Myakka Headwaters Preserve Project

2022-2023

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December 2023
On behalf of the:
Coastal & Heartland National Estuary Partnership (CHNEP)

Abstract
The Myakka River floodplains found at Myakka Headwaters Preserve (MHP), located in Myakka City, FL, are a high-risk environment for restoration efforts, including restoration plantings. In this paper, we discuss a restoration project at MHP undertaken by Conservation Foundation of the Gulf Coast in 2022 and 2023, in partnership with Southwest Florida Water Management District and the Coastal & Heartland National Estuary Partnership. The project consisted of herbicide control of invasive exotic plants, as well as plantings of native wetland plants. The challenges of restoration plantings are discussed, and recommendations are provided for future restoration efforts.

Introduction / Background

Contractor Beautiful Ponds (BP) was contracted by the Coastal & Heartland National Estuary Partnership (CHNEP) and Charlotte County, on behalf of site owner and manager Conservation Foundation of the Gulf Coast (CFGC), to implement restoration work at Myakka Headwaters Preserve (MHP or the Property), located at 9600 Wauchula Rd, Myakka City, FL 34251. This 432-acre preserve is owned in fee-simple by CFGC and managed for wildlife and natural resource benefits. The mission of CFGC is to "Preserve land and water in Southwest Florida for the benefit of people and nature."

Project Intent

This project (the Project) consisted of three tasks: herbicide pre-treatment of planting areas and planting, herbicide control of invasive exotic plants in selected areas, and preparation of a final report (including timelines, methods, photos, results and discussion). The Project was conducted at Myakka Headwaters Preserve with funding from the Southwest Florida Water Management District SWIM Program, in partnership with the Coastal & Heartland National Estuary Partnership (CHNEP). Broadly speaking, the goals for the SWIM Program and CHNEP are, in part, to conserve, restore and enhance the water and wildlife resources of the region, including those of the Myakka River. Myakka Headwaters Preserve is located near the headwaters of the Myakka River, within Flatford Swamp, where seven creeks converge to form the Myakka River. SWFWMD preserves and manages 2,357-acres within Flatford Swamp Preserve, which is immediately upstream of MHP. Restoration and enhancement of the resources at MHP will directly benefit water and wildlife resources within this target area.

This Project was designed to restore natural resources that had been degraded by two primary ecological stressors: hydrologic alterations and cattle grazing.

Hydrologic Alterations

Flatford Swamp has been negatively impacted by excess freshwater flows for decades, and one of the primary negative affects has been the death of many hardwood trees throughout riparian areas of the Myakka. The causes, effects, and mitigation strategies for these excess flows has been a major initiative of SWFWMD, and many reports are available from SWFWMD that detail this work. Similar to other areas of Flatford Swamp, large areas of MHP have also lost significant tree cover, and it is assumed that a primary driver has been excess freshwater inputs. While this Project did not target freshwater inputs, it did target replanting of trees, with the intent to assess the materials and methods necessary for successful reforestation of MHP.

Cattle Grazing

Myakka Headwaters Preserve has been negatively impacted by historic cattle grazing practices. Currently, the Property is not grazed by cattle or used for other agriculture; however, prior cattle grazing did not follow best management practices and seriously degraded the landscape. Specific impacts include loss of plant diversity due to direct grazing, erosion of stream banks due to cattle watering behavior, and loss of riparian forests due to stream bank erosion. Therefore, a key component of this Project was to help restore resources directly impacted by cattle. CFGC acquired MHP in two phases, the first purchase occurring on September 30, 2020. Cattle were historically grazed on the entirety of MHP, without rotational grazing or rest periods. At the time of purchase, the stocking rate was approximately 30 adult cows, plus calves. CFGC discontinued grazing of the site in the fall of 2020; therefore, the site has remained un-grazed for approximately three full years.

In cattle-grazed landscapes, the concept of *increasers* and *decreasers* is an important differentiator between forage species. *Increasers* are plants that are unpalatable and avoided by cattle – they therefore generally increase in number within a given area while that area is grazed by cattle. *Decreasers* are plants that are palatable, high-protein forage, that are therefore preferentially grazed by cattle and generally decrease in number within a given area while that area is grazed.

Methods

Herbicide Treatment, Pre-planting (November 2022)

BP applied wetland-approved herbicides to targeted undesirable plants within planting areas, to decrease competition with the undesirable plants as well as facilitate planting by clearing the area of blocking vegetation. Bermuda grass, *Cynodon dactylon*, was treated within Maidencane Area 1 and 2, and within the Ogleby Creek area. West Indian Marsh grass, *Hymenachne amplexicaulis*, was treated within the Myakka Creek area and within the Mixed Area. Both species formed dense stands within large portions their respective areas. Treatment dates, herbicides, adjuvants, mixing rates, and other details are provided in Figure 5.

Planting Selection, General (December 2022)

On December 3, 2022, Contractor Beautiful Ponds planted 14,821 plants, consisting of 27 total species, twelve trees and shrubs, six herbaceous emergents, and seven grasses. Plant species were selected with a few considerations in mind:

1) Plants were selected that are known *decreases* that were likely extirpated by cattle grazing (maidencane, southern cutgrass, and fakahatchee grass).
2) Plants were selected that may be able to compete with west Indian marsh grass, an aggressive exotic plant (e.g. *Phragmites*, alligator flag, and the taller tree species).
3) Plants were selected that are already found onsite and may therefore be likely to survive (e.g. all trees on the list, and the emergent plants that are not *decreasers*)
4) *Lythrum flagellare* was selected as an endangered endemic already found onsite and worthy of conservation.
5) A diversity of plant species was selected to minimize the risk of failure for any one species and to test performance for multiple species.

A complete list of planted species is found in Figure 3.

Lygodium Treatment (April 2023)
BP treated Old World climbing fern, *Lygodium microphyllum*, within the area shown in Figure 1, using the chemical mixtures described in Figure 5. Herbicide was dispensed by hand-crews carrying machetes and 4-gallon backpack sprayers. Herbicide was applied by foliar application, and vines growing overhead were *poodlecut* and treated at the base. Two treatments were applied – an initial treatment and a follow up treatment.

Results

Herbicide Treatment – Pre-planting
Treatment of Bermuda grass appeared to result in a mixture of "burn" of the plants, but not total kill. That is, post-treatment, the treated grass appeared brown and dead (see photos, Figure 4). The result greatly improved the rate of planting, as crews could easily access the bare earth and insert grass plugs. However, after a few months, some percentage of culms began to show green leaves. Final inspection occurred twelve months later, on November 9, 2023. Upon final inspection, Bermuda grass was found throughout all areas; however, the growth habit was altered. Pre-treatment, Bermuda grass formed dense, monospecific groundcover, with a spongy, carpet-like appearance and healthy green coloration. No bare earth could be seen through the Bermuda grass. Twelve months later, the Bermuda grass persists weakly under a dense canopy of dotted smartweed, *Persicaria punctata.* The Bermuda grass grows about 8-12 inches tall, and the smartweed about 24 inches tall. The Bermuda grass is no longer dense, and the growth habit is stringy, with individual culms or stolons visible snaking through under the smartweed. The growth habit is no longer carpet-like. Bare earth is visible throughout, and green seedlings of unknown dicotyledonous plants are visible.

Treatment of West Indian marsh grass (WIMG) was 100% effective, with no plants re-growing post treatment. Upon final inspection on November 9, 2023, some WIMG was present within target areas, however the density was low, and these plants were assumed to have grown from seed, not from surviving culms.

Planting / Survivorship
Plants were inspected on November 9, 2023, approximately 12 months post-planting. Estimates of plant survivorship in each area are shown in Figure 3.

Lygodium Treatment
Lygodium was inspected on May 17, 2023 and the observed death rate at that time appeared to be 97% or better.

Discussion

Lygodium Treatment
Lygodium treatment at MHP proved difficult and not as effective from initial inspection to final inspection. While two treatments were applied, the long-term outcome is less than optimal, in that many vines have started to re-grow twelve months later. Upon final inspection on November 9, 2023, many new plants were observed within the areas of treatment (see photo examples for pre-treatment, initial post-treatment inspection and final inspection, Figure 4).

It is unclear whether this is due to poor kill rate, or due to new plants growing from spores. However, Project staff spoke with invasive plant treatment coordinator Mike Sowinski of Florida

Fish and Wildlife Conservation Commission, who shared that his observation is that plants usually re-grow from spores within a treatment area, and that multiple treatments are needed over a period of five years to achieve control. SWFWMD staff noted that creeks can create wind channels for spores to move, spores can also be left behind when a waterway recedes after staging up. Finally, game trails along rivers are also corridors for spore transport. These items should be considered this when choosing where to prioritize treatment, choosing areas that are easily accessed for continued treatment and less subject to introductions of new spores via the abovementioned pathways. CFGC will continue to monitor and treat *Lygodium* on the Property.

Pre-Planting Herbicide Treatment
Treatment of WIMG prior to planting was successful and will be repeated on future projects.

Treatment of Bermuda grass was successful in the near term and the result greatly facilitated planting. Furthermore, a very dense stand of dotted smartweed, *Persecaria puntata*, naturally recruited to the all the areas that were treated. This recruitment was so strong that it may be worthwhile to spray Bermuda grass without planting afterward.

However, in the longer term, some fraction of Bermuda grass did regrow (to about 12 inches tall) and are visible twelve months later, growing below the canopy of smartweeds (about 24 inches tall). Whether this is a problem for long-term establishment of native plants is unknown. At present, the dense native plant shades the thinner stand of exotic grass. Monitoring and evaluation of this interaction should continue in order to see whether smartweed and other native plants successfully out-compete Bermuda grass in the long run.

Should further restoration efforts target Bermuda grass, it is recommended that the herbicide mixture be modified in an attempt to improve the kill rate. None the less, the outcome of the dense growth of dotted smartweed may prove enough to merit a less-than-perfect kill rate. This will be further monitored and evaluated in future treatments conducted by CFGC.

Planting/Environmental Stressors
The floodplains of the Myakka River present significant challenges for restoration plantings, especially environmental stressors that are present during every season. These stressors include:

- March-May: Dry season, drought-like conditions during the spring cool season
- June-November: Hurricane season, high floods and high winds (see figure 6)
- December-March: Winter, frost potential as early as December, with a 90% chance by February.

Between drought, flood, high winds, and frost, there is virtually no time of year when planting success is assured. Therefore, risk mitigation is key. For the purposes of this project, all planting was conducted at the same time. Recommendations on how to optimize plant survival based on environmental stressors and individual species needs are included below.

Maidencane Planting
Based on the results of this Project and discussions with other land managers, maidencane may be best planted in June. Anecdotes from multiple land managers suggest that maidencane plantings are very successful, so long as they are planted in standing water. As another anecdote, Conservation Foundation planted additional maidencane on June 10th, 2023, outside of the scope of this project. Half were planted in drier sites (moist, sandy soil

but no standing water) half in wetter sites (moist, mucky soil, with standing water). Of these plants, survivorship was significantly greater in standing water (perhaps 80%) as compared to the dry sites (roughly 20%). Granted, soil type may also play a role; however, within the Myakka watershed, maidencane is often found on sandy soils, not mucky soils, and it seems plausible that soil type is a lesser driver than hydroperiod or simply moisture content during the planting and establishment period.

Alternatively, maidencane might also be planted in October if standing water is still present, but it may not perform as well entering the dormant season, as compared with June. The planned October planting was delayed due to the arrival of late season hurricanes (Ian and Nicole) that had a direct impact on the Myakka River region. Once site conditions would allow, maidencane was planted in three locations, each with slightly different elevations (see elevation map, Figure 2). Although water levels in the region remained higher than average throughout November and December of 2022, bare root plants were planted during a dry spell when soil moisture was low in early December and showed signs of stress within hours of planting. Supplemental water was provided within about seven days, but this did not appear to be sufficient as most plants died back to the roots. Three weeks later, in late December a water levels rose again and re-hydrated the area (Figure 6). Although this saved many maidencane plants, many others did not survive the next spring when drought conditions persisted. Survival appeared to be directly related to soil moisture and level of hydration during establishment, with wetter soils and locations performing better.

As mentioned above, planting tasks for this project were not separated out by species but instead by planting areas. While October-November may be ideal for some trees, it may not be optimal for other wetland plants. This October-November timeframe was delayed by Hurricanes Ian and Nicole making landfall in the region during the original planned planting dates, thus planting took place in December. The drier conditions soil conditions in December 2022 were exacerbated by a very dry February and March in 2023 that led to extreme drought conditions which lasted until early May when the wet season rainfall pattern set in. However, the region never totally recovered from the early season rainfall deficit as the rainy season did not deliver the usual rainfall to these areas due in large part to a weaker than normal subtropical high over the western Atlantic leading to a predominant southwest to west wind flow which pushed most of the daily summer thunderstorms away from the Gulf coast and towards the east coast. Quite unusually, drought conditions returned to coastal sections of SW Florida in August and persisted into early December 2023 as reported by the National Weather Service.

As all projects can be subject to unforeseen circumstances or weather that could affect site conditions or contract and funding stipulations, it is recommended that projects build flexibility into tasks and timelines to the greatest extent possible. This could mean conducting iterative planting events, allowing for species or areas to be planted at the ideal timeframe while being responsive to current conditions as site conditions in the Myakka River floodplains can change significantly in a short time.

Lythrum Planting

Lowland loosestrife cuttings were collected by hand at MHP, under a FDACS permit, and sent to Sandhill Native Growers for propagation under overhead mist. Sandhill reported that

they rooted readily. The returned plants were healthy and easy to plant. This species is easy to work with and is recommended for future work from that perspective. However, due to its very short stature, it will not be suitable for all restoration projects, but only those areas where vegetation stature is short. It appears to thrive at MHP and at the Upper Myakka Lake, where annual floods knock-back competing vegetation, creating mudflats in the spring. Under these conditions, lowland loosestrife may thrive.

Phragmites Planting
Native *Phragmites* was harvested from Myakka River State Park under a FDACS permit and nursery-grown. The plants were easy to harvest and propagate. Two areas were planted with *Phragmites* – one area along Myakka Creek and one along Ogleby Creek. At both sites, *Phragmites* established readily and is thriving. No mortality was observed.

The Ogleby Creek plants are performing significantly better than the Myakka Creek plantings, with the former standing nine or ten feet tall, and the latter about seven feet tall. It is not known why the sites have performed differently, but it may be related to soil type or hydroperiod.

Phragmites was planted specifically to compete with WIMG; however, this interaction has not been observed as of yet. WIMG formerly created a monoculture in both areas and was treated with herbicide. Upon final inspection, WIMG was seen in some areas but not all areas and was not present within the *Phragmites* area. The *Phragmites* area still contains open space and may be colonized at a later date. This interaction must be monitored in the long-term in order to draw conclusions.

Further trials are recommended for the native *Phragmites* in order to cautiously evaluate the plant's potential to become too aggressive on restoration sites. At present, the plant shows excellent restoration value due to its ease of propagation, robust growth habit, and potential to stabilize shorelines and compete with invasive exotic plants.

Spartina bakerii Planting
All the planted sand cordgrass planted in December survived and demonstrated strong new growth at this time of year. This plant is recommended for future plantings.

Thelypteris interrupta Planting
Thelypteris fern cuttings were harvested from the project site and grown under nursery conditions. Cuttings consisted of 4" long segments of rhizomes, each with a growth bud positioned in the middle. Segments were planted in 4" pots and grown until they grew new leaves. Planted ferns seem to have performed well, but it is somewhat difficult to determine, since successful plants blend in with the existing population at the Myakka Creek site. At the Ogleby Creek site, the planted ferns seem to struggle to compete with the Bermuda grass and smartweed, which forms a thick groundcover. If further fern plantings are used, it is recommended that the ground cover be diminished to reduce competition.

Tree Planting

The results of this project suggest that trees are best planted in October-November within Myakka Floodplains. During this time, the Myakka waters are generally low and receding, and flood risk is low. At the same time, soil moisture is high at the start of this period, and will be high for the next four to five months. These are good conditions for establishment of roots during the winter dormant season. Furthermore, the wetland trees that grow onsite naturally are deciduous and therefore more resilient to frosts; these include: popash; willow; buttonbush; tupelo; dahoon; maple; elm; swamp dogwood; and Virginia sweetspire. Such trees may generally perform best if planted in the fall**.**

Based on the results of this project, Carolina willow appears to be the most resilient tree for planting on this site, followed by popash and buttonbush. The fact that Carolina willow is a hardy grower is well known. Pop ash is less familiar, but based on this project, young pop ash trees appear to withstand complete submersion better than most other wetland trees. Many young pop ash trees were observed with algae growing on their leaves, post-flood, proving that the leaves persisted through floods. By contrast, multiple other planted tree species did not survive.

Conservation Foundation planted 80 1-gallon pop ash trees as part of this Project, each standing about six feet tall at installation. CFGC also planted approximately 830 pop ash trees contemporaneously using a different source of funding, consisting of 600 2-inch trees standing about 18" tall at installation, and 230 1-gallon trees standing about 24" tall at installation. Overall survivorship of the larger trees was approximately 50%. Survivorship of the smaller trees (1 gallon and 2") was low, approximately 10%.

The cause of such high mortality in larger trees could be due to several factors. The trees were planted a little late in the season (December), during a time when the soils were unusually dry for that time of year. A portion of the trees may have died during the following spring drought. Finally, there were trees that survived and put forth new leaves during the summer but died later in year. Some of these trees may later re-sprout from the roots, so roots that may still be viable were not removed.

A few potential causes of tree mortality are discussed in the following paragraphs. Discussion on how to optimize plant survival based on environmental stressors and individual species needs are included in the Recommendations section below.

Tree Mortality – Hydroperiod

A certain number of trees must have succumbed to flood waters – either peak flood depth or a combination of peak flood depth times duration of inundation (Figure 3, Figure 6). For instance, wax myrtle is found throughout the swamps, but is usually growing on tussocks in the swamp. It likely succumbed to a problem of flooding too deeply for too long of a time. Similarly, the 18"-tall pop ash trees likely were submerged too long in water, along with multiple other species. While these species are found throughout the swamps on the property, establishment may be possible only during dry years, or if the plants are planted on an artificial tussock of some sort as small changes in elevation can change water depths and hydroperiods.

Tree Mortality - Smartweed Allelopathy

One interesting, but tenuous, possible cause of tree mortality is that dotted smartweed, *Persicaria punctata,* is allelopathic. The logic is that dotted smartweed recruited strongly to the planting sites, formed a monoculture on this site, commonly forms monocultures on other properties, and that several other plants in the *Polyganaceae* are known to be alleopathic and even invasive (Lun et al. 2023; Kato-Noguchi, 2021; Fan et al. 2009). This possibility should be investigated further.

Tree Mortality - Water Quality

Another possible explanation for higher-than-expected tree mortality is a water quality problem, such as sulfide toxicity. SWFWMD has established that the soils of Flatford Swamp contain highly elevated levels of sulfur, and that sulfide toxicity may affect the health of trees within the swamp. For instance, tupelo, *Nyssa biflora*, is known to be highly sensitive to sulfide toxicity. At MHP, pop ash trees appear healthy, whereas most mature tupelo trees show signs of severe stress, including sparse canopy cover, snapped trunks and branches, and complete death. All of this even though tupelo are more tolerant of longer hydroperiods. Multiple possible mitigation measures exist for sulfide toxicity, including iron soil amendments, application of sulfur-metabolizing microbes, and planting plants that introduce greater amounts of oxygen into the soil (Lamers et al, 2012). Further work on this issue is recommended.

Recommendations

Recommendations - Iterative Planting Events

In a high-risk environment such as the Myakka River floodplains at MHP, there is significant value to following an iterative, adaptive approach to restoration, using small-batch plantings. Small batch plantings have significant benefits: they spread the risk of stressors (hurricane, drought, pestilence, frost) over multiple years, and increase the likelihood that *some* plants may survive *some* seasons; they also enable project managers to perform adaptive management, wherein plantings are monitored for success, and the lessons learned are used to inform subsequent small-batch plantings, thereby improving the success rate over time. Project managers may be well advised to try multiple small-batch plantings, each using a variety of plant species and a variety of planting strategies (see below), to implement them iteratively over the course of 3 or more years, to monitor and adapt accordingly, and to use the results to select a winning strategy that can be scaled up.

Recommendations - Risk Management Strategies

The following is a list of risk-management paradigms, presented in brief, for land managers to consider.

Mitigation Strategy	Example
Flood avoidance	Plant at higher elevations (e.g. fakahatchee grass in oak hammocks) Plant taller plants (e.g. trees, swamp hibiscus, phragmites, *Spartina bakerii*) Plant in dry season
Flood resilience, inundation tolerance	Young popash, willow, or buttonbush are resilient to submersion
Flood resilience, rapid elongation	Plant herbaceous plants capable of rapid-elongation that can grow above flood waters – e.g. maidencane
Flood destruction, seed bank re-growth	Plant cool season annuals that form strong seed banks, e.g. *Coreopsis*, giant amaranth, *Rumex* spp.
Flood destruction, root stock re-growth	Unknown, possibly *Lythrum flagellare* and *Persecaria punctata.* The exotic Bermuda grass behaves this way.

Other Recommendations

Additional recommendations are provided here, in brief, for land managers to consider during restoration projects:

- Prioritize reforestation of lost riparian forests, as these provide significant benefits such as: shoreline stabilizing by roots; shoreline armoring by fallen limbs and trucks; reduced erosion and sedimentation; reduced nutrient inputs from legacy-nutrients locked in soils; shading and cooling of water with resulting increase in oxygen for fish; improved structure for aquatic life.
- Smaller tree sizes – e.g. 2" liners - are likely to perform better than large sizes – e.g. 3-gallon pots; however, planted trees must be tall enough to remain above peak flood heights.
- Do not remove plant that appear "dead" immediately, as they may re-grow from the roots.
- Carolina willow is a strong performer but is aggressive and should be used cautiously. Where desired, land managers can easily plant willow "stakes" (or cuttings) for free or a fraction of the price. Fact sheets are available online for more information.
- The capacity to provide supplemental irrigation will reduce risk and expand planting windows beyond those mentioned above.
- *Persecaria punctata* readily grows from the seedbank. If target invasives such as WIMG are mixed with smartweed, spray both plants to achieve a total control of WIMG – do not spare WIMG if is mixed with smartweed to save the smartweed. The smartweed will regrow.
- If projects utilize public funds, procurement and task timelines will be a factor in scheduling project work. Build flexibility into contract tasks, possibly making plantings 'task order' by species or conducting iterative small-batch planting events where results from each planting can inform the next stage. It is recommended that every effort is made complement seasonal planting needs for species to the greatest extent possible this builds resilience to near-term environmental stressors. Project success is predicated on seasonal environmental conditions which can shift between extremes rapidly in the Myakka River

floodplain. Consider utilizing the model of ongoing herbicide and maintenance contracts for plantings as well so that a work order can be issued quickly when the ideal environmental conditions are observed. For individual projects- longer performance periods and options to extend deadlines or options to make modifications to the proposed work minimizing change order paperwork will also help ensure responsiveness to site conditions for the best outcomes (e.g. a contract might include both upland and wetland areas, or multiple types of work, such as invasive plant treatment and planting, each with different seasonal needs, so that work can pivot to the best location and task according to the site conditions.)

- Contract-growing plants will greatly expand the selection available for projects. Additional CFGC plantings on site were contract-grown - Lythrum, Phragmites, Thelypteris, swamp mallow, 2" pop ash; and although not all performed well in all situations, some are strong performers under the right conditions. Furthermore, contract-grown plants may be purchased as liner-size material, which is a fraction of the cost. The 2" pop ash liners cost 30 cents each, versus 4.50 for 3-gallon. Most nurseries will not sell liners without a contract. Affordable liners enable low-cost trials as well as large-scale plantings. Liners also avoid root-bound plants, which may have been a contributing factor to mortality on this project. Most nurseries will readily contract-grow plants if they are supplied with seeds. Pop ash seeds can be readily harvested by hand starting in mid-to-late September. Harvests will be severely reduced by hurricane or tropical storm winds if they occur during the summer. Pop ash trees in 2" liners can reach 18" tall in about six months. Communicate with the nursery regarding how long you want them to grow the plants for. If only six months (18"-tall product), then fall-harvested seeds may be stored under refrigeration and planted in the summer in order to support out-planting in the fall. If a longer grow time is desired (taller end-product), then the nursery may want to charge a little more.
- Agencies that have difficulty with contract-grows may partner with a non-profit group or start their own nurseries to find a supply of desired plants.
- Soil samples may be tested by working with the University of Florida County Extension offices cheaply and should be performed at the start of every planting project.

Future Maintenance and Management

CFGC is committed to the restoration and management of MHP and will continue to restore and manage the property, including those areas targeted by this Project. During 2024, CFGC will undertake the following actions:

- Continued *Lygodium* treatment
- Continued WIMG treatment
- Continued pop ash plantings in January 2024 (approximately 500-600 more trees)
- Further monitoring of water quality
- Soil tests to determine soil iron content (neutralizes toxic sulfide) and other nutrients
- Basic tests of smartweed allelopathy under nursery conditions
- Basic tests of soil amendments, including bacterial, fungal, and iron supplements

This Project and the plantings in January 2024 will inform a scaled-up popash planting, tentatively scheduled as 20,000 trees in October-December 2024. This planting may be postponed if the causes of low tree survival are not better understood by the end of 2024.

Citations

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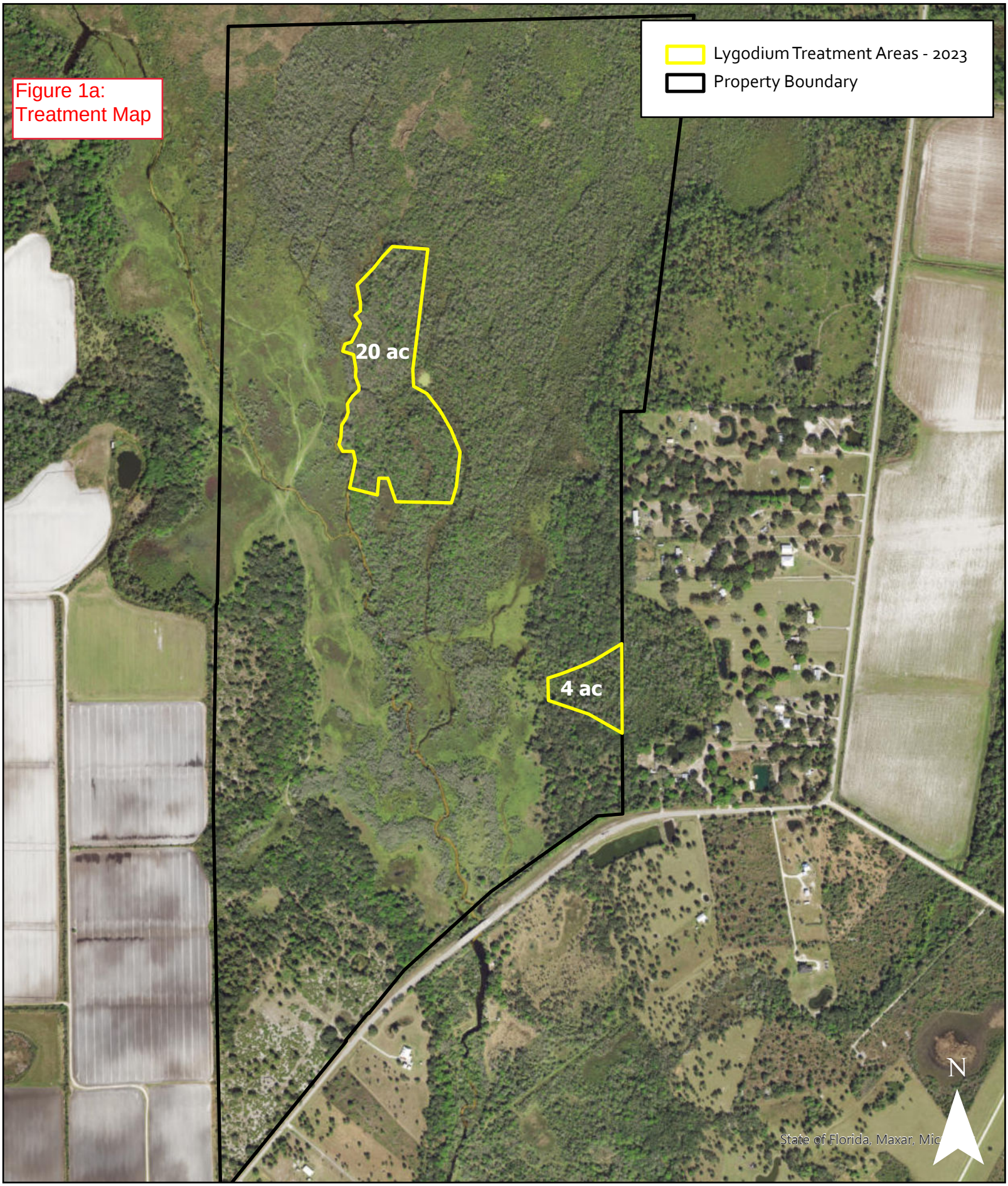

Myakka Headwaters Preserve

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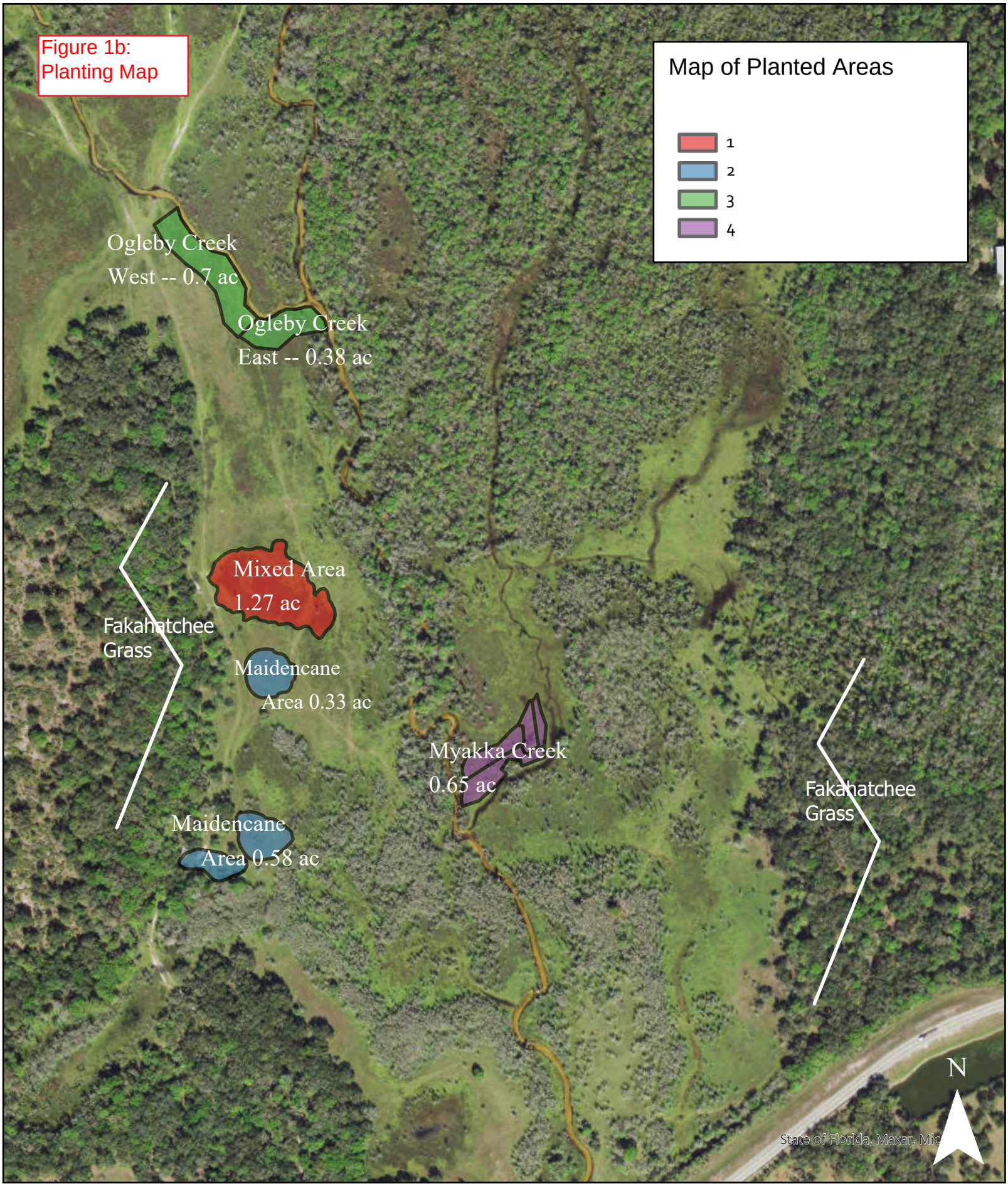
Conservation Foundation of the Gulf Coast



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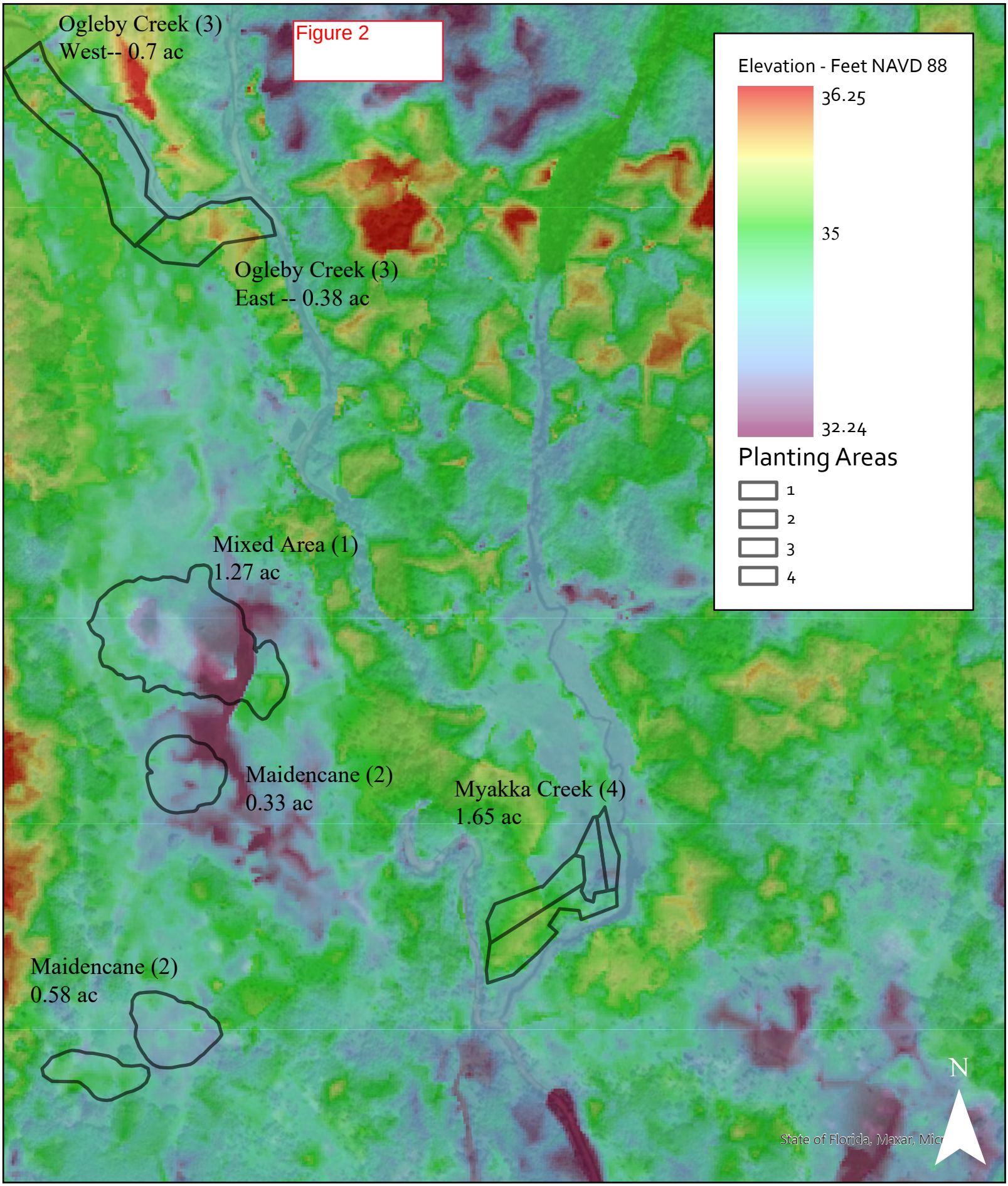


Myakka Headwaters Preserve

9600 Wauchula Rd, Myakka City, FL 34251

Conservation Foundation of the Gulf Coast

Figure 3

Common Name	Scientific Name	Size	Qty	Percent Survivorship (approx)	Likely cause of mortality
Black Gum / Tupelo	Nyssa sylvatica	3G	95	0%	Unknown*
Red Maple	Acer rubra	3G	60	0%	Flooding
Willow	Salix caroliniana	1G	240	100%	
Dahoon	Ilex cassine	1G	90	0%	Flooding
Elm	Ulmus americana	3G	30	0%	Flooding
Buttonbush		1G	120	50%	
Wax myrtle		3G	90	0%	Flooding
Dogwood		1G	130	0%	Flooding
Laurel Oak	Quercus laurifolia	1G	20	0%	Flooding
Elderberry		1G	50	0%	Flooding
Phragmites		1G	120	100%	
Hottentot Fern	Thelypteris interrupta	4"	227	non-zero, but hard to distinguish from existing population	
Pop Ash		3G	80	30%	Unknown*
Maidencane		BR	9000	50% (north) 0% (south)	Dry conditions at planting time
Alligator Flag	Thalia geniculata	BR	300	50%	Unknown*
Arrowhead lance leaf	Sagittaria lancifolia	BR	500	Unknown. Obscured by smartweed if still present	
Pickerelweed	Pontederia cordata	BR	400	Unknown. Obscured by smartweed if still present	
Fakahatchee grass		1G	400	100%	NA
Sand cordgrass	Spartina bakeri	4"	100	100%	NA
Sawgrass	Cladium jamaicense	4"	200	0%	Dry conditions at planting time
Tickseed		LN	2000	100%	NA
Rose mallow		3G	20	10%	Unknown*
Sedge	Cyperus haspan	4"	102	Unknown. Obscured by smartweed if still present	
Cutgrass		LN	247	Unknown. Obscured by smartweed if still present	
FL loosestrife		LN	200	Unknown. Obscured by smartweed if still present	

25 species total 14,821

*See further discussion within the report narrative

Figure 3

Big Flats - Maidencane Areas - 0.91 acre

Maidencane	6342	30" OC (mix with maidencane)	70% of total	8542
Tickseed	2000			
Loosestrife	200	cluster		

Big Flats Depression - 1.27 acre

Maidencane	2658		cluster, 30% of total	4317
Alligator Flag	300		multiple clusters	
Sawgrass	100		cluster	
Rose Mallow	10	36" OC	scattered	
Sedge	102		scattered	
Cutgrass	247		cluster	
Sagittaria	500		scattered	
Pickerelweed	400		scattered	

Ogleby Creek - West 400' - 0.7 ac

Fern	113	24" OC	Cluster	663
popash	50			
Tupelo	95			
Willow	90			
Elm	20			
Dahoon	60			
Red maple	30	8' OC		
Buttonbush	80			
Wax myrtle	50			
dogwood	80			
Q. laurifolia	10			
Elderberry	10			

Ogleby Creek - East 200' - 0.38 ac

Phragmites	100	36" OC	cluster	290
Willow	120			
Buttonbush	10			
Wax myrtle	10	8' OC		
dogwood	20			
Elderberry	30			

Myakka Creek

Fern	114	24" OC	Cluster	524
Alligator Flag			Cluster	
Sawgrass	100	36" OC	Cluster	
Rose Mallow	10		Cluster	
Phragmites	20		Cluster	
popash	30			
Tupelo				
Willow	30			
Elm	10			
Dahoon	30			
Red maple	30	8' OC		
Buttonbush	30			
Wax myrtle	30			
dogwood	30			
Q. laurifolia	10			
Elderberry	10			

Scattered Under Oaks

Fakahatchee & Spartina	500		Scattered	500

TOTAL 14821

Figure 4 - Photos (before)

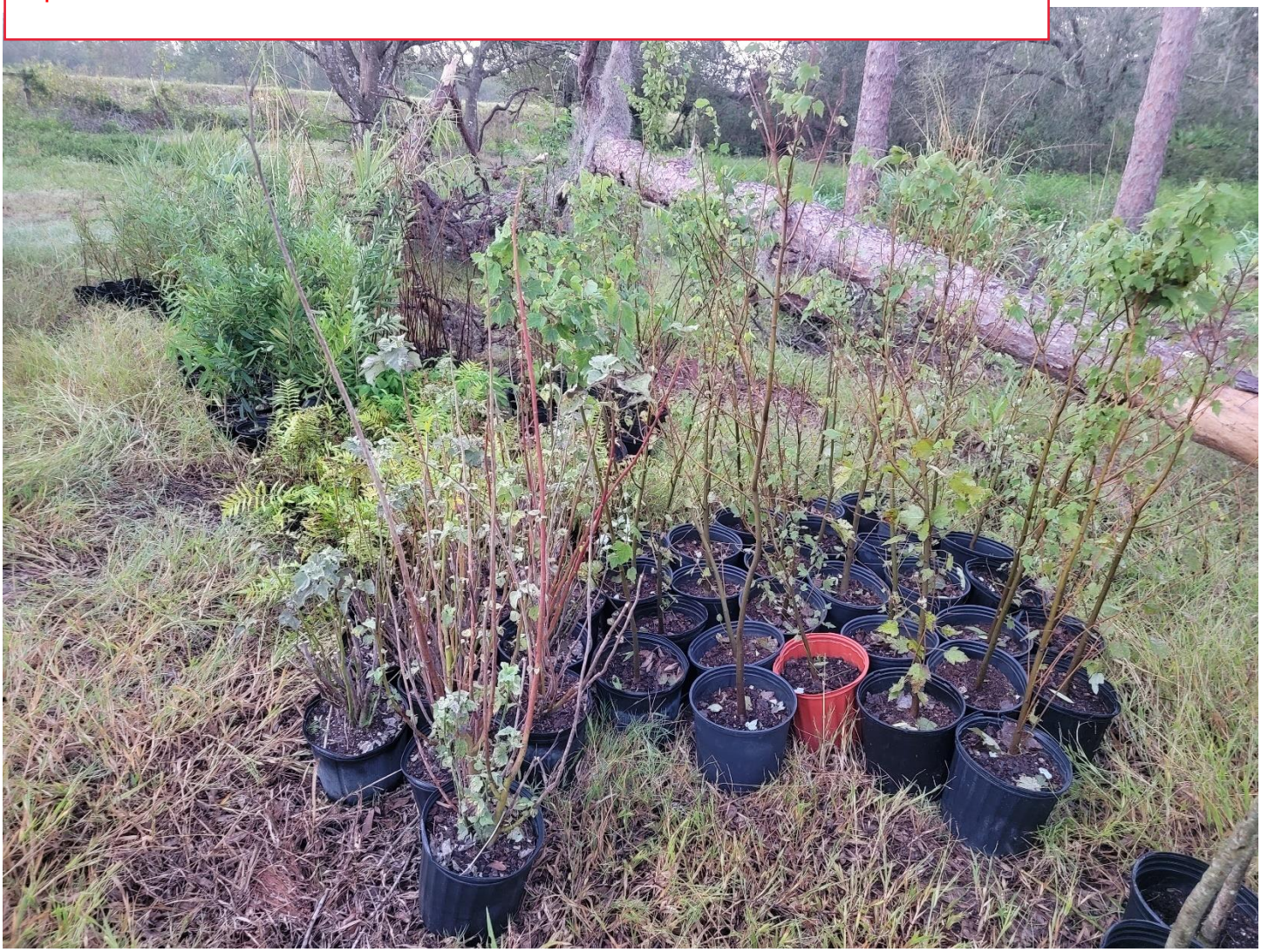
Photo of Donor Site - Maidencane
Blackbeard Ranch 12/03/22
27.241131, -82.136293

Representative Photos of the Plants - Coreopsis

Figure 4 - Photos (before)

Representative Photos of the Plants - Misc. Hardwoods, incl. Pop Ash

Representative Photos of the Plants - Misc. Shrubs & Ferns



Representative Photos of the Plants - Misc. Shrubs & Ferns

Representative Photos of the Plants - Misc. Shrubs

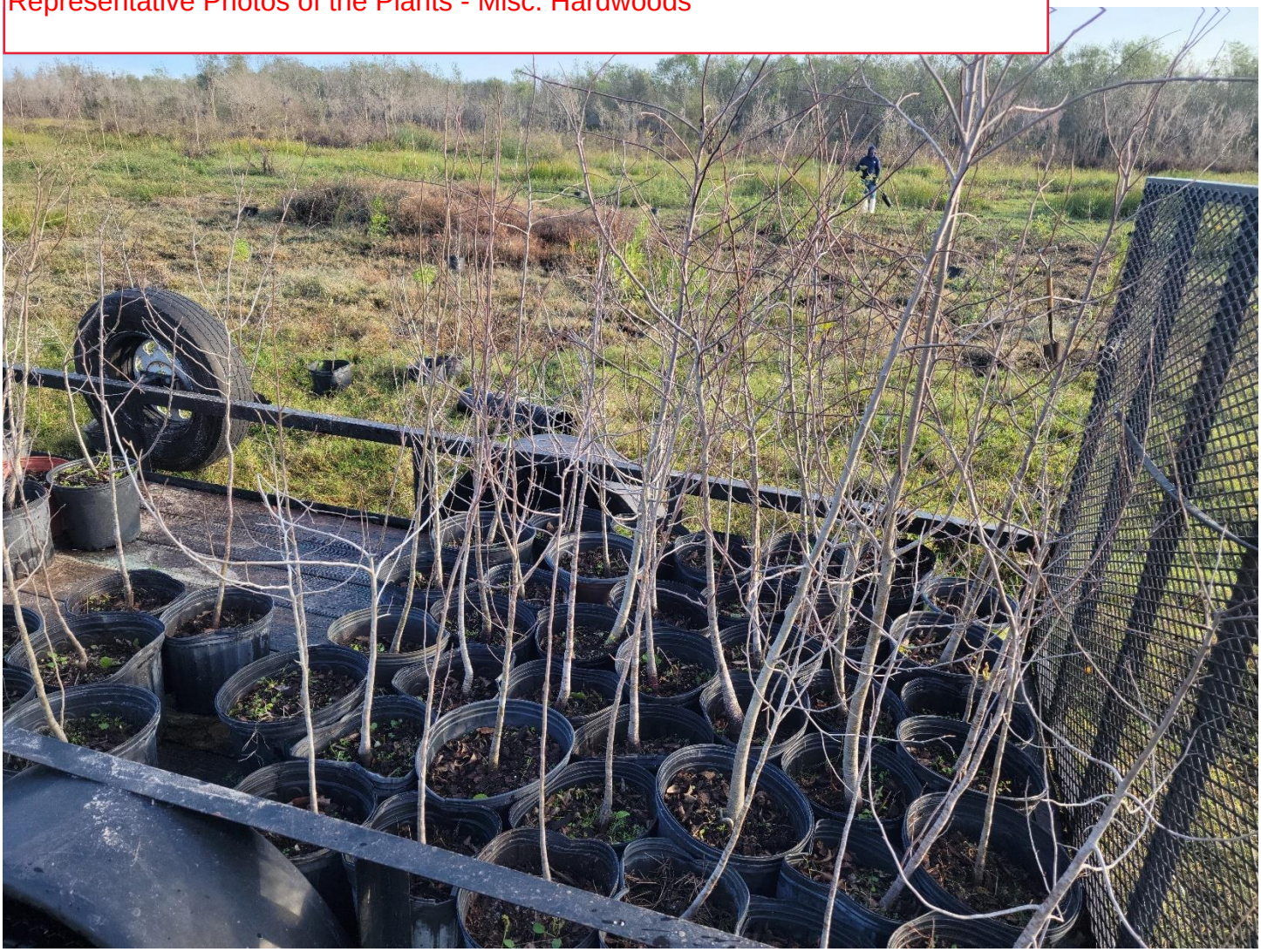
Representative Photos of the Plants - Misc. Shrubs

Representative Photos of the Plants - Fakahatchee Grass

Representative Photos of the Plants - Fakahatchee Grass

Representative Photos of the Plants - Wax Myrtle

Representative Photos of the Plants - Misc. Hardwoods

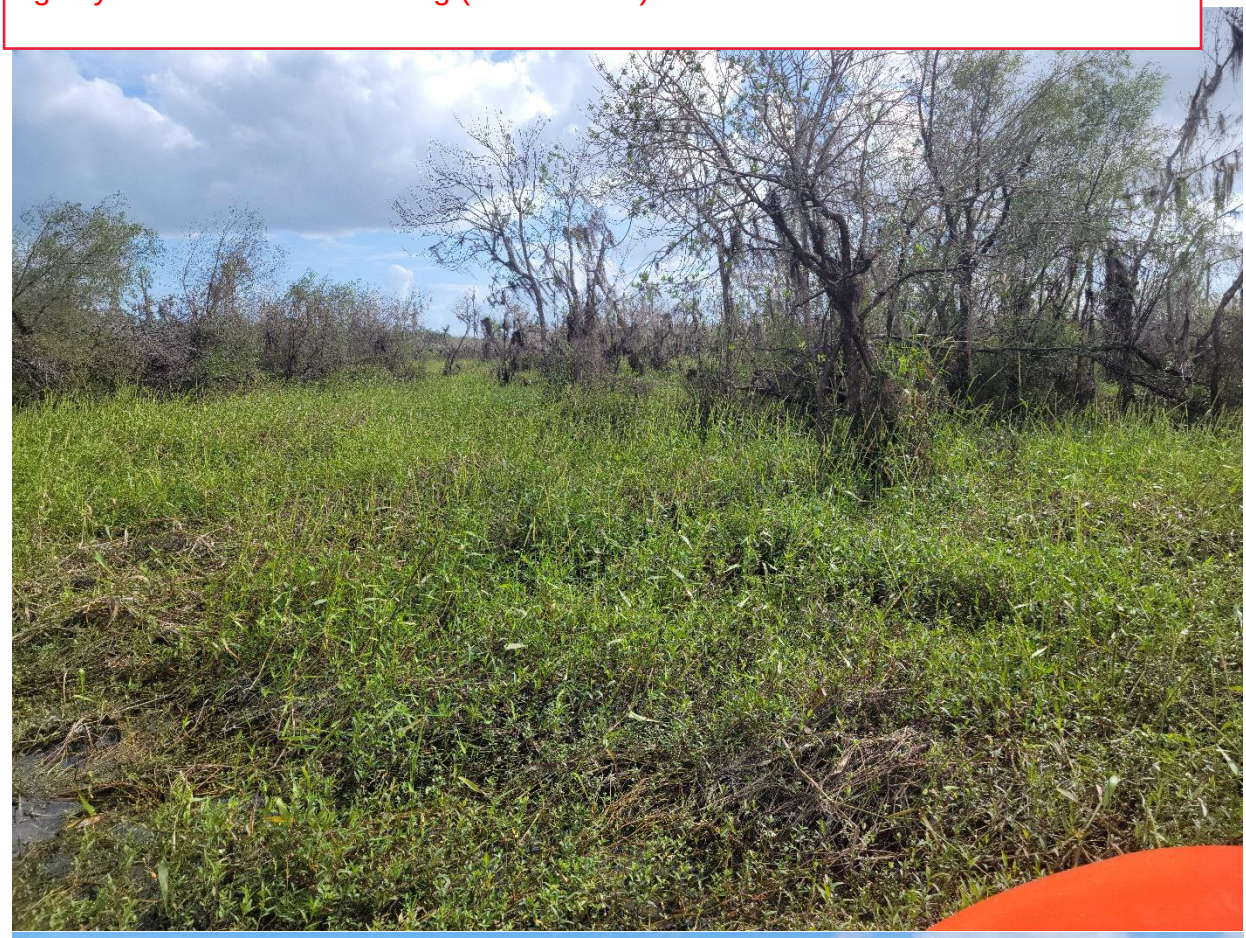


Myakka Creek - Before Planting (Two Photos)

Maidencane Areas - Before Planting (Three Sites, One Photo Each)

Mixed Area - Before Planting

Ogleby Creek - Before Planting (Two Photos)



Myakka Creek - Post Planting - Note effective WIMG treatment (brown)

Ogleby Creek - Post Planting - Note effective WIMG treatment

Maidencane Area - Post Planting (Two Photos)

Myakka Creek - Post Treatment & Planted (Two Photos)

Ogleby Creek - Post Treatment & Planted (Two Photos)
Note effective WIMG treatment (brown vegetation)

Figure 4 - Photos
(before)

Lygodium Pre-Treatment Photos April 15, 2023

Figure 4 - Photos
(after)

Lygodium Initial Post-Treatment Photos May 17, 2023

Figure 4- Photos (Final Inspection)

The following photos were taken during final inspection, Nov 9. 2023

Lygodium Treatment Area

Photos showing re-growing lygodium

Ogleby Creek Area

Planted phramites are thriving in this location.

Ogleby Creek Area - 2" popash appear to have fared better than 3-gallon.

Ogleby Creek area, top photo showing dominating ground cover of smartweed.


Ogleby Creek area, surviving 3-gallon popash photo left and dead wax myrtle, photo right.

Mixed Planting Area

Thalia did not survive as well as expected, cause unknown.

Northern Maidencane Area

Northern Maidencane area, dominated by smartweed, photo right, with 50% survival of planted grass, photo left.

Northern maidnencane area, dominated by smartweed.

Southern Maidencane Area

Southern maidnencane planting area, dominated by smartweed. Photo right showing abundant sprouting plants below the smartweed, possibly Coreopsis that seeded from the prior planting.

Myakka Creek Area

Myakka Creek area showing healthy Phragmites, left, and willow, right.

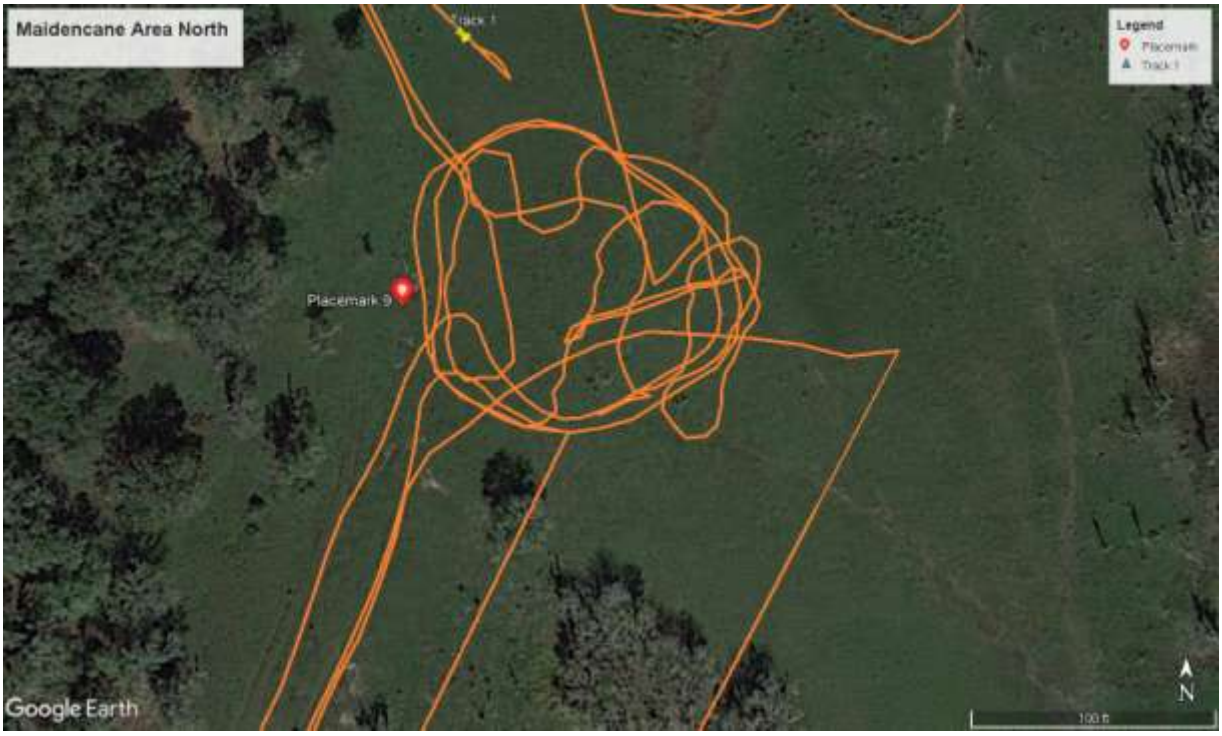
Myakka Creek area showing health buttonbush, left, and a dead tree, right.

Myakka Creek area showing health pop ash, left, and red maple, right. Both were planted at a higher elevation near the riparian tree line of Ogleby Creek.

Figure 5

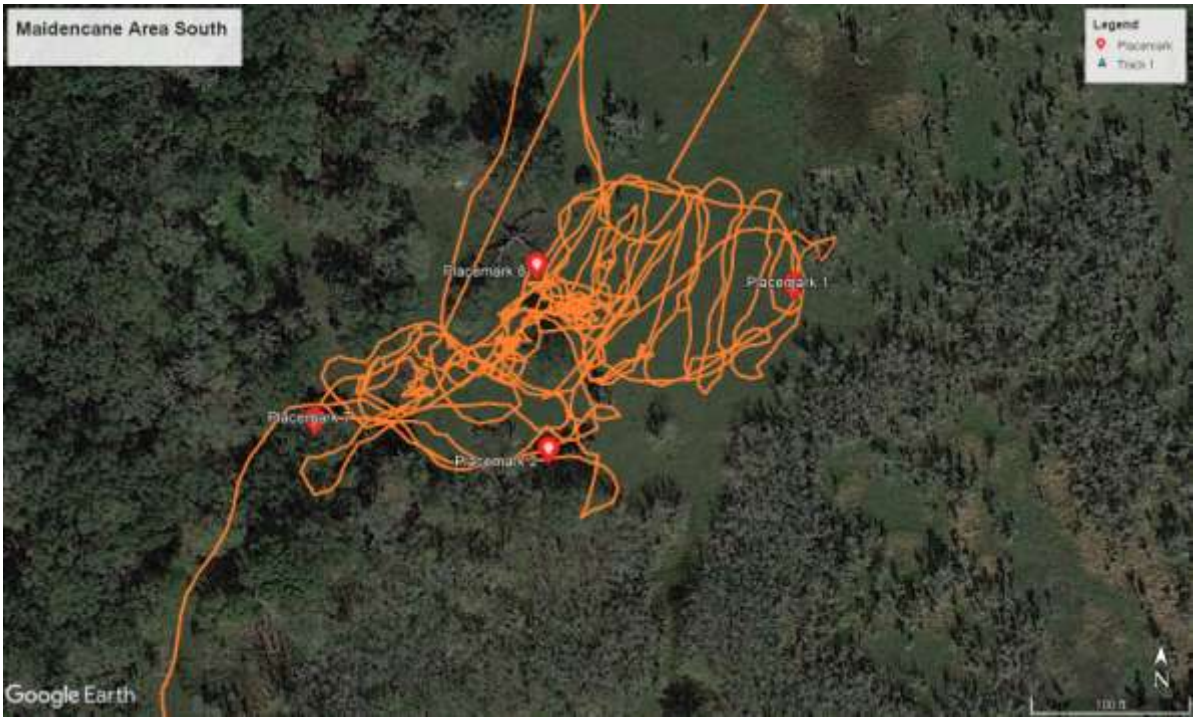
Treatment Logs, Including Movements of Contractor Throughout Areas

DAILY TREATMENT LOG



Date	11/25/2022
Time	11 am
Temperature	73-81
Wind Speed, Wind Direction	WSW6 to ESE 6
Precipitation Potential for the 6 Hours Post-Treatment	5%
Treatment A	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration	West Indian Marsh Grass, Bermuda grass, Alligator weed ATV – Wand Systemic - Broadleaf Rodeo 2% Cidekick 1%
Treatment B	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration e) Total Herbicide Volume	N/A

DAILY TREATMENT LOG



Date	11/25/2022
Time	8 am
Temperature	73-81
Wind Speed, Wind Direction	WSW6 to ESE 6
Precipitation Potential for the 6 Hours Post-Treatment	5%
Treatment A	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration	West Indian Marsh Grass, Bermuda grass, Alligator weed ATV – Wand Systemic - Broadleaf Rodeo 2% Cidekick 1%
Treatment B	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration e) Total Herbicide Volume	N/A

DAILY TREATMENT LOG

Date	11/28/2022
Time	2 pm
Temperature	73-77
Wind Speed, Wind Direction	NE to E 4
Precipitation Potential for the 6 Hours Post-Treatment	5%
Treatment A	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration	West Indian Marsh Grass, Primrose, Bermuda grass, Alligator weed, Torpedo grass, Limpograss ATV – Wand Systemic - Broadleaf Rodeo 2% Cidekick 1%
Treatment B	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration e) Total Herbicide Volume	N/A

DAILY TREATMENT LOG

Date	11/28/2022
Time	9 am
Temperature	73-77
Wind Speed, Wind Direction	NE to E 4
Precipitation Potential for the 6 Hours Post-Treatment	5%
Treatment A	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration	West Indian Marsh Grass, Primrose, Bermuda grass, Alligator weed, Torpedo grass, ATV – Wand Systemic - Broadleaf Rodeo 2% Cidekick 1%
Treatment B	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration e) Total Herbicide Volume	N/A

DAILY TREATMENT LOG

Date	11/25/2022
Time	12 pm
Temperature	73-81
Wind Speed, Wind Direction	WSW6 to ESE 6
Precipitation Potential for the 6 Hours Post-Treatment	5%
Treatment A	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration e) Total Herbicide Volume	West Indian Marsh Grass, Primrose, Bermuda grass, Alligator weed, Torpedo grass, Limpograss ATV – Wand Systemic - Broadleaf Rodeo 2% Cidekick 1%
Treatment B	Indicate Location On Above Map
a) Targeted Species b) Treatment Method c) Herbicide Type d) Herbicide Concentration e) Total Herbicide Volume	N/A

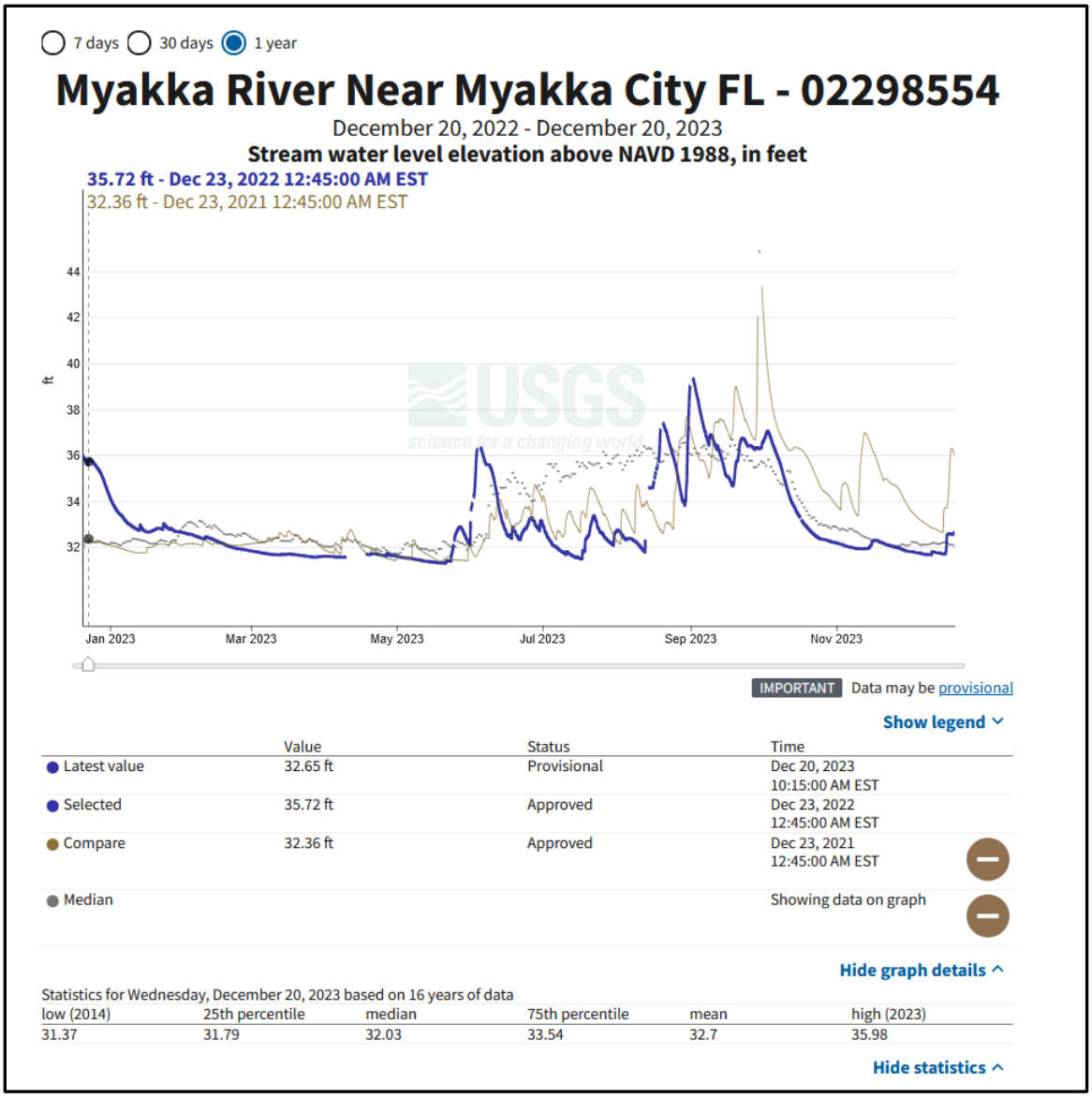
Figure 6 - Stream Elevation Data

FIGURE 6. Stream elevation data in NAVD 1988 for the Myakka River at MHP, taken from the stream gauge maintained by the USGS at the Wauchula Rd Bridge, Myakka City, FL (located at the downstream outfall of the Project site). 2023 stream elevation data shown as a solid blue line, 2022 data as a solid grey line, and the mean elevation as a dashed grey line.

Project plantings took place on December 3, 2022, with a fortuitous irrigating flood taking place in late December/early January.

At MHP, mean flood heights hover around 35-36 ft NAVD 1988 throughout the rainy season (dashed line), and the Myakka/Ogleby creeks overtop their banks at about 33 feet. Thus, 1-3' of flooding is present on average throughout the rainy season. Planted plants must be able to grow above this height, at a minimum, to survive.

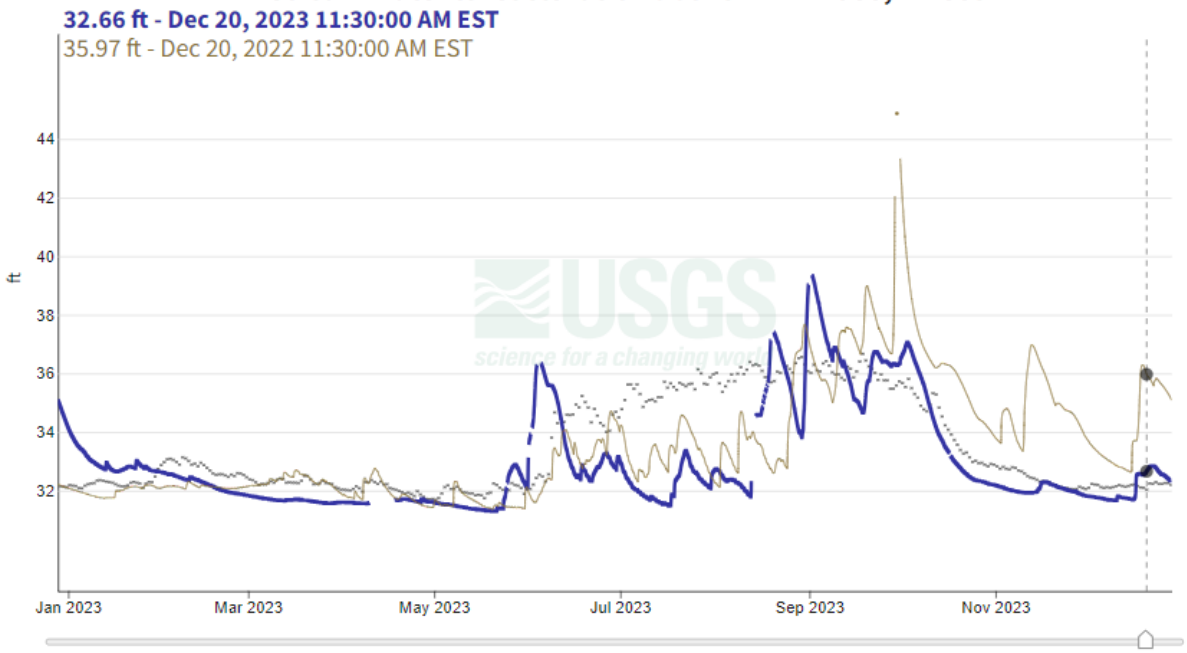
Note peak flood heights above 44 feet during Hurricane Ian, September 28-29, 2022. Note an early-season flood in June 2021 that overtopped marshes with seven feet of water. Both floods would likely have killed any restoration plantings that did not have at least a few months of establishment prior to the flood.



Myakka River Near Myakka City FL - 02298554

December 28, 2022 - December 28, 2023

Stream water level elevation above NAVD 1988, in feet



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	32.35 ft	Provisional	Dec 28, 2023 14:15:00 PM EST
Selected	32.66 ft	Provisional	Dec 20, 2023 11:30:00 AM EST
Compare	35.97 ft	Approved	Dec 20, 2022 11:30:00 AM EST
Median			Showing data on graph