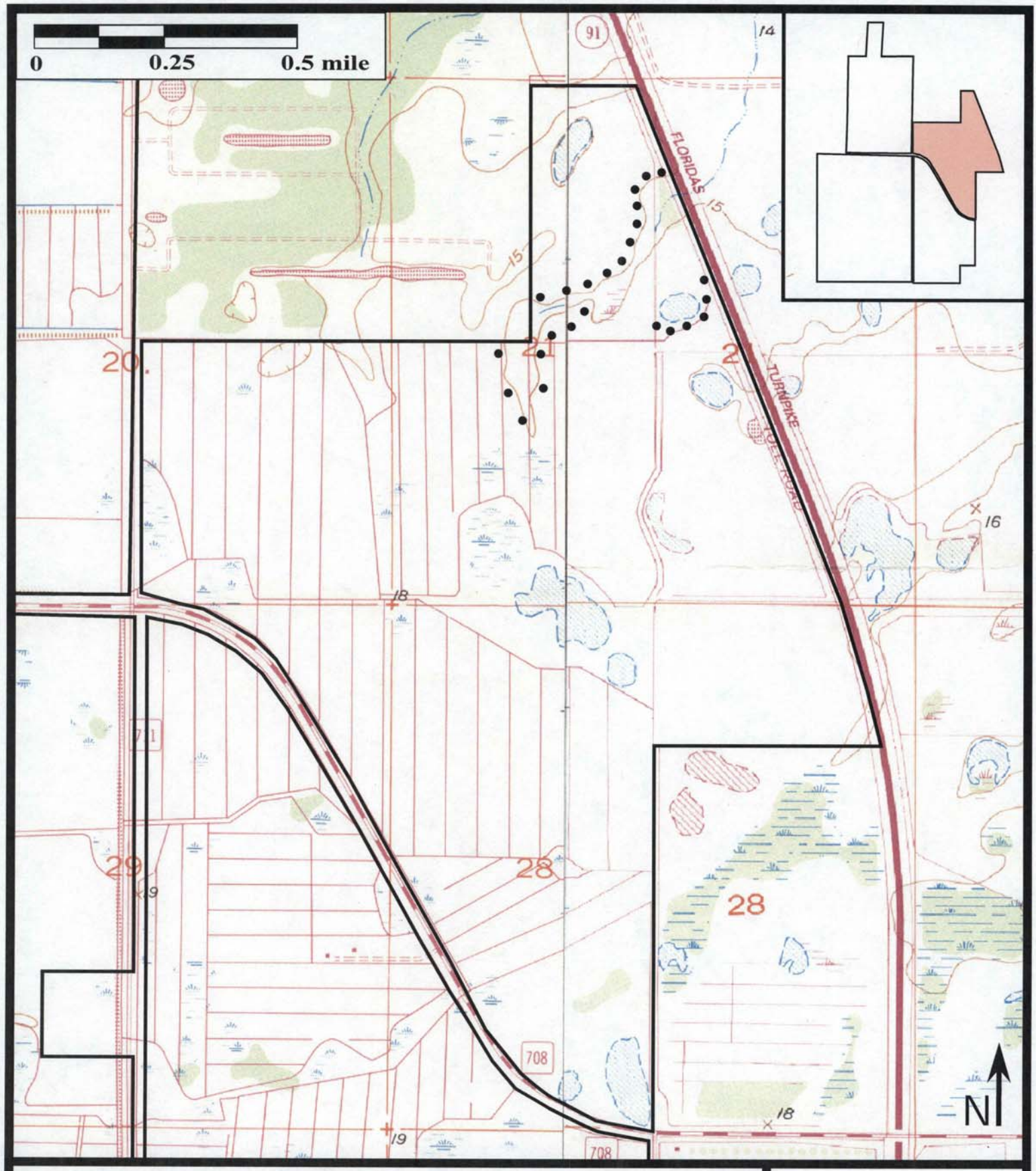


Figure 6.2. Approximate Location of Shovel Tests Within the Harmony Ranch Project Area; Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983). Testing based on approved research design, Appendix F.

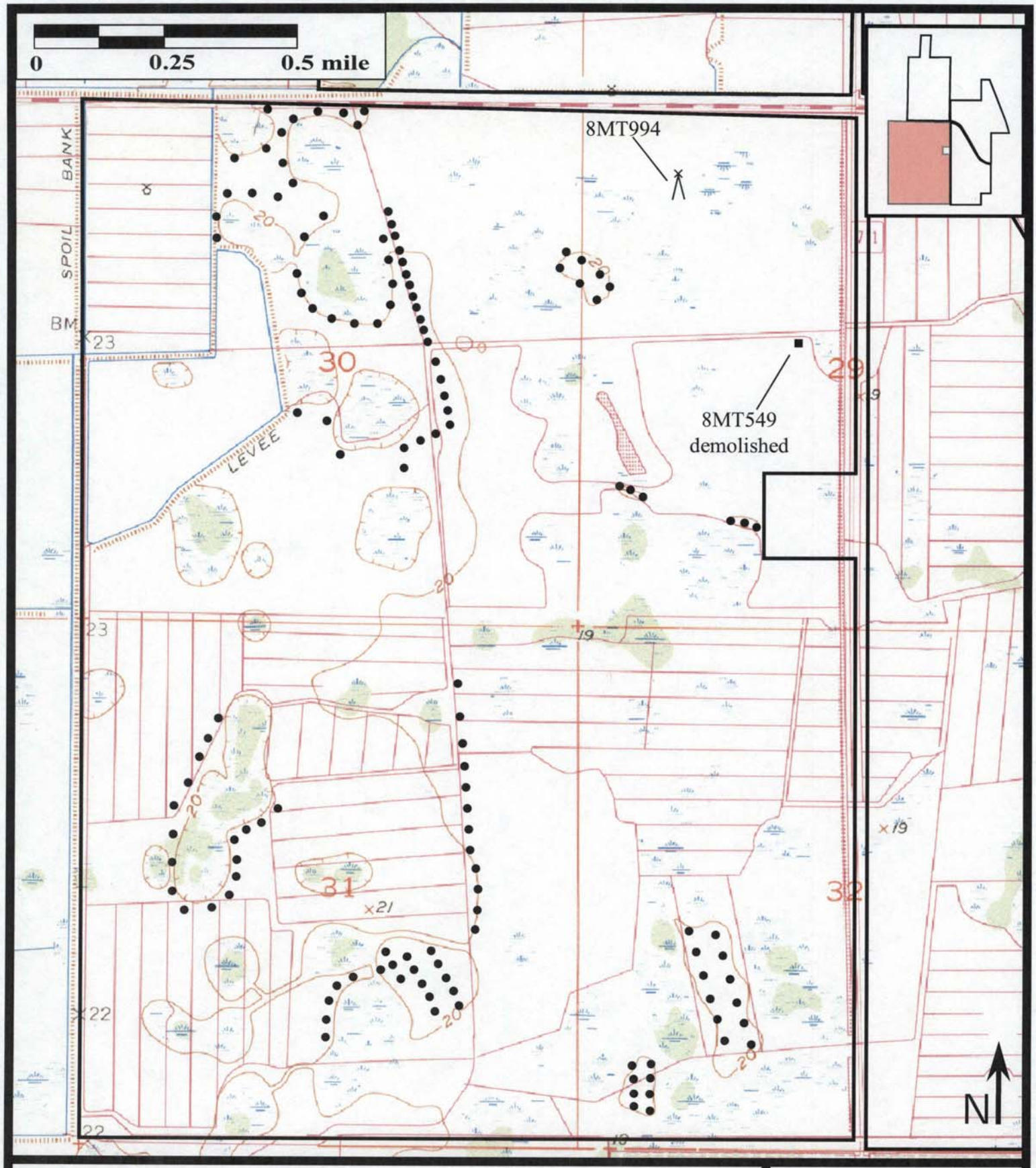


Figure 6.3. Approximate Location of Shovel Tests and Previously and Newly Recorded Historic Resources Within the Harmony Ranch Project Area; Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983). Testing based on approved research design, Appendix F.

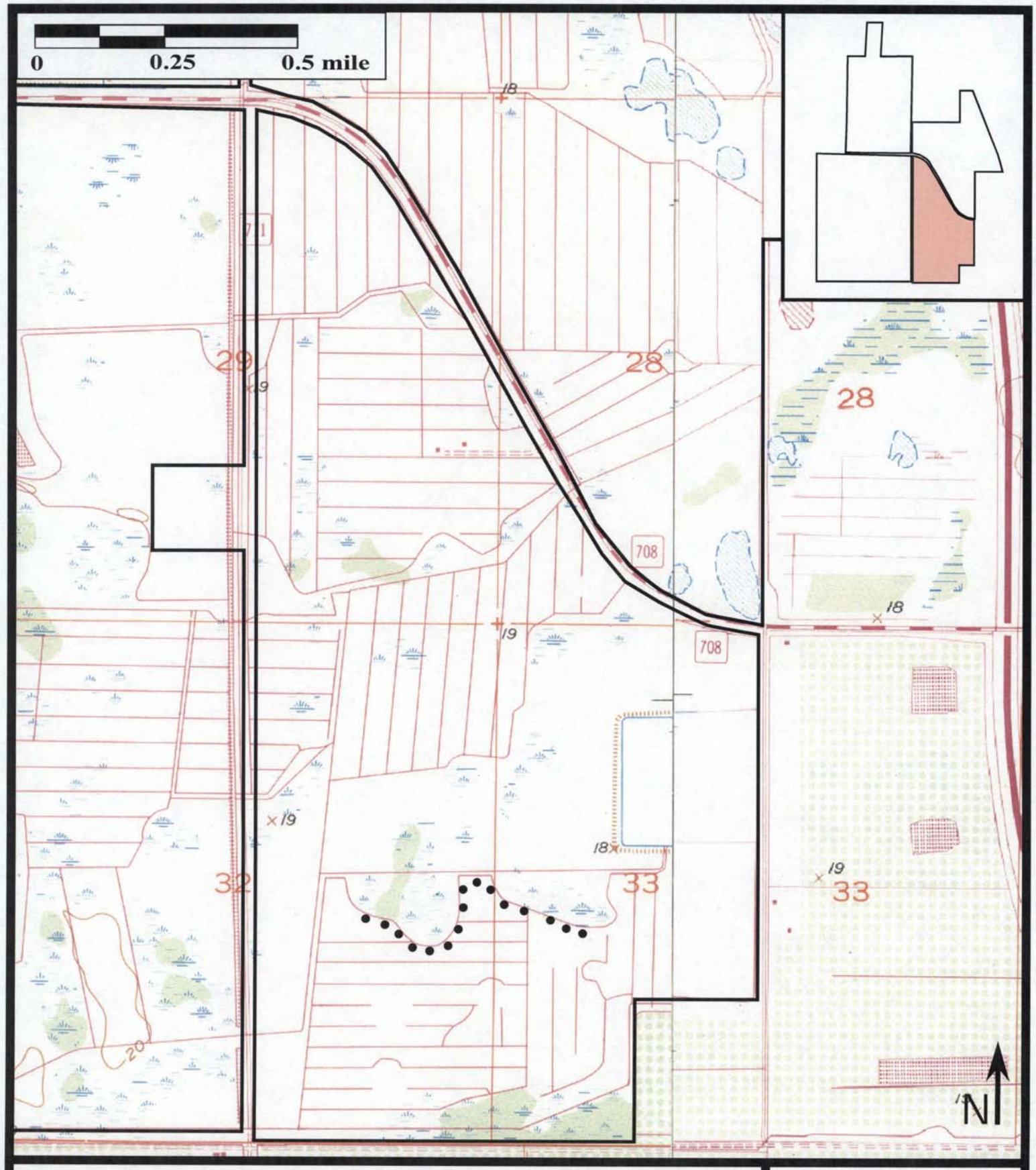


Figure 6.4. Approximate Location of Shovel Tests Within the Harmony Ranch Project Area; Township 39 South, Range 41 East (USGS Indiantown SE, Fla. 1953, PR 1983 and Gomez, Fla. 1948, PR 1983). Testing based on approved research design, Appendix F.

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APPENDIX A: Zones of Archaeological Probability – Harmony Ranch, Martin County, Florida

ARCHAEOLOGICAL CONSULTANTS INC.

ARCHAEOLOGICAL SURVEYS AND EXCAVATIONS

HISTORIC BUILDING SURVEYS AND EVALUATIONS

ARCHIVAL RESEARCH

CULTURAL RESOURCE ASSESSMENTS

NATIONAL REGISTER NOMINATIONS

INTERPRETIVE DISPLAYS

PRESERVATION PLANNING

May 5, 2004

Ms. Laura Kammerer
Division of Historical Resources
Review and Compliance Section
500 S. Bronough St., RA Gray Bldg
Tallahassee, FL 32399-0250

RE: Zones of Archaeological Probability – Harmony Ranch
Martin County, Florida

Dear Ms. Kammerer:

Archaeological Consultants, Inc. (ACI) is providing cultural resource services for the Harmony Ranch project area located in Sections 17, 18, 19, 20, 21, 28-33 of Township 39 South, Range 41 East in Martin County (Figure 1). More specifically, the project is between SR 76 and SR 91, just west of I-95; SR 70 bisects the project area (Figure 2). The purpose of this effort is to determine Zones of Archaeological Potential (ZAPs) for those areas within the Harmony Ranch project area most likely to contain previously undiscovered archaeological resources prior to field survey. We are requesting your review and approval of our research considerations, proposed field methodology, and laboratory procedures before initiating the field survey of this project.

Background Research and Literature Review

ACI conducted a review of pertinent archaeological literature, records and data to determine the types of cultural resources known in the project area, their temporal/cultural affiliations, site location information, and other relevant data. This included a review of sites listed in the National Register of Historic Places (NRHP), the Florida Master Site File (FMSF), cultural resource survey reports, published articles and unpublished manuscripts and maps, and data from the files of ACI.

The purpose of this preliminary archaeological assessment is to: 1) determine, on the basis of prior investigations, the spatial distribution of known (recorded) archaeological resources in the area; 2) generate an informed set of expectations concerning the kinds of sites which might be anticipated to occur within the project, and; 3) provide a regional perspective for evaluating any discovered sites.

A Full Service Cultural Resource Management Company

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American Cultural Resource Association

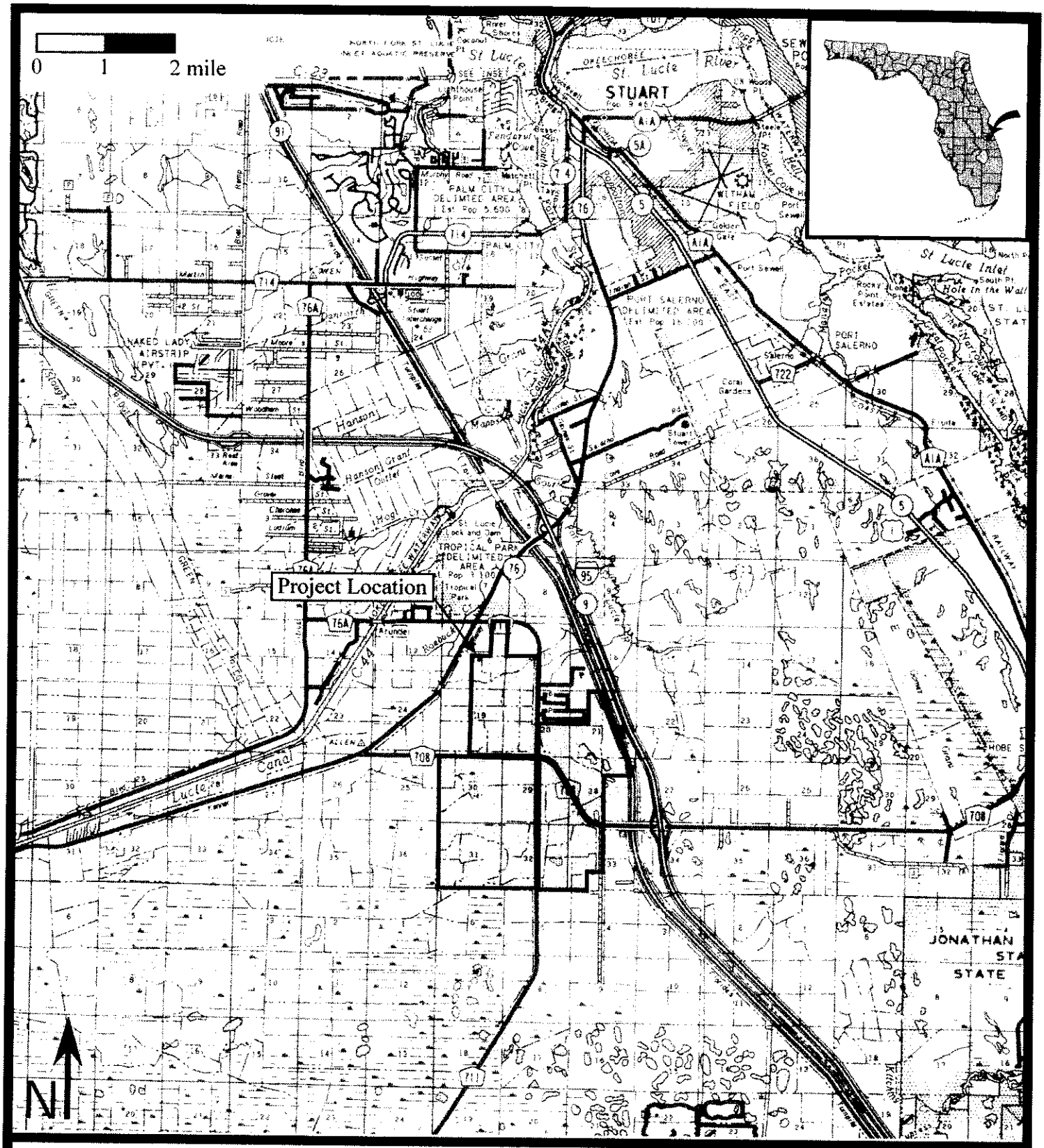


Figure 1. Harmony Ranch Project Area, Township 39 South, Range 41 East, Martin County (State Topographic Office 1985).

Archaeological Background: A review of the FMSF indicated that there are no previously recorded archeological sites in the project area. However, data from surveys in environmentally similar areas in Martin County (Fuhrmeister 1991; Athens 1993; Bland 1998; ACI 2001, 2003) and county-wide assessments (Carr 1995a, 1998) provide information concerning the types and locations of sites expected to occur within the project boundaries. As archaeologists have long realized, aboriginal populations did not select their habitation sites and special activity areas in random fashion. Rather, many environmental factors had a direct influence upon site location selection. Among these variables are distance to freshwater, soil drainage, relative topography, and proximity to food and other resources including stone and clay.

In general, the proximity to a source of freshwater including lakes, sloughs, rivers, creeks, wet prairies, and marshes is the key to prehistoric site location. In addition, elevated margins adjacent to these freshwater sources correlate with prehistoric site occurrence regardless of soil drainage. Within the Harmony Ranch project area, the soils are poorly drained and for the most part support a flatwoods type of vegetation interspersed with some hammock vegetation (Table 1). Also, the terrain is nearly level with very little relief (Figure 2).

Soil Type	Relief/Drainage/Environment
Boca fine sand	Nearly level, poorly drained; Flatwoods
EauGallie fine sand	Nearly level, poorly drained; Flatwoods
Floridana fine sand, depressional	Nearly level, very poorly drained; Sloughs, Depressions
Holopaw fine sand	Nearly level, poorly drained; Drainageways
Malabar sand	Nearly level, poorly drained; Flatwoods & Sloughs
Oldsmar fine sand	Nearly level, poorly drained; Flatwoods
Oldsmar fine sand, depressional	Nearly level, poorly drained; Depressions
Pineda sand	Nearly level, poorly drained; Grassy Flats
Pinellas fine sand	Nearly level, poorly drained; Flatwoods, Hammock
Rivera fine sand	Nearly level, poorly drained; Flats & Drainageways
Rivera fine sand, depressional	Nearly level, poorly drained; Depressions
Tequesta variant muck	Nearly level, poorly drained; Depressions & Marsh
Wabasso sand	Nearly level, poorly drained; Flatwoods
Wabasso sand, depressional	Nearly level, poorly drained; Depressions

Table 1. Project Area Soils and Their Characteristics.

In applying these known site location predictive factors to the project area, ACI determined that a number of locales have a moderate potential for prehistoric site occurrence. Specifically, these include the areas on the slightly elevated terrain within the pine flatwoods and hammock areas above the surrounding wetlands. Sites anticipated to be found include shell and/or black dirt middens and possibly small artifact scatters containing lithics or ceramics. The moderate ZAPs are noted on Figure 2.

For historic period archaeological sites, the data contained in the 19th century federal surveyors plats and field notes were reviewed (State of Florida 1845a, 1845b, 1853) as well as the Martin County soil maps (USDA 1981). Given the results of the literature review, no historic period archaeological sites, including 19th century homesteads, forts, military trails, or Indian encampments are expected.

Historic Structures: Background research at the FMSF revealed that one structure had previously been recorded within the project area. 8MT549 is a Frame Vernacular style structure which was evaluated as not eligible for listing in the NRHP (Carr 1995b). If this structure still exists within the project area, then it will be updated. Additional research, which included a review of the Martin County soils maps and the Gomez and Indiantown SE SGS quadrangles did not reveal the potential for additional structures. However, if structures (50 years of age or older) are observed, they will be recorded in the FMSF and evaluated for NRHP eligibility.

Survey Methodology

ACI will follow standard state procedures: moderate ZAPs will be tested at a 50 m (164 ft) interval and the low ZAPs will be subjected to a visual reconnaissance and judgmentally tested as deemed appropriate. Other than the moderate ZAPs noted in Figure 2, the remainder of the property is considered a low ZAP, mainly as a result of the land altering activities (such as ditching and disturbances associated with road construction) that have occurred in and adjacent to the Harmony Ranch project area.

Shovel tests will be circular and measure approximately .5 m (20 in) in diameter by at least 1 m (3.3 ft) in depth, conditions permitting. All soil removed from the test pits will be screened through a 6.4 mm (.25 in) mesh hardware cloth to maximize the recovery of artifacts. The locations of all shovel tests will be plotted on aerials, and, following the recording of relevant data such as stratigraphic profile and artifact finds, all test pits will be refilled.

Laboratory Procedures

Artifacts will be cleaned and sorted by artifact class. Lithics will be divided into tools and debitage on the basis of gross morphology. Tools will be measured, and the edges examined with a 10x hand lens for traces of edge damage. Lithic debitage will be subjected to a limited technological analysis focused on ascertaining the stages of stone tool production. Flakes and non-flake production debris (i.e., cores, blanks, preforms) will be measured and examined for raw material type and absence or presence of thermal alteration. Flakes will be classified into four types (primary decortication, secondary decortication, non-decortication, and shatter) on the basis of the amount of cortex on the dorsal surface and the shape. Aboriginal ceramics will be

classified into commonly recognized types based upon observable characteristics such as paste and surface treatment. Faunal material will be subjected to a limited analysis in order to determine the types of food resources being consumed.

All recovered artifacts and associated records will be housed at Archaeological Consultants, Inc. in Sarasota, pending transfer for curation, at the client's request.

Unexpected Discoveries

If human burial sites such as Indian mounds, lost historic and prehistoric cemeteries, or other unmarked burials or associated artifacts are found, then the provisions and guidelines set forth in Chapter 872, F.S. (Florida's Unmarked Burial Law) will be followed. Although burial mounds have been recorded in the general region, it is not anticipated that such sites will be found within the Harmony Ranch project area.

Report

Following completion of field survey and laboratory procedures, ACI will prepare and forward to you a cultural resource assessment report which will comply with Chapter 1A-46, Florida Administrative Code and with Chapters 267 and 373, *Florida Statutes,* Florida Coastal Management Program, and implementing state regulations regarding possible impact to significant historical properties.

In closing, ACI thanks you for reviewing our research considerations, proposed field methodology and laboratory procedures. If you need additional information or have a question, please call me.

Sincerely,

Lee Hutchinson, RPA
Project Manger
LH/jlm

Attachment: References Cited, Figures
xc: Paul Ezzo, EW Consulting

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1995b A Historic Architectural Survey of Martin County, Florida. Manuscript on file, The Archaeological and Historical Conservancy, Inc., Miami.
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State of Florida
1845a Plat, Township 39 South, Range 41 East.
1845b Field Notes, Township 39 South, Range 41 East.
1853 Field Notes, Township 39 South, Range 41 East.

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1981 *Soil Survey of Martin County, Florida.* Soil Conservation Service, Washington, D.C.

United States Geological Survey (USGS)
1948 Gomez, Fla. Photorevised 1983
1953 Indiantown SE, Fla. Photorevised 1983

APPENDIX B: Florida Division of Historical Resources Letter of Concurrence

FLORIDA DEPARTMENT OF STATE
Glenda E. Hood
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Ms. Lee Hutchinson, RPA
Archaeological Consultants, Inc.
8110 Blaikie Court - Suite A
Sarasota, Florida 34240

May 18, 2004

RE: DHR No. 2004-4167
Harmony Ranch
Zones of Archaeological Probability and Survey Methodology
Martin County, Florida
Job No. P04055

Dear Ms. Hutchinson:

Our office received the above referenced documentation May 11, 2004. At your request we reviewed the project location and the delineated zones of archaeological probability (ZAP) and the proposed survey methodology. It is the opinion of this agency that the ZAPs survey methodology (and research design) is soundly based on current archaeological standards and methods. We concur with the proposed methodology/scope of work plan, and maintain no objections.

If you have any questions concerning our comments, please contact Laura Kammerer, Historic Preservationist Supervisor, at (850) 245-6333. Your interest in protecting Florida's historic properties is greatly appreciated.

Sincerely,

Laura A. Kammerer, Supervisor

for Frederick Gaske, Director, and
Deputy State Historic Preservation Officer

500 S. Bronough Street • Tallahassee, FL 32399-0250 • http://www.flheritage.com

☐ Director's Office (850) 245-6300 • FAX: 245-6435
☐ Archaeological Research (850) 245-6444 • FAX: 245-6436
☒ Historic Preservation (850) 245-6333 • FAX: 245-6437
☐ Historical Museums (850) 245-6400 • FAX: 245-6
☐ Palm Beach Regional Office (561) 279-1475 • FAX: 279-1476
☐ St. Augustine Regional Office (904) 825-5045 • FAX: 825-5044
☐ Tampa Regional Office (813) 272-3843 • FAX: 272-2340

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FLORIDA DEPARTMENT OF STATE
Glenda E. Hood
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Ms. Marion Almy
Archaeological Consultants, Inc.
8110 Blaikie Court, Suite A
Sarasota, Florida 34240

June 25, 2004

Re: DHR Project File No. 2004-5367 (20044167) / Received by DHR: May 25, 2004
Cultural Resource Assessment Survey: Harmony Ranch, Martin County, Florida.

Dear Ms. Almy:

We note that in May 2004, Archaeological Consultants, Inc. (ACI) conducted the above referenced survey for EW Consultants, Inc., in anticipation of a request by the Florida Division of Historical Resources for a cultural resource assessment survey. Our office proceeded to review this report with the expectation that EW Consultants, Inc. will be engaging in permitting processes that will require this office to comment on possible adverse impacts to cultural resources listed or eligible for listing in the *National Register of Historic Places (NRHP)*, or otherwise of historical, architectural, or archaeological significance. We recommend at the time such actions are taken, a copy of this letter be forwarded to the permitting agency(ies) with the application. This may eliminate the permitting agency(ies) from having to submit an application to the Division of Historical Resources for review or, if applications are forwarded to the Division, would facilitate our review.

The cultural resource assessment survey consisted of an archaeological and historical investigation of moderate Zones of Archaeological Probability within the project area, in accordance with the research design previously submitted by ACI and approved by this office (DHR Project File No. 2004-4167). One previously recorded historical structure and one previously unrecorded historical structure were identified within the project area during the investigation.

The Becker Grove House (8MT549), previously identified in the center of the project tract (DHR Survey No. 4106), was a circa 1945 frame vernacular residence. 8MT549 could not be relocated during this investigation. It is the opinion of ACI that 8MT549 has been demolished since its initial recording. Based on the information provided, our office concurs with this determination. We note the submission of a Change of Status Form for 8MT549.

The Harmony Ranch Windmill and Water Trough (8MT994) is a multi-component manufactured structure consisting of an aluminum blade windmill, cement water trough, and well system located in the center of the project tract. 8MT994 represents a traditional cattle watering/agricultural system typical throughout Florida. The date of construction for 8MT994 is uncertain. It is the opinion of ACI that 8MT994 does not appear eligible for listing in the *NRHP*. Based on the information our office concurs with this determination.

It is the opinion of ACI that development of the Harmony Ranch property will have no effect on historical properties listed or eligible for listing in the *NRHP*. ACI recommends no further investigation of Harmony Ranch project area.

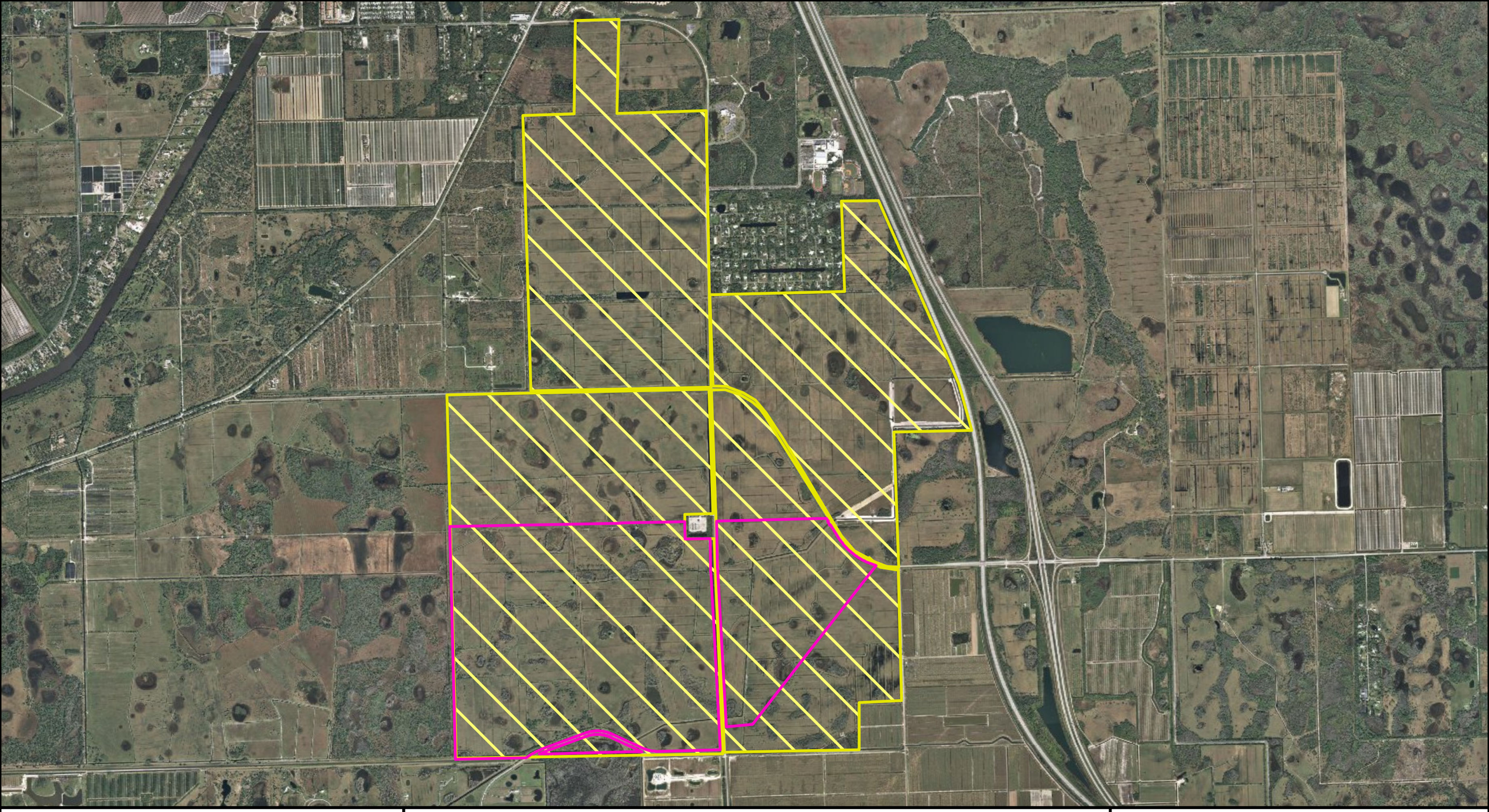
Based on the information provided, our office concurs with these determinations and finds the submitted report complete and sufficient in accordance with Chapter 1A-46, *Florida Administrative Code*.

If you have any questions concerning our comments, please contact Ariana Slemmens, Historic Sites Specialist, by phone at (850) 245-6333, or by electronic mail at abslemmens@dos.state.fl.us. Your continued interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura R. Kammerer, Supervisor

for Frederick Gaske, Director, and
Deputy State Historic Preservation Officer



Harmony Ranch Study Area

Study Area

Previously Surveyed (FMSF Survey No. 10011)

Martin County

Feet
0 2,000

Meters
0 500


Archaeological
Probablity Zones
Study Area
High Probability
Moderate Probability
Meters
0
200
400
Feet
0
500
1,000
N

Pero Farm 2003

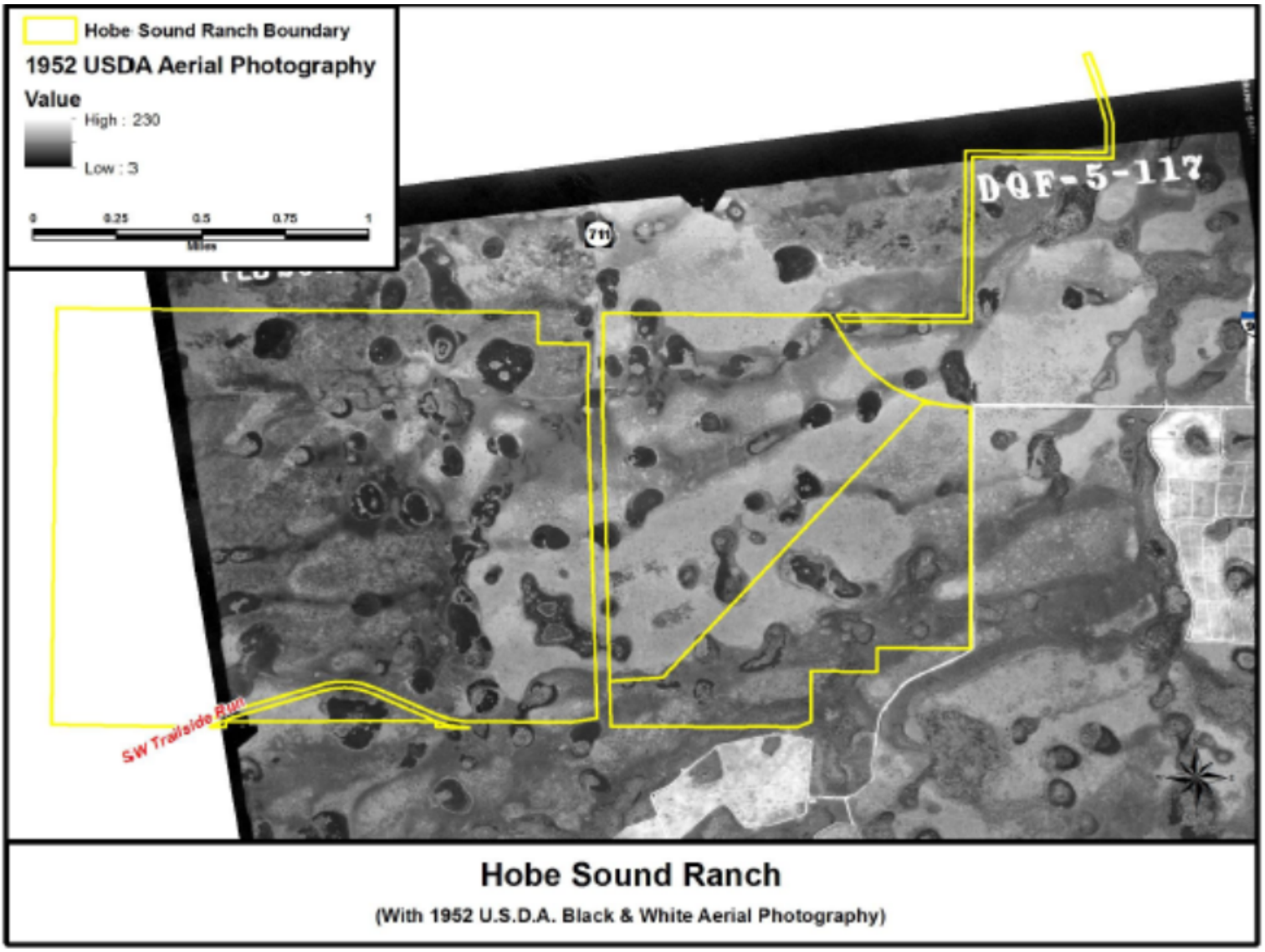
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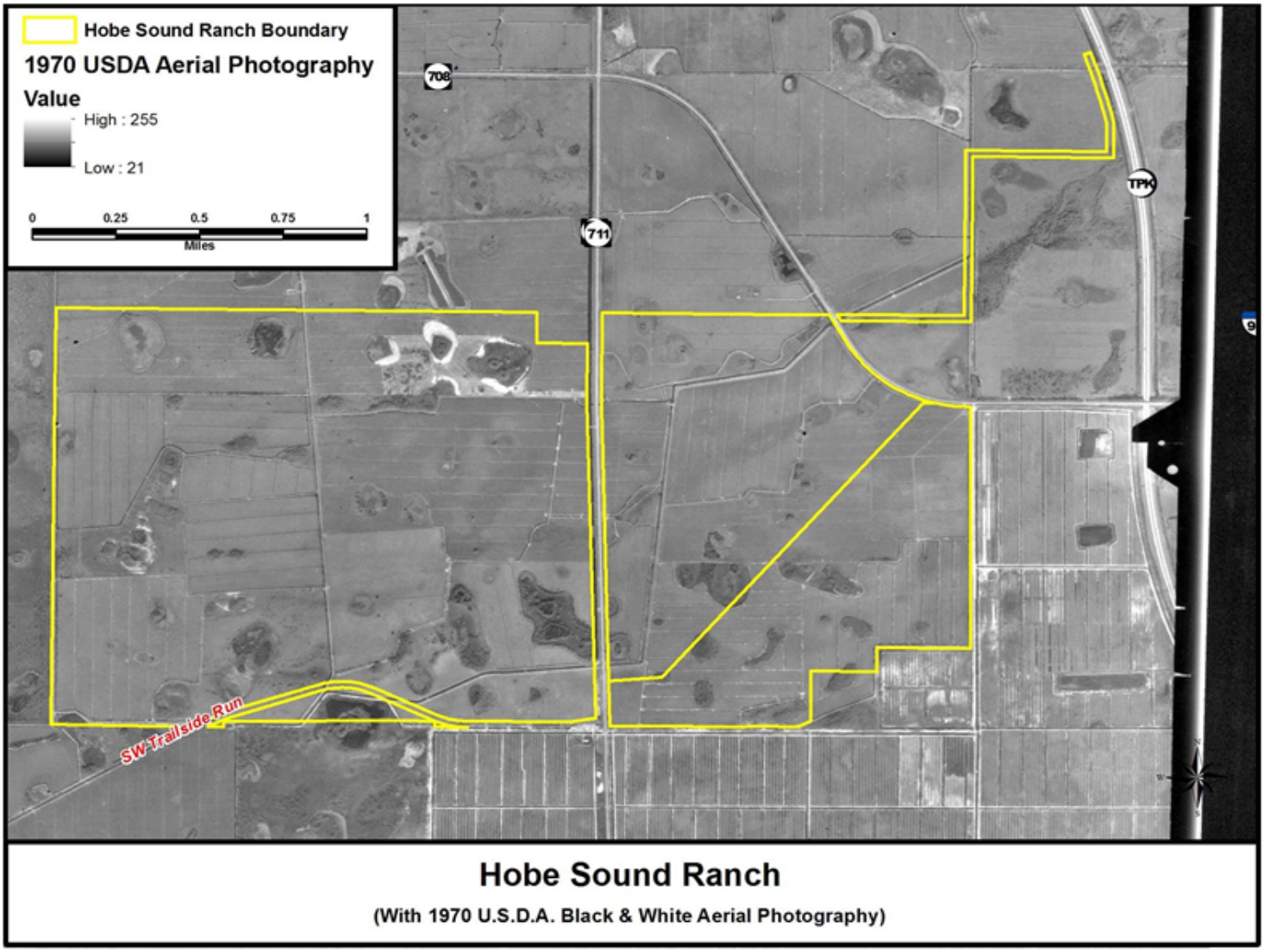
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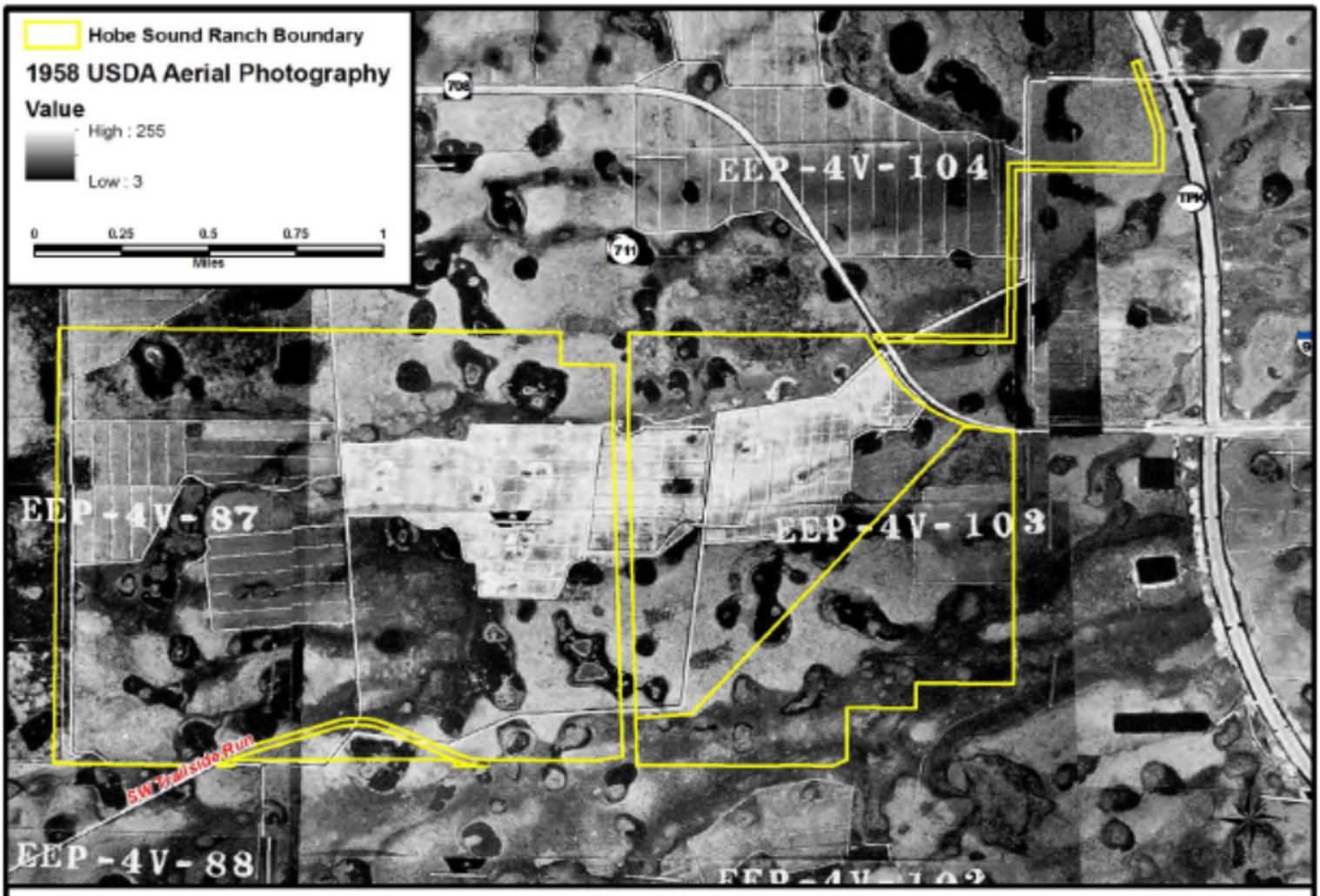
Hobe Sound Ranch

(With 1952 U.S.D.A. Black & White Aerial Photography)



Hobe Sound Ranch

(With 1970 U.S.D.A. Black & White Aerial Photography)



Hobe Sound Ranch

(With 1958 U.S.D.A. Black & White Aerial Photography)