

Cowbone Marsh Restoration Plan

1. Background

Cowbone Marsh (Marsh) is an approximately 2,500 acre relatively ovoid freshwater marsh system that is located between open flow way portions of Fisheating Creek in central Glades County and is contained within the 40-mile long 18,272-acre Fisheating Creek Wildlife Management Area (WMA) (see Exhibit 1). The Marsh transects Fisheating Creek 8 miles upstream of the Creek's mouth at the western shore of Lake Okeechobee. The Marsh is located approximately 6 miles east of US27 and 6 miles west of SR78 near Lakeport. The Marsh is approximately three times wider than the Fisheating Creek flow way corridor, and is about 3 miles in length. It is bordered by a cypress slough system upstream, and an open grassy alluvial system characterized by oxbows downstream.

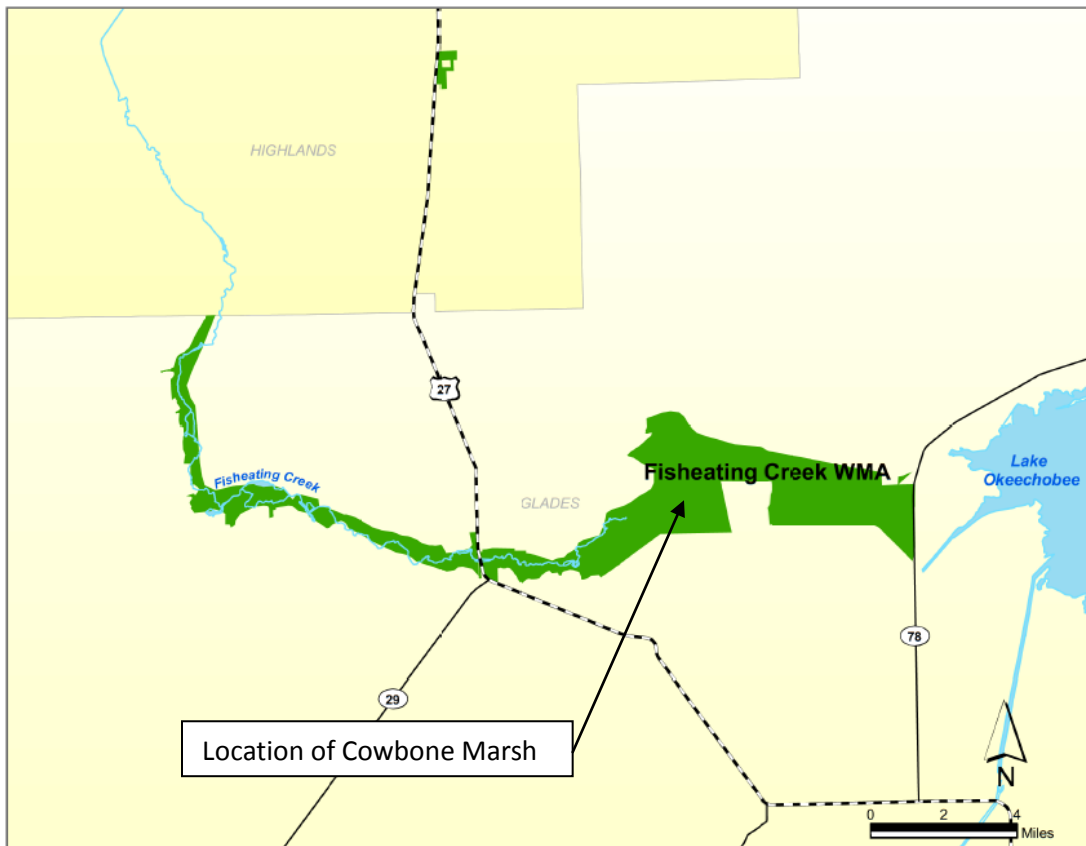


Exhibit 1 – Fisheating Creek Wildlife Management Area

Regional projects have altered the hydrologic regimen of the Marsh over the years, particularly in the last century. These projects include the construction of the Herbert Hoover Dike around Lake Okeechobee and subsequent water control regimen as well as development of agriculture interests upstream. The construction of the Hoover Dike followed along the ridge that separated Fisheating Creek from Nicodemous Slough to the south, just upstream of the Marsh. From this ridge the dike was constructed in a southerly direction, cutting off Nicodemous Slough from the cypress wetlands that conveyed water flowing northeast to Cowbone Marsh, and transecting flow east through Nicodemous Slough to Lake Okeechobee. As a result of these hydrologic alterations, all surface runoff upstream of the Marsh in the upper Fisheating Creek basin has flowed through the Marsh since the late 1930s.

At the same time more flow was being directed to the Marsh, the downstream Lake Okeechobee levels were reduced and kept more consistent through management protocols based on agriculture and flood protection. Although no longer receiving surface flows, the Nicodemous Slough has remained hydrated. The South Florida Water Management District (SFWMD) is planning to use the Nicodemous Slough as a future water storage basin that through additional earth works, will be able to store water. This may have an impact on the future water levels in Fisheating Creek and Cowbone Marsh.

Upstream agricultural activities consist primarily of cattle and citrus. Although cattle lands have little impact to the water regimen, they have been identified as a source of nutrients. Citrus demand significant irrigation. Methods employed up to the latter part of the twentieth century resulted in reduced ground water tables and resultant impacts to Fisheating Creek upstream of the Marsh.

Although it is difficult if not impossible to define how these alterations of the regional hydrology have specifically impacted the Marsh, historic evidence is available that provides information on the Marsh's succession in the past 80 years. First and foremost is the United States Army Corps of Engineers (USACE) 1929 survey showing Fisheating Creek to be an open water route from Lake Okeechobee through the Marsh and cypress upstream to US27 and beyond (see Exhibit 2).

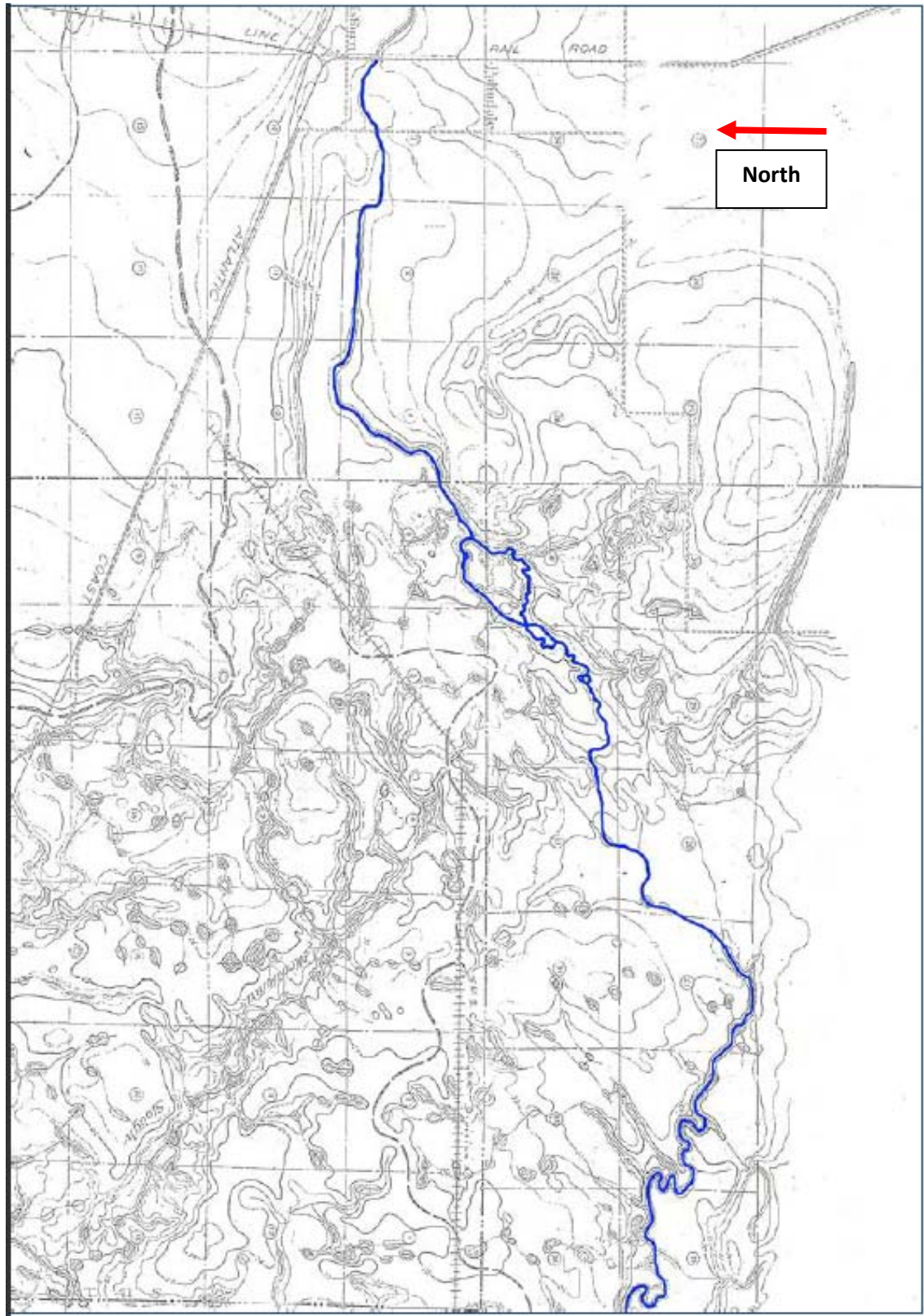


Exhibit 2 – US Army Corps of Engineers 1929 survey

Aerials from the late 1940s depict large open water areas that dominated the lower third of the Marsh, just downstream of the cypress (see Exhibit 3). These large open water areas are estimated to have been approximately 150 acres in size, but have closed in over the succeeding 60 years, with the few remnant open areas totaling less than 15 acres (see Exhibit 4). There has also been a vegetation shift in the upper half of the Marsh, with willow (*Salix caroliniana*) now the predominant species in both those areas that were open water and those previously vegetated by herbaceous plants. Aerial photos also indicate linear canals were dredged within the Marsh, two of which are still discernable via current aerial photos and ground truthing. These historically dredged cuts have resulted in vegetation changes from that of the surrounding area. Although no research has been conducted to ascertain the cause of vegetation changes in these areas, it is consistent with changes in hydrology, most likely from drainage activities. Aerial photos also reveal a wide swath (~1,000 ft) of vegetative change resulting from an herbicide application conducted in the 1990's within the Marsh prior to state ownership (see Exhibit 5). The 1990s herbicide application has dramatically altered species composition within the affected area and is still clearly evident today.

Cowbone Marsh has been impacted in the past 80 years, both through indirect and direct impacts. The result is a system that is dynamic in response to these impacts. With the planned works for the adjacent Nicodemous Slough, upstream development projects, and increased public access, it is anticipated that it will remain at the very least a dynamic system.

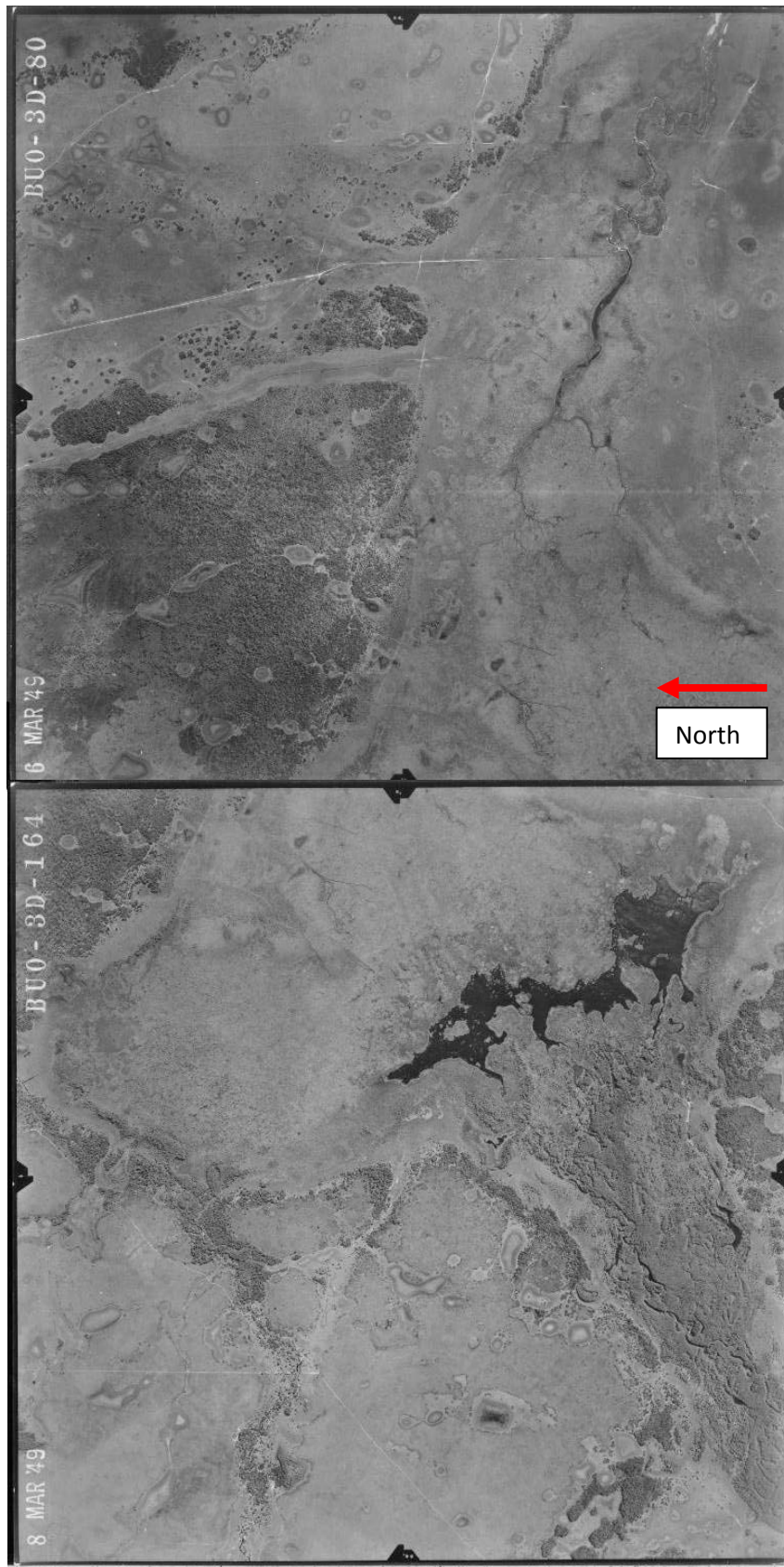


Exhibit 3 – 1949 Aerial of Cowbone Marsh open water areas

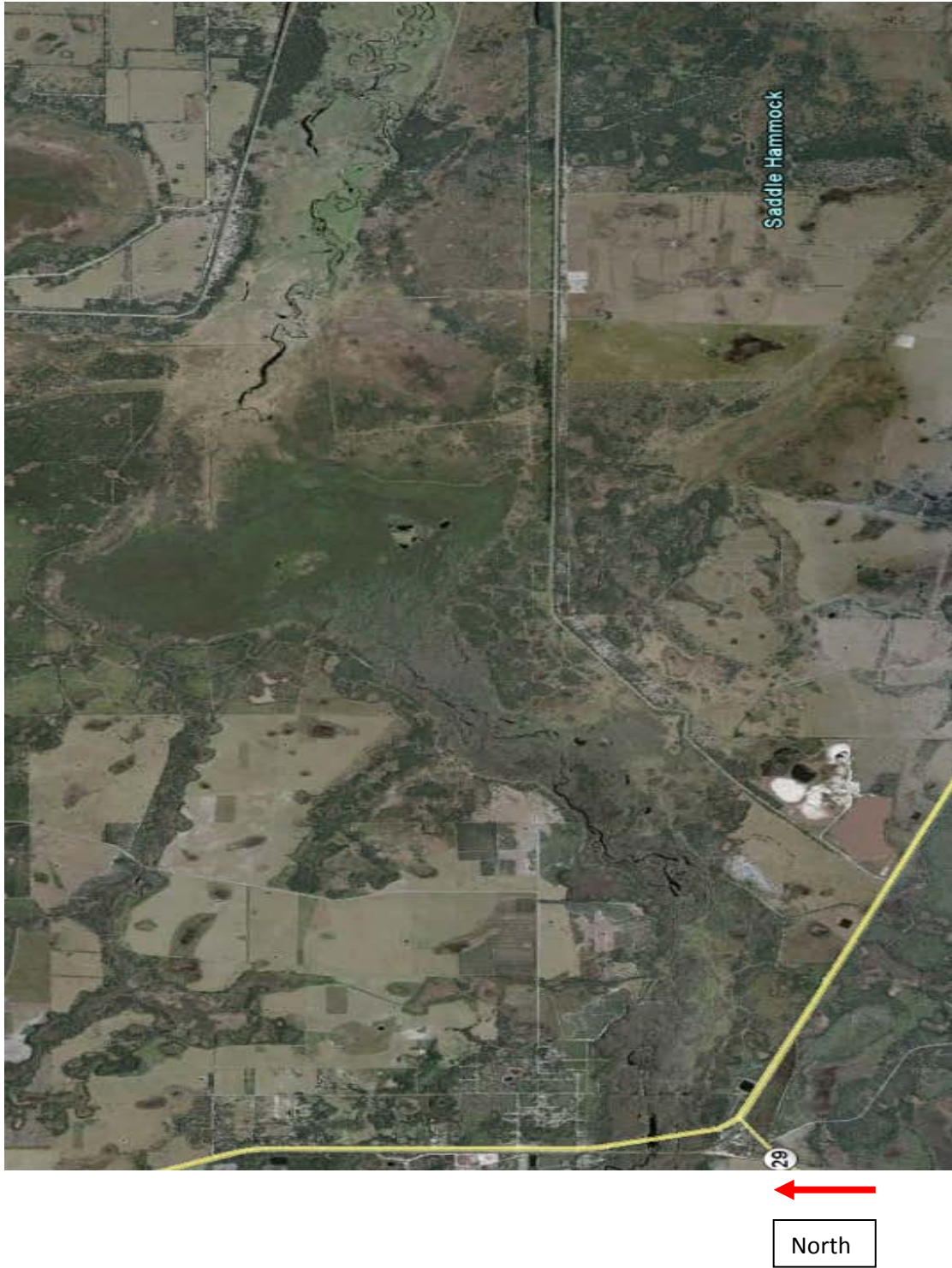


Exhibit 4 - 2010 Aerial of Cowbone Marsh

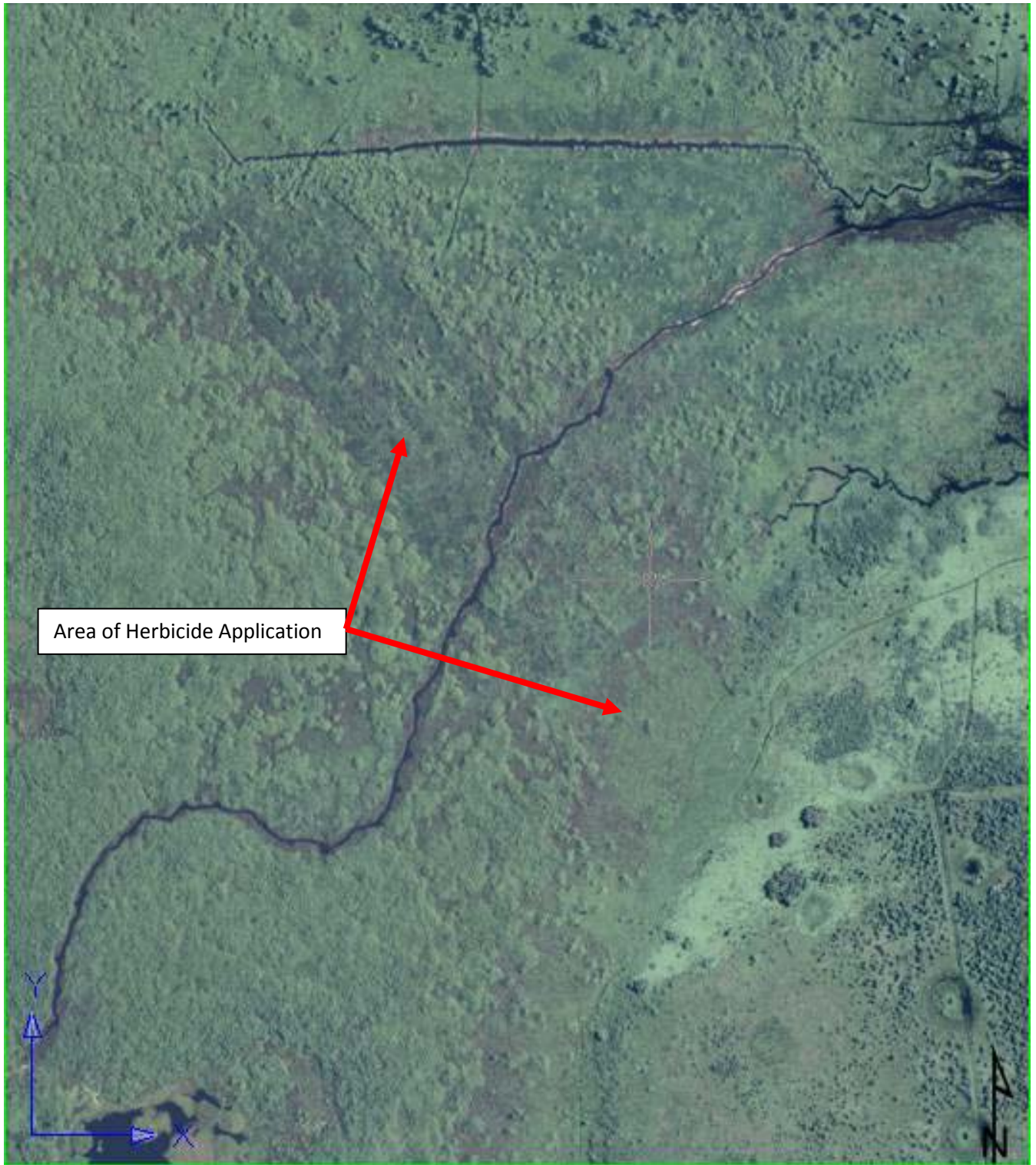


Exhibit 5 - 1990s Herbicide Application in Cowbone Marsh

The issue of public access to Fisheating Creek has been the subject of numerous and protracted legal actions ultimately resulting in a Settlement Agreement between the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida, Save Our Creeks, Inc., Environmental Confederation of Southwest Florida, Inc. and the Lykes Bros. Inc.; the State of Florida's purchase of lands along the creek from Lykes Bros., Inc.; and the creation of the Fisheating Creek WMA managed by the Florida Fish and Wildlife Conservation Commission (FWC).

The Settlement Agreement is incorporated into the Fisheating Creek WMA management plan and its enforcement is overseen by a citizens group set up by the Department of Environmental Protection (DEP), Division of State Lands called the Settlement Agreement Advisory Board (SAAB). The SAAB is made up of representatives of Save Our Creeks, Inc., Audubon of Florida, Lykes Bros., Inc., and the Environmental Confederation of Southwest Florida.

The Settlement Agreement requires that the state maintain and enhance the navigability of Fisheating Creek through a navigation maintenance program. While the FWC had removed fallen logs and invasive aquatic plants in the parts of the creek that were wide open water, the agency did not aggressively manage the portion of the Creek within the Marsh and this section continued to close up, becoming more occluded over time. In 2008 in response to requests from the SAAB, FWC began efforts to restore Fisheating Creek along the 1929 USACE surveyed navigation channel through the Marsh. Agency staff met with staff from the SFWMD and USACE to let them know that FWC was being asked to undertake the project.

In January 2009, FWC aeriually sprayed vegetation along the creek channel following the 1929 USACE surveyed navigation channel. The FWC conducted extensive scouting in high and low water conditions and determined that it would be feasible to restore the channel through the Marsh by using a machine called an Agitator to shred vegetation occluding the channel. The FWC understood from reviewing the 1929 USACE surveyed navigation channel map and the other materials related to past legal decisions that this was a watery trail that had been covered over by vegetated tussocks. In April 2010, FWC informed USACE and SFWMD that it would begin work to clear the 1929 USACE surveyed navigation channel through the Marsh. The intent was to take advantage of high water

conditions before swallow-tailed kites gathered at their roost (in the vicinity of Cowbone Marsh though not near the trail). FWC's contractor worked from mid-April to mid-May 2010 using the Agitator to shred vegetation along the 1929 USACE surveyed navigation channel route until water levels dropped and the work was stopped with about ½ to ¾-mile remaining to finish.

In July 2010 DEP and the USACE issued emergency orders requiring FWC to stop any further work. The USACE referred enforcement action to the Environmental Protection Agency (EPA), which also issued an emergency order. In immediate response to the emergency order an aluminum weir structure was installed within the cleared trail.

2a. Restoration Plan

In order to prepare a restoration plan to comply with the orders, the FWC formed a technical committee comprised of participants from FWC, DEP, SFWMD, USACE, and the University of Florida (UF) Department of Environmental Engineering Sciences. The Committee has defined four actions necessary for restoring the Marsh. They are:

1. Restoring the hydrology of the Marsh
2. Minimizing flow velocities which will reduce the transport of sediment during the wet season through the 1929 USACE defined trail, and maintaining the trail along the 1929 USACE surveyed navigation channel with minimal impact to the system.
3. Determining the feasibility of various options to backfill the trail opening without significant detrimental environmental impacts.
4. Accomplishing the above in such a way to provide public access during high water

The EPA, USACE, and DEP set standards for the works to achieve these restoration criteria that all material used for restorative purposes shall be of natural materials, with the objective that they will break down over time and become a natural element of the environment.

As the restoration plan is being implemented the FWC will continue to work with the technical committee and the regulatory agencies to monitor and evaluate the performance of the check dam structures that will be installed to comply with objectives 1, 2 and 4 for a minimum of one full wet and dry cycle. This information will be utilized to support the backfill feasibility assessment and to determine which backfill option meets objective 3 above. This assessment will be completed within 18 months following the completion of the check dams and a report will be provided to EPA.

2b. Onsite Restoration Activities

With input from the committee FWC has determined that restoration of the Marsh hydrology is best accomplished through the construction of a series of six earthen check dams constructed in the recently re-opened trail following of the channel depicted in the 1929 USACE survey. The check dams were determined to be the only practical solution that would meet all requirements of the criteria. The dams will restore the hydrology of the Marsh by:

- restoring the water levels to the ground surface elevations
- minimizing the flow velocities in the channel by forcing the waters into the adjacent marsh areas which re-establishes the pre-channel flow patterns,
- providing the additional of partially restoring some of the historical open water bodies in the marsh that have disappeared during the past 80 years due to both natural and manmade changes to the environment, and
- will allow public access during high water.

These check dams are to be constructed of natural materials consisting of burlap sand bags, marine plywood, coconut matting, and palm trees (see Attachment 1). The check dams will be sloped to ease portaging of canoes and kayaks across them by the public. The six check dams will be spaced such that there will only be an approximately six-inch drop in the water levels across each dam. Based on a survey performed in 2010, the surface elevation drops 6 inches from the channel end to the existing weir structure and then drops an additional 32 inches from the weir to the channel mouth.

Therefore, the check dams will be installed at approximately equidistant intervals from the weir to the channel mouth (see Exhibit 6).

The temporary riser weir will be removed (see Exhibit 7). Though the structure was effective at restoring the upstream hydrology and providing safe passage across the weir for watercraft, it did not meet the requirements of using only natural materials that would break down over time. Therefore, the riser weir will be removed during the construction phase of the check dams once it is no longer needed.

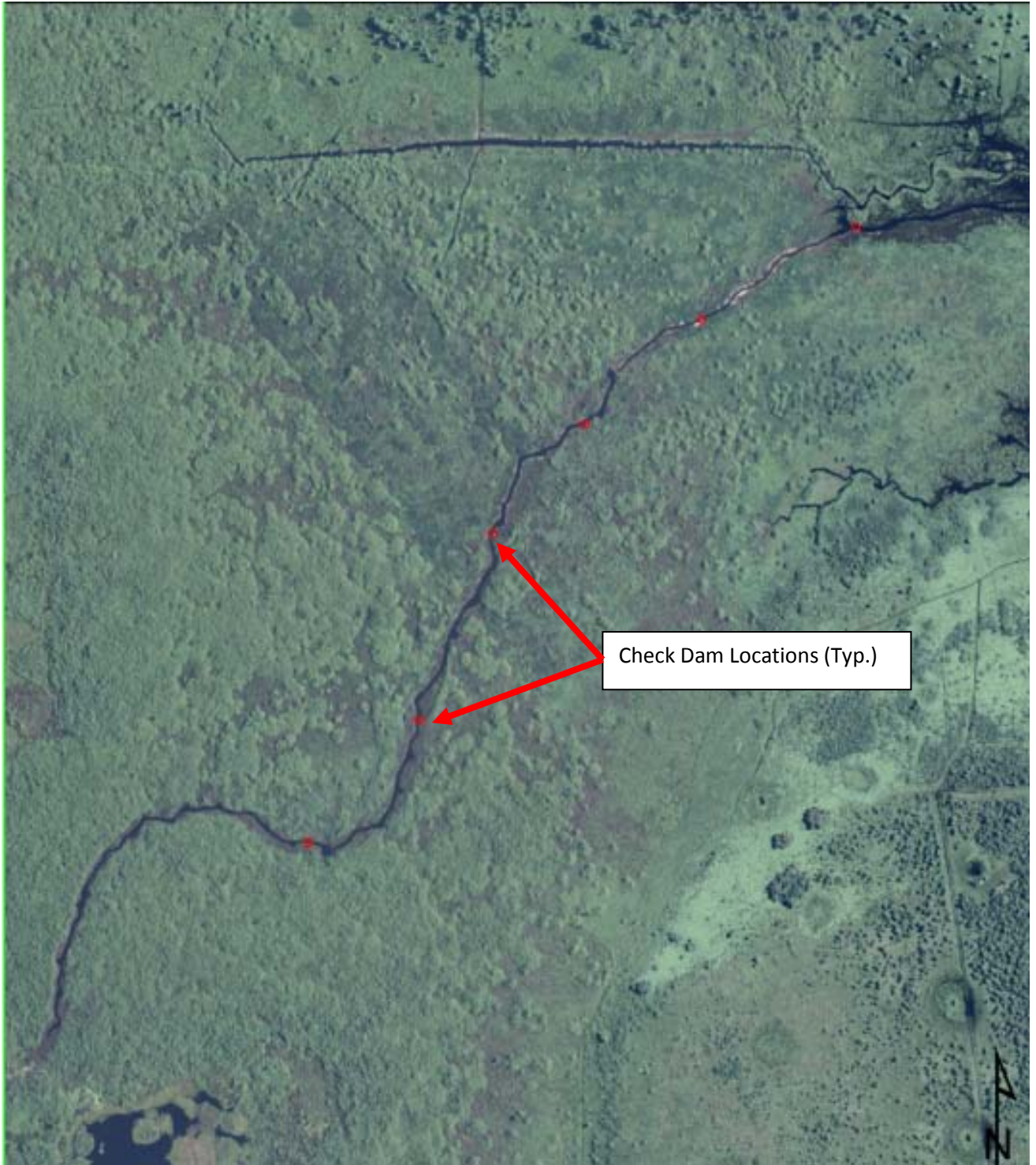


Exhibit 6 - Cowbone Marsh Check Dam Locations

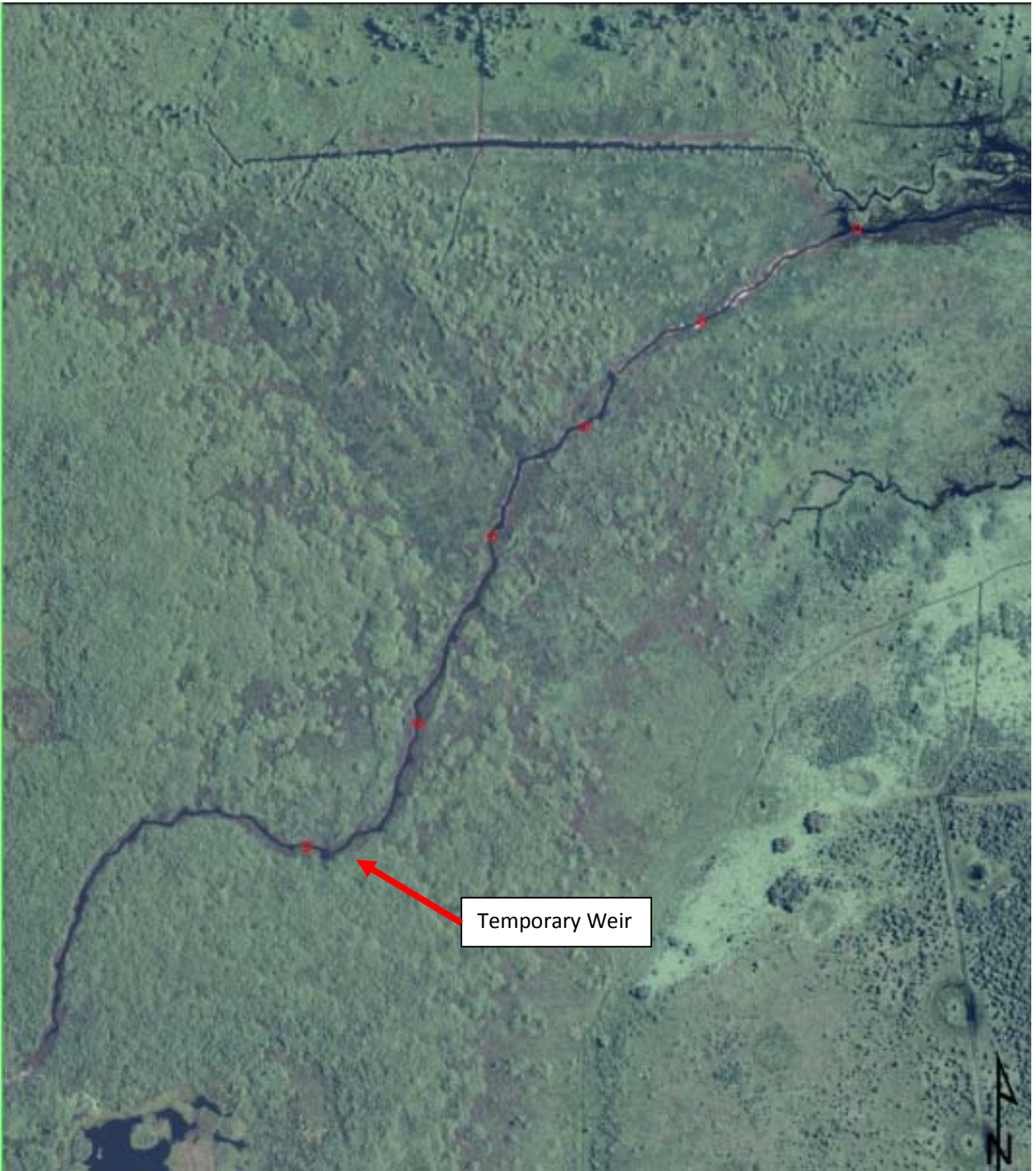


Exhibit 7 - Cowbone Marsh Temporary Weir Location

2c. Vegetation

The species observed during a recent vegetation survey on the west end of the 1929 USACE surveyed navigation channel route (in the cypress to the west of the Marsh) were:

Fire flag, a.k.a. alligator flag (*Thalia geniculata*), cypress, dotted smartweed (*Polygonum punctatum*), West Indian marsh grass (*Hymenachne amplexicaulis*), maidencane (*Panicum hemitomon*), sesbania (*Sesbania herbaceae*), and water hyacinth (*Eichhoria crassipes*). There are also pockets of old world climbing fern (*Lygodium microphyllum*) and aquatic soda apple/wetland nightshade (*Solanum tampicense*).

On the east end of the USACE 1929 route (within the Marsh to the edge of the cypress) most of the vegetation within the proposed channel is still dead from the aerial herbicide treatment. Species present, both dead and alive, include:

Primrose willow (*Ludwigia peruviana*), Carolina willow (*Salix caroliniana*), cattail (*Typha spp.*), dotted smartweed (*Polygonum punctatum*), alligator flag (*Thalia geniculata*), maidencane (*Panicum hemitomon*). There were several species of sedges, grasses, and ferns present during the growing season that have now died back.

Following are pictures of both the east portion and west portion of the trail vegetation, as well as some pictures from Summer 2010 on the east portion near the end of the cut (see Exhibits 8.1 and 8.2). The identification of the miscellaneous grasses, sedges, and ferns from the summer pictures are undetermined since most of them are taken from too far away.



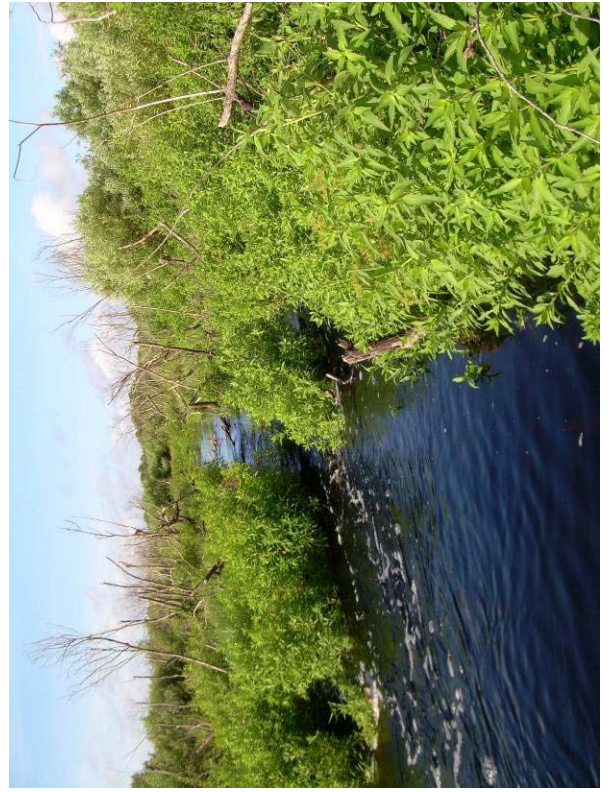


Exhibit 8.1 - Cowbone Marsh Vegetation Photos



Exhibit 8.2 - Cowbone Marsh Vegetation Photos

This should not be regarded as a complete survey of the plants along the route; many of the species normally present have died back in the cool temperatures and are not currently visible. Access to the area is extremely challenging and it is currently not possible to traverse the entire route by boat so there may be plants along the route that have been omitted.

2d. Vegetation Management

Aquatic plants will require periodic maintenance control to sustain safe passage through the trail along the USACE 1929 surveyed route through the Marsh. The plant management program to sustain the trail will require routine maintenance control of indigenous and non-indigenous plants that may encroach into the trail from the adjacent marsh. Non-indigenous plant species in this management area include the floating plants *Eichhornia crassipes* and *Pistia stratiotes* that are present upstream of Cowbone Marsh, and emergent *Hymenachne amplexicaulis* which is prevalent throughout the Marsh.

FWC estimates that approximately five acres of floating plants may require control annually using glyphosate or diquat herbicide. About one acre of *H. amplexicaulis* may require control using glyphosate. Other emergent non-indigenous plants including *Colocasia esculenta* and *Solanum tampicense* are present at a much lesser extent in Fisheating Creek upstream of the Marsh and may require occasional spot control using glyphosate.

2e. Trail Vegetation Control

The most abundant plants that may encroach into the trail include: *Typha* spp., *Sagittaria* spp., *Pontederia cordata*, *Salix* spp., *Thalia geniculata*, and *Ludwigia* spp. As much as five acres of these comingled plants may require control annually to preserve navigation. Herbicide applied quarterly by airboat, especially during peak growth months, will provide satisfactory control of aquatic plants.

3a. Restoration Monitoring Plan and Monitoring Methodology

Monitoring of the Cowbone Marsh Restoration Plan will include three elements: 1) the cleared trail; 2) the check dams; and 3) the marsh areas adjacent to the 1929 USACE surveyed navigation channel route. The monitoring will consist of performance based evaluations of these three elements. The purpose of the plan is to monitor the hydrologic restoration of the marsh in the area of the USACE 1929 surveyed route.

Monitoring of the cleared trail will consist of evaluating the plant growth in and adjacent to the trail. Staff will monitor the vegetation for exotic and nuisance species quarterly. Staff will also monitor the vegetation for both indigenous and non-indigenous species and determine the frequency of vegetation control along the trail for both trail passage and invasive species. The monitoring results will provide a basis for the types and frequency of future vegetation control. During vegetation monitoring, staff will also record use of the trails, dam, and open water bodies by wildlife, birds, turtles, alligators, etc.

Additionally, trail monitoring will include a monthly observation of any sediment transport or side channel scour along the channel length, if any. The rate of sedimentation occurring in the channel will be monitored for detrital deposits at each check dam and evaluated quarterly for five years or until a steady rate has been determined. Staff gauges are to be installed on both the upstream and downstream sides at each check dam for use in measuring sedimentation rates and water levels.

Monitoring of the check dams will include an evaluation of the condition of each check dam, the growth rate of the vegetation on the dam. The monitoring is essential to ensuring the dams are stabilized and preventing any potential failures. As vegetation establishes itself on the sides of the dam, the root system will help stabilize the dam against damage from the use by boaters.

3b. Restoration Success Criteria

The criteria for determining if the initial Marsh Restoration Plan is a success are based on the original objectives:

- 1) Restoring the hydrology of the Marsh. The intent of the hydrological restoration is to maintain the marsh hydrology conditions to those which existed prior to the FWC's 2010 enhancement of the USACE 1929 surveyed channel by installing a step system of check dams throughout the channel length creating a series of cells between the check dams. The upstream and downstream water levels at each check dam are to remain within six inches of each other. Monitoring of the cell water levels will occur biweekly when the channel is accessible. If a check dam does not meet the success criteria, a corrective action will be prepared and submitted to EPA. This will restore the previous sheet flow conditions that existed in 2009. Additionally, the check dams will capture and trap the rainwater runoff thereby providing longer periods of hydration for the marsh as compared to the rapid runoff and extended durations of low groundwater levels experienced currently.
- 2) Minimize flow velocities to reduce the transport of sediment. The check dams are to minimize the benthic and side channel scour to less than 5 percent or declining. The higher flow velocities, when they occur, will occur near the surface in the center of the channel more so than along the bottom and sides. The channel scour is to be monitored on a monthly basis and any substantial conditions are to be evaluated for possible remediation. An annual report will be prepared documenting the benthic and side channel scour conditions in the channel.
- 3) Maintenance of the 1929 USACE surveyed navigation channel with minimal impact to the system. Minimize the exotic and nuisance encroachment to less than 5 percent or declining. An annual report will be prepared documenting the results with the 1929 USACE surveyed navigation trail reopened for public use during the wet weather season. The trail is to be maintained in such condition as to be accessible to the public and as needed by law enforcement and life safety personnel.

