Hyco Lake 5-year Aquatic Habitat Enhancement Plan

2020-2025

Inland Fisheries Division

Updated: June 19, 2020

Objectives:

The purpose of this 5-year plan is to enhance habitat for the fisheries of Hyco Lake, to improve angler catch rates and satisfaction, and to activate the public to participate in habitat improvement efforts. To meet these objectives the Commission proposes to establish native vegetation at seven locations, to add six new artificial habitat sites, and to refurbish existing artificial habitat sites that need enhancement. Public involvement will aid in selecting and deploying artificial habitat as well as planting native vegetation.

Need:

Impounded reservoirs often have limited natural habitat such as vegetation or woody debris. Over time reservoirs lose aquatic habitat through increased sedimentation and decomposition of large woody debris. Previously, aquatic vegetation disappeared within 2 years of the accidental Redbelly (*Tilapia zillii*) and Blue Tilapia (*Oreochromis aureus*) introductions (Crutchfield et al. 1992). However, recent cold winters have resulted in an apparent reduction, as reflected in fisheries surveys by Duke Energy and the Commission, in the Tilapia populations opening a window for biologists to attempt to re-establish native vegetation.

Expected Results and Benefits:

This plan will identify possible sites for both native vegetation establishment and artificial and natural structures using bathymetry, lake zoning, residential considerations, and existing vegetation. With proper time and effort, planted aquatic vegetation will continue to grow and expand to new areas within the lake. Native aquatic vegetation is beneficial to the ecosystem and landowners because it provides important habitat for juvenile and adult sportfish and other wildlife and acts as a food source for aquatic organisms and waterfowl. Vegetation can also improve water quality, reduce rates of shoreline erosion and sedimentation, and help slow the spread of nuisance aquatic plants. This project will also give anglers an opportunity to directly provide input to biologists on beneficial sites for habitat enhancement.

Background

Hyco Lake is a 1,760-ha impoundment formed by Carolina Power and Light Company (now Duke Energy) in the early 1960s to serve as a cooling reservoir (Crutchfield 1995). The lake is fed by four main tributaries, Cane Creek, Cobbs Creek, North Hyco and South Hyco rivers. The power plant is located at the confluence of the North and South Hyco River and it produces a warm water effluent that keeps the surface water temperature in and around the discharge canal above 14°C year-round (Crutchfield 1995; Reid Garrett, Duke Energy, personal communication). During this process, organic matter and nutrients are filtered out of the water resulting in an environment that is more oligotrophic downstream of the plant's discharge. Hyco Lake is used for recreation, angling, and power plant cooling.

There is one public boat access area at the Hyco Lake Marina which is operated by the Person-Caswell Lake Authority (PCLA). Hyco Lake's shoreline is designated as either prohibited, reserved, or subleased per an agreement between the PCLA and Duke Energy (Figure 1). Prohibited and reserved shorelines are reserved to be undeveloped land whereas subleased shoreline is either developed or has the possibility to be developed in the future. There are many personal residences on the lake and homeowners have expressed concern over sedimentation in certain areas. Increased development within the watershed and reduced shoreline buffers could lead to increased nutrient loading over time and harmful algae outbreaks. Duke Energy has monitored and reported nutrient levels within the lake. The North Carolina Division of Water Resources has also monitored nutrients and productivity within Hyco Lake as a part of the Ambient Lake Monitoring Program.

Existing Conditions

Fisheries.— Hyco Lake contains many fish species of interest to anglers including sunfish *Lepomis* spp., catfish *Ictalurid* spp., White Crappie *Pomoxis annularis*, Black Crappie *Pomoxis nigromaculatus*, and Largemouth Bass *Micropterus salmoides* and more recently, Hybrid Striped Bass (Bodie Bass) *Morone chrysops* x *Morone saxatilis*. The lake also contains populations of both Redbelly and Blue Tilapia. In 1984, an estimated 100 Tilapia, both species in combination, were accidentally released into the heated effluent area of Hyco Lake (Crutchfield 1992). Within two years of this accidental introduction, the submersed macrophyte community was eliminated and the abundance of certain prey fish declined (Crutchfield et al. 1995).

The Commission monitors changes in population characteristics of sport fish every 2-5 years. Duke Energy performs whole fish community assessments annually on Hyco Lake. Current Commission monitoring efforts continue to document average to below average sport fisheries compared to other Piedmont reservoirs. The current Largemouth Bass fishery displays below average growth and condition and is comprised of a large percentage of fish that are less than harvestable size (Lincoln and Baumann 2016a). The current Black Crappie fishery is comprised of a large percentage of harvestable sized fish that display average growth and condition (Lincoln and Baumann 2016b).

Aquatic Habitat.— Native aquatic vegetation is beneficial to the ecosystem because it provides important habitat for juvenile and adult sportfish and other wildlife. Vegetation also acts as a food source for aquatic organisms and waterfowl (Dibble et al. 1996) and helps prevent the spread of nuisance aquatic plants (Smart et al. 1994). It can also be beneficial to homeowners and recreational users because it improves water quality and clarity (James and Barko 1990) and reduces rates of shoreline erosion and reservoir sedimentation (James and Barko 1995). However, Hyco Lake has limited aquatic vegetation because of heavy grazing by Tilapia (Crutchfield et al. 1992). In recent years, as the Tilapia population appears to have declined, SAV has increased in some areas. Hydrilla *Hydrilla verticillata*, was present in Hyco Lake prior to the accidental Tilapia introduction, concerning some homeowners that it may return in the absence of Tilapia. In the event Hydrilla returns to the lake, the NC DEQ Aquatic Weed Control

Program will be notified and involved in developing a separate plan for managing nuisance invasive plants.

Other forms of habitat structure, natural and artificial, can provide opportunities for fish to carry out certain habitat related tasks and improve angler catch rates. Fish can use structures for spawning, resting, feeding, migration, and as a nursery habitat for young fish. These habitat structures can provide areas for algae attachment and aquatic insect colonization which is beneficial for planktivorous fish. Complex structures provide better refuge for small fish, while less complex cover in nesting areas is effective habitat for spawning activities. In addition, habitat structures can attract and congregate fish (Bohnsack et al. 1997, Basset 1994) which can improve angler catch rates. Hyco Lake has very little existing habitat structure. There are no flooded timber stands and very little woody habitat due to shoreline development. There are currently 11 existing artificial habitat sites (Figure 3).

Approach

Proposed Habitat Enhancements

This plan's approach for improving habitat is made up of four components: 1) public involvement, 2) native aquatic vegetation, 3) artificial habitats, and 4) natural structure (felled trees). This plan includes a detailed timeline outlining project activities for the next five years. While this project will seek input from public the plan will generally be steered by PCLA, the NCWRC, and Duke Energy who will meet periodically to update and implement the plan.

All proposed habitat work will be completed in areas in the reservoir where oxygen levels are adequate for fish to use year-round, characterized as the Habitat Enhancement Zone (HEZ) (Clark-Kolaks 2016). During summer months fish can utilize habitat down to 4 to 5 m in most of the lake (Duke Energy 2016).

Public Involvement.— Incorporating volunteers from the Hyco Lake community and other members of the public is essential to the mission of this project. The Commission will seek public input by providing an on-line survey which will also be distributed at in person events (see timeline) and through the marina. This survey will seek comments on where to place artificial and natural structures as well as where to begin native vegetation efforts. This survey will also be a way for stakeholders and members of the public to provide feedback on the project and to sign up to be a volunteer. Other efforts to gather volunteers will be made by speaking at local fishing groups, attending events hosted by the PCLA, and attending large fishing expositions in the area if necessary.

Commission staff will work with the PCLA, Duke Energy, and the public to develop and implement this plan. The plan will be updated periodically based on stakeholder input. Design, construction, and placement of all aquatic habitat will be approved by the Commission, PCLA, and Duke Energy. Commission staff will always be on site during enhancement activities to

supervise and assist in construction and placement of natural and artificial habitat and planting native aquatic vegetation.

Native Aquatic Vegetation.— Proposed revegetation sites (Figure 2) were selected based on Duke Energy and PCLA's shoreline use designation (Figure 1), proximity to homeowners, and habitat availability. These 23 identified locations are sites where biologist have indicated a possibility in establishing vegetation. However, these sites have not been formally evaluated for suitability, nor approved by Duke Energy or PCLA, and thus, the Commission expects the actual number of suitable sites to be less (i.e., these are sites that are available to choose from). The number and location of sites are subject to change as input is received from the community, PCLA, and Duke Energy. Proposed plant species for each site (Table 3) were based on substrate type, topography, water depth appropriate for each species, the plant's desiccation tolerance, existing plants within the reservoir, and susceptibility to herbivory (Table 1). Establishing native aquatic vegetation in reservoirs is a multi-year effort. Successful revegetation often requires a community effort and is typically completed in two phases.

During Phase 1, potential sites and the desired plant species will be identified. To aid in further identifying and validating proposed or potential sites, vegetation surveys will be conducted during Phase 1. The Commission will complete a whole lake visual survey of emergent and rooted-floating leaf vegetation. Duke Energy will survey the SAV using sonar and point intercept sampling. Once sites are chosen, the revegetation work will focus on establishing submergent, rooted floating leaf and emergent plants (Table 2; Appendix B). Water Willow, Maidencane and Buttonbush are not as susceptible to herbivory and can be planted outside protective exclosures. Water Willow has also already been successfully established within the Roanoke River system downstream in John H. Kerr (Buggs Island) and Gaston Reservoirs. Lastly, a pilot site may be implemented Phase 1 to demonstrate the effectiveness and logistics of exclosure use for revegetation efforts.

Phase 2 involves planting and monitoring plants that are either within or without small protective fenced areas, called exclosures. Monitoring during Phase 2 will help to determine the level of grazing pressure present in the lake and which species will likely result in the successful establishment of founder colonies. The size and number of sites will be expanded in Phase 2 and should result in the successful establishment of founder colonies. These colonies can spread in the reservoir through vegetative growth, seed production, and fragmentation (Smart et al. 1996, 1998). This information will then be used to determine how to proceed for Phase 3, which will likely occur after this 5-year plan. Phase 3 will include continued monitoring of established vegetation and possibly expanding vegetation efforts by adding additional sites.

Commission biologists will utilize protocols designed to reduce the transport and spread of invasive or nuisance plants and animals. Exclosures will be constructed in near-shore areas in shoreline designated as sublease or prohibited and in areas that are unlikely to be utilized by boat traffic. High visual yellow fence guards will be placed on top of the exclosures and corners may also be marked with PVC pipe with reflective tape at the top. Exclosures will be marked

with signs supplied by the Commission notifying reservoir users that the fencing and plants are for improving aquatic habitat.

Artificial Habitat.— Artificial habitat locations will be based on the following factors: 1) the extent of the Habitat Enhancement Zone, 2) guidelines for deploying fish attractors in Duke Energy Lakes for installing aquatic habitat (Duke Energy 2020), 3) shoreline zoning, and 4) public input. The guidelines established by Duke Energy maintain that habitat may be approved for placement without buoys if it is underneath a properly permitted structure, is associated with a pier (given several stipulations), or is in water that is less than 20 ft (or 6 m) deep (based on a 5 ft tall habitat structure).

Over the course of five years, the existing artificial habitat sites will be re-furbished as needed and six new sites will be created (Figure 3). If possible, biologists will seek input from the community and anglers on their overall satisfaction and success with existing structures through the survey described in the public involvement section. Biologists will survey existing structures to determine which existing sites (if any) need to be re-furbished or enhanced. The six proposed sites identified in Figure 3 may change based on public input. These sites will incorporate complex artificial habitats designed to provide refuge for prey fish and cover for larger predators. The four main types of structures used will be a modified Georgia Cube, poly trees, spider blocks and/or Mossbacks (Appendix A).

Following to Duke Energy's guidelines, new and re-furbished sites will be marked with buoys. Buoys will be maintained and monitored annually by the Commission. All fish attractor sites will also be identified with GPS coordinates that are available to download from the Commission's website (https://www.ncpaws.org/ncwrcmaps/fishattractors).

Felled Shoreline Trees.— Felled shoreline trees can provide excellent fish habitat and congregate adult and juvenile Bluegill, black bass, and Black Crappie (Basset 1994). Trees are readily available, environmentally friendly, require minimum amounts labor, and are less costly than artificial habitats. Felled trees provide a diversity of interstitial space that can be used in a variety of ways by many species. They also provide natural surface area for periphyton and invertebrates which act as a food supply for fish. Trees should be felled in areas with sufficient shoreline depth (>10ft) and cabled to their stump to ensure the trunk will not float off and cause a boating hazard. Commission staff will identify potential trees to cut and cable to the shoreline during the 2020 whole lake survey.

Proposed Timeline

Year 1 – 2020

- Complete a survey of existing emergent, and floating-rooted vegetation along the entire shoreline, assess existing artificial habitats, locate woody debris such as fallen trees and assess bathymetry and other natural features in order to identify and evaluate potential sites for habitat enhancement (Commission Staff).
- Complete a submergent vegetation survey (Duke Energy Staff).

- Identify potential trees that can be cut and cabled to the shoreline.
- Further develop habitat enhancement plan.
- Plant native aquatic vegetation at one demonstration site.

Year 2 – 2021

- Obtain public input on locations and type of artificial habitats that could be used to improve aquatic habitat as well as locations for native vegetation sites.
- Utilize public input to update the habitat enhancement plan.
- Re-furbish existing artificial habitat sites.
- Assess community feedback on the demonstration site to determine how best to proceed via a public survey and in person outreach events.
- Assess vegetation in pilot study.
- Implement aquatic vegetation enhancements using community feedback and sites identified in the plan.

Year 3 – 2022

- Install two to three of the artificial habitat sites from the habitat enhancement plan.
- Assess vegetation in founder colonies.
- Implement additional aquatic vegetation enhancements using community feedback and sites identified in the plan.

Year 4 – 2023

- Install two to three of the artificial habitat sites from the habitat enhancement plan.
- Assess vegetation in founder colonies.
- Implement additional aquatic vegetation enhancements using community feedback and sites identified in the plan.

Year 5 – 2024

- Assess vegetation in founder colonies.
- Whole lake vegetation survey
- Implement additional aquatic vegetation enhancements using community feedback and sites identified in the plan.
- Survey public opinion on the success of habitat enhancement efforts
- Develop 2025 - 2026 habitat plan
- Final report will be completed by June 2025.

Literature Cited

Bassett, C.E. 1994. Use and evaluation of fish habitat structures in lakes of the eastern United States by the USDA Forest Service. *Bulletin of Marine Science*, 55(2–3): 1137–1148.

Bohnsack, J.A., Ecklund, A. M. and Szmant, A. M. 1997. Artificial reef research: is there more than the attraction-production issue. *Fisheries*, 22(4): 14–16.

Clark-Kolaks, S.J. 2016. Aquatic Habitat Enhancement Plan for the placement of natural and artificial habitats in Indiana's reservoirs. Indiana Department of Natural Resources, Indiana. 22 pp.

Crutchfield, J.U., D.H. Schiller, D.D. Herlong, and M.A. Mallin. 1992. Establishment and impact of Redbelly Tilapia in a vegetated cooling reservoir. Journal of Aquatic Plant Management 30:28–35.

Crutchfield, J.U. 1995. Establishment and expansion of Redbelly Tilapia and Blue Tilapia in a power plant cooling reservoir. American Fisheries Society Symposium 15:452–461.

Dibble, E.D., K.J. Killgore, and S.L. Harrel. 1996. Assessment of fish-plant interactions. American Fisheries Society Symposium. 16:357-372.

Duke Energy. 2016. Roxboro Steam Electric Plant Environmental Monitoring Report. Raleigh, North Carolina.

Duke Energy. 2020. Guidance for Wildlife Resource Agency Deployment of Fish Attractors in Duke Energy Lakes. Raleigh, North Carolina.

James, W.F., and J. W. Barko. 1990. Macrophyte influences on the zonation of sediment accretion and composition in a north-temperate reservoir. Archives of Hydrobiology 120:129 - 142.

James, W.F., and J.W. Barko. 1995. Effects of submersed macrophytes on sediment resuspension in Marsh Lake, Minnesota. Pages 169-175 *in* Proceedings of the 29th annual meeting, Aquatic Plant Control Research Program. U.S. Army Corps of Engineers, Waterways Experiment Station, Miscellaneous Paper A-95-3, Vicksburg, Mississippi.

Lincoln, K.J., and J.R. Baumann. 2016a. Hyco Lake Largemouth Bass survey, 2016. North Carolina Wildlife Resources Commission, Summary Report, Federal Aid in Fish Restoration, Project F-108, Raleigh.

Lincoln, K.J., and J.R. Baumann. 2016b. Hyco Lake Black Crappie survey, 2016. North Carolina Wildlife Resources Commission, Summary Report, Federal Aid in Fish Restoration, Project F-108, Raleigh.

Smart, R.M., J.W. Barko, and D.G. McFarland. 1994. Competition Between *Hydrilla vercillata* and *Vallisneria Americana* under different environmental conditions. Technical Report A---94---1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Smart, R.M., G.O. Dick, and R.D. Doyle. 1998. Techniques for establishing native aquatic plants. Journal of Aquatic Plant Management 36:44-49.

Smart, R. M., R. D. Doyle, J. D. Madsen, and G. O. Dick. 1996. Establishing native submersed aquatic plant communities for fish habitat. Pages 347-356 *in* L. E. Miranda and D. R. DeVries, editors. Multidimensional approaches to reservoir fisheries management. American Fisheries Society, Symposium 16. Bethesda, Maryland.

Webb, M.A., J. Richard A. Ott, C.C. Bonds, R.M. Smart, G.O. Dick. and L. Dodd. 2012. Propagation and establishment of native aquatic plants in reservoirs. Texas Parks and Wildlife Department, Inland Fisheries Division, Management Data Series.

TABLE 1.—The various plant species typically used in re-vegetation efforts in North Carolina and their biological characteristics.

Species Name	Common Name	Plant Type	Substrate	Planting Depth (cm)	Max. Depth (m)	Desiccation Tolerant	Susceptible to Herbivory	Individual Spacing (m)
Justicia americana	Water Willow	Emergent	Rock or gravel	0 - 91	1.2	Yes	Low	0.9
Panicum hemitomon	Maidencane	Emergent	Clay to muck	0 - 15	2.1	Yes	Low	0.3 - 0.9
Pontederia cordata	Pickerelweed	Emergent	Sand to muck	0 - 91	1.2	Moderate	Moderate	0.9
Schoenoplectus tabernaemontani [Scirpus validus]	Softstem Bulrush	Emergent	Sand to muck	0 - 91	1.5	Yes	Low	0.9
Nuphar advena [N. lutea]	Spatterdock	Floating Rooted	Sand to muck	50 - 91	1.8	Yes	Low	1.8 - 2.7
Nymphaea odorata	White Water Lily	Floating Rooted	Sand to muck	50 - 91	1.8	Yes	Low	1.8 - 2.7
Cephalanthus occidentalis	Buttonbush	Shrub	Sand to muck	0 - 15	0.6	Yes	Low	0.9 - 2.7
Potamogeton nodosus	American Pondweed	Submergent	Sand to muck	30 - 122	3	Yes	High	0.9
Vallisneria americana	Eelgrass	Submergent	Sand to muck	30 - 122	3	no	High	0.9

TABLE 2.—Proposed revegetation sites in Hyco Lake. Sites sorted by the need for an exclosure.

Site ID	Shoreline	Plant (s)	Sediment	Wave Action	Exclosure	x	y	Comments
H1	Reserved	Water Willow	Unknown	Medium to high	No	36.47811	-79.09608	Cove near heated effluent
H2	Reserved	Water Willow	Rocks	Low	No	36.47866	-79.11950	Along 57 bridge
H3	Reserved	Water Willow	Unknown	Low	No	36.46710	-79.12588	Opening at end of cut through
H4	Reserved	Water Willow	Sandy/Rocky	Low	No	36.46604	-79.09263	Along Roxboro Plant Rd. near island
H7	Reserved	Water Willow	Rocky	High	No	36.45567	-79.08984	Rock wall
H8	Reserved	Water Willow	Unknown/rocks	High	No	36.47524	-79.10363	Near bridge
P1	Prohibited	Water Willow	Sandy	Medium to high	No	36.48330	-79.08794	Cove near heated effluent
P2	Prohibited	Water Willow	Unknown	Low	No	36.48928	-79.08246	Near intake
P3	Prohibited	Water Willow	Sandy/Rocky	Low to Medium	No	36.50893	-79.04480	Cove near dam
P4	Prohibited	Water Willow	Unknown	Medium to high	No	36.50510	-79.04096	Under powerlines near dam
S2	Sublease	Water Willow	Sandy/Rocky	Medium	No	36.45742	-79.17059	Sandy spot near Osmond Rd.
S3	Sublease	Water Willow	Sandy	Medium to high	No	36.47079	-79.15857	Cove
S8	Sublease	Water Willow	Unknown	High	No	36.50496	-79.05435	Shallow shoal near dam

TABLE 2.—Continued

Site ID	Shoreline	Plant (s)	Sediment	Wave Action	Exclosure	x	y	Comments
H5	Reserved	Pickerweed, Bullrush, Water Willow	Unknown	Low to Medium	Yes	36.45256	-79.09118	Cove
H6	Reserved	Pickerweed, Bullrush, Water Willow	Unknown	Low to Medium	Yes	36.45879	-79.09229	Cove
S1	Sublease	Pickerweed, Spadderdock, Lillies	Mucky/Sandy	Low	Yes	36.44874	-79.18124	Mouth of Reedy Fork
S4	Sublease	Pickerweed, Spadderdock, Lillies	Sandy/mucky	Low	Yes	36.41216	-79.11048	Mouth of S. Hyco Creek
S5	Sublease	Pickerweed, Bullrush, Water Willow	Unknwon	Low	Yes	36.50037	-79.05376	Cove, possibly near cow pasture
S6	Sublease	Pickerweed, Spadderdock, Lillies	Mucky/Sandy	Low	Yes	36.45889	-79.13419	Mouth of Cobb Creek
S7	Sublease	Pickerweek, Bullrush, Lillies	Mucky/Sandy	Low	Yes	36.44786	-79.08803	Mouth of Little Duck Creek
S9	Sublease	Pickerweed, Spadderdock, Lillies	Mucky/Sandy	Low	Yes	36.43027	-79.10606	Backwater cove in S. Hyco Creek
S10	Sublease	Pickerweed, Spadderdock, Lillies	Mucky/Sandy	Low	Yes	36.44120	-79.17932	Mouth of Hyco Creek
S11	Sublease	Pickerweed, Spadderdock, Lillies	Mucky/Sandy	Low	Yes	36.43945	-79.10175	Backwater cove in S. Hyco Creek

FIGURE 1. Map of shoreline delineation according to the agreement between the PCLA and Duke Energy.

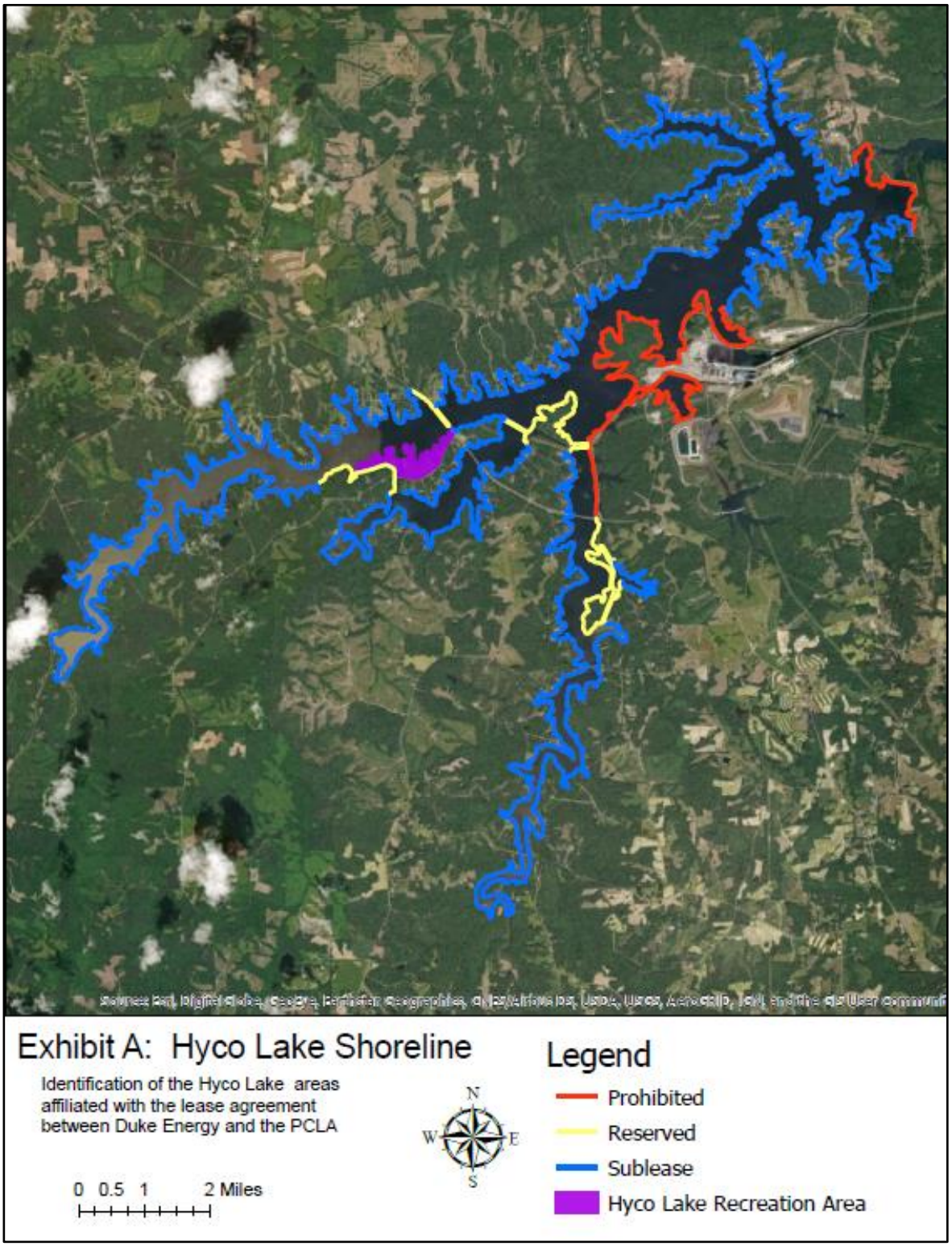


FIGURE 2. Map of proposed revegetation sites where blue pins represent subleased shoreline, yellow represents reserved shoreline, and red represents prohibited shoreline.

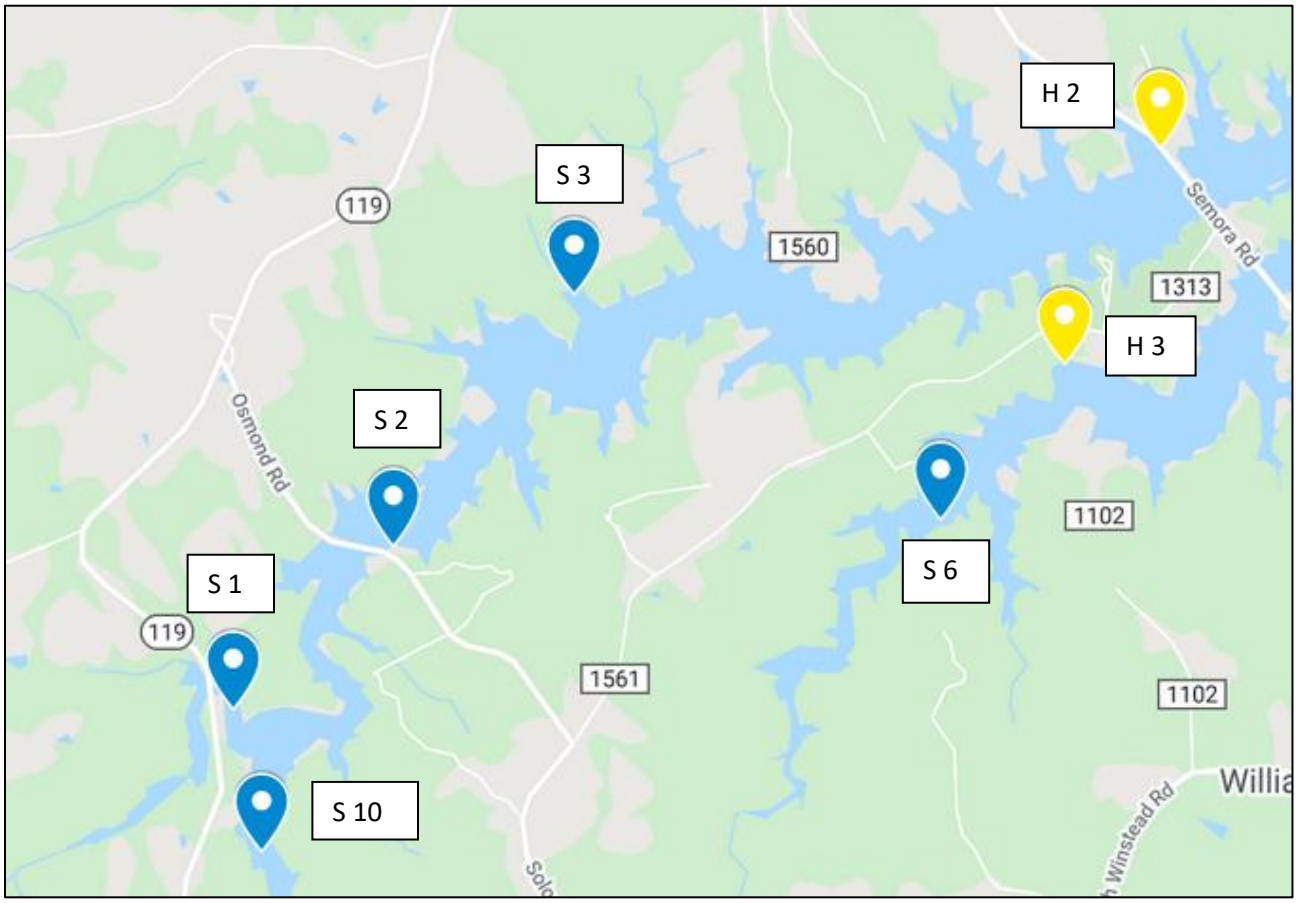


FIGURE 2 (Cont.). Map of proposed revegetation sites where blue pins represent subleased shoreline, yellow represents reserved shoreline, and red represents prohibited shoreline.

FIGURE 2 (Cont.). Map of proposed revegetation sites where blue pins represent subleased shoreline, yellow represents reserved shoreline, and red represents prohibited shoreline.

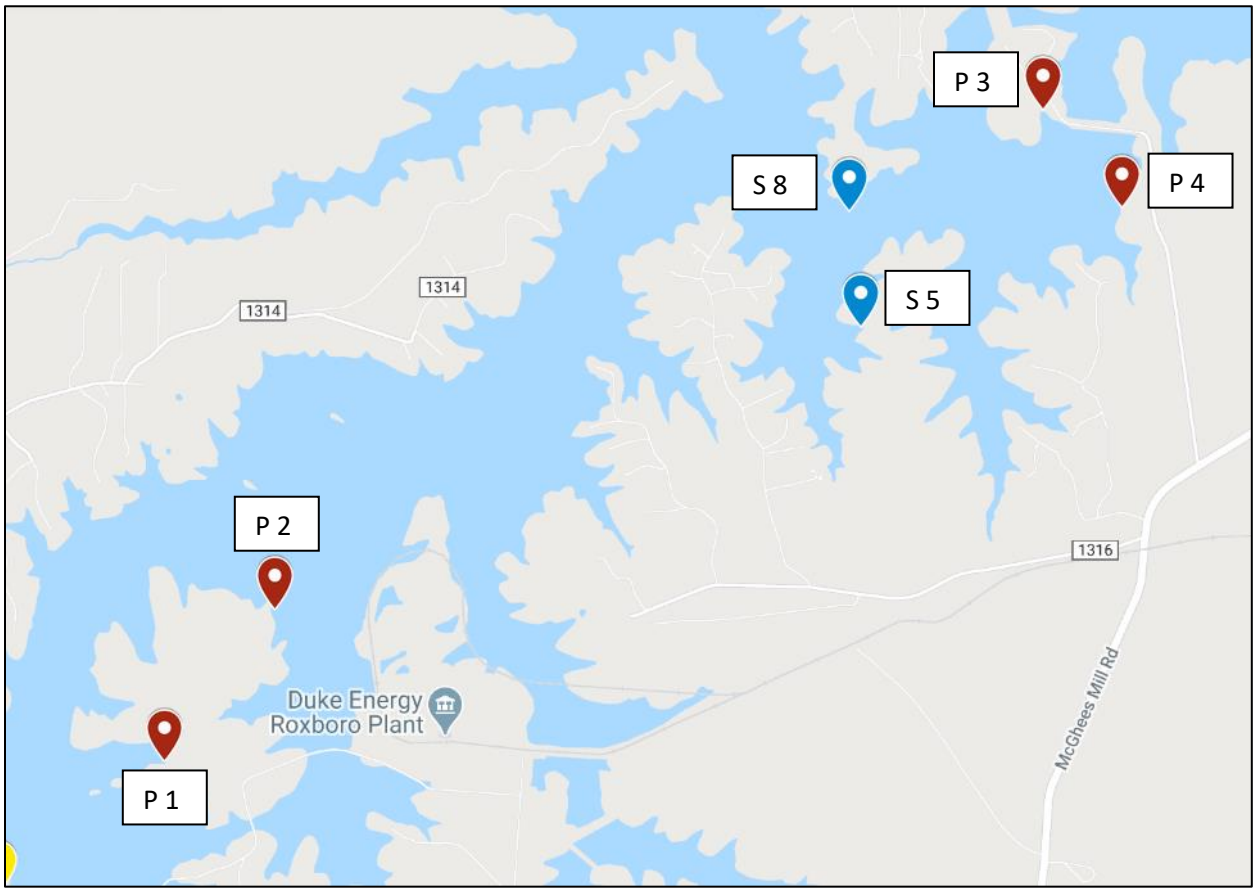
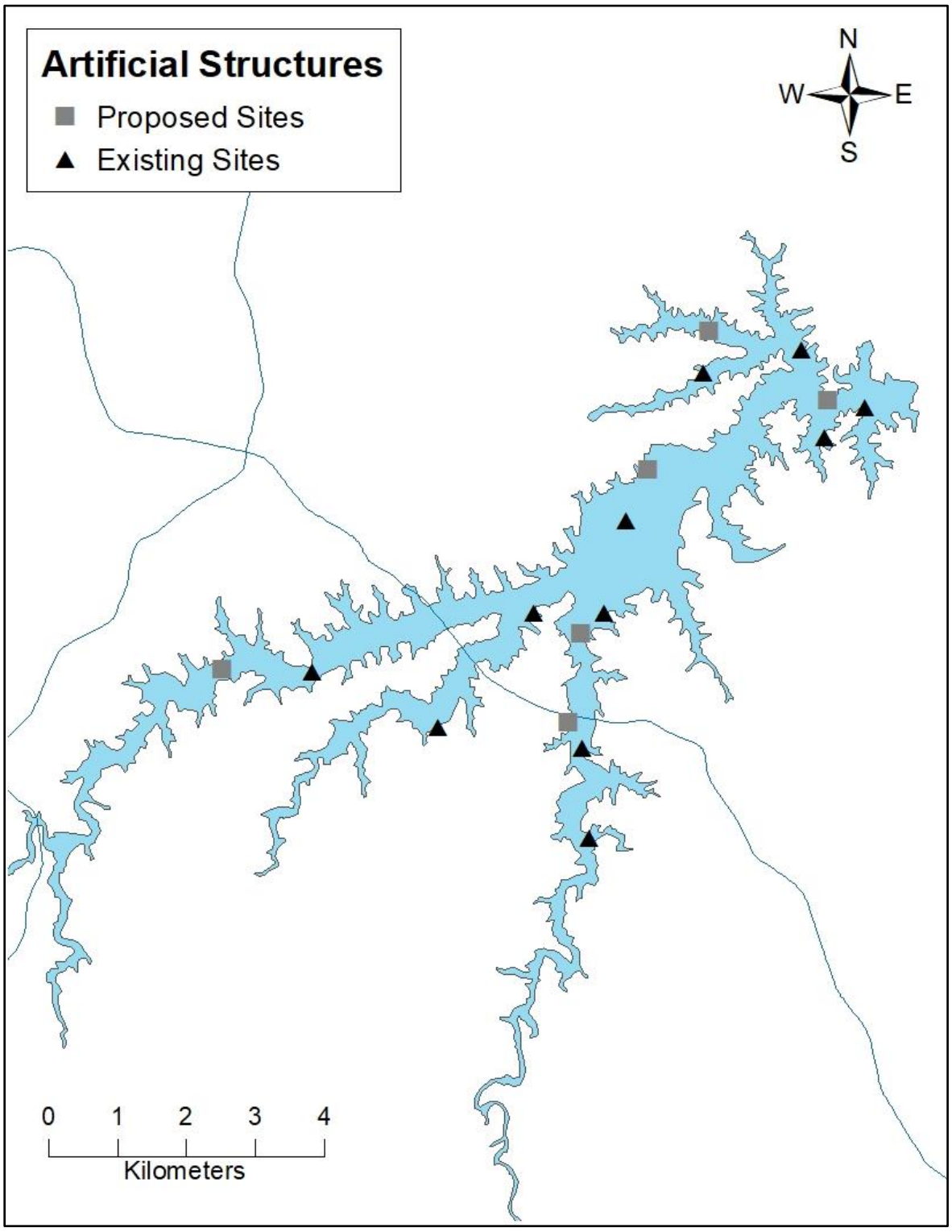


FIGURE 3. Map of existing and proposed artificial habitat sites.



Appendix A – Potential Artificial habitats

Polytree

Spider Block

Mossbacks

Modified GA-DNR Cube

Felled Shoreline Trees

Appendix B – Proposed Native Aquatic Plants

Source: Webb, M. A., J. Richard A. Ott, C. C. Bonds, R. M. Smart, G. O. Dick and L. Dodd. 2012. Propagation and establishment of native aquatic plants in reservoirs. Texas Parks and Wildlife Department, Inland Fisheries Division, Management Data Series.

Water Willow

Scientific name	*Justicia americana*
Common names	Water willow, American water-willow
Growth form	Rhizomatous emergent forb.
Reproduction	Produces new shoots along rhizomes. Also reproduces by fragmentation and seed.
Perennation	Herbaceous perennial; overwinters as dormant rhizomes.
Range	Eastern U.S.
Use	Valuable for fish habitat and erosion control.

<u>Field Planting</u>

Propagule	Mature potted transplants.
Season	Early spring to midsummer.
Substrate	Sand to muck.
Depth	Moist soil to 91cm.
Comments	Highly tolerant of drought and herbivory; will tolerate depths of 1.2m once established.

Maidencane

Scientific name	*Panicum hemitomon*
Common names	Maidencane**,** Paille fine, canouche
Growth form	Rhizomatous emergent grass.
Reproduction	Produces new shoots along rhizomes. Also reproduces by fragmentation and seed.
Perennation	Herbaceous perennial; overwinters as dormant rhizomes.
Range	Southeastern coastline from New Jersey to Texas and Tennessee.
Use	Valuable for fish habitat and erosion control.

Field Planting

Propagule	Mature potted transplants, seed.
Season	Early spring to midsummer.
Substrate	Firm clay to muck.
Depth	Moist soil to 15cm.
Comments	Tolerant of drought and herbivory.

Source: USDA Plant Guide https://plants.usda.gov/plantguide/pdf/pg_pahe2.pdf

Pickerelweed

Scientific name	*Pontederia cordata*
Common name	Pickerelweed, pickerel plant
Growth form	Rhizomatous emergent forb.
Reproduction	Produces new shoots along rhizomes; also reproduces sexually by seed.
Perennation	Herbaceous perennial; overwinters as dormant rhizomes.
Range	Eastern U.S.
Use	Valuable for fish habitat and waterfowl food.

<u>Field Planting</u>

Propagule	Mature potted transplants.
Season	Early spring to late summer.
Substrate	Sand to muck.
Depth	Moist soil to 91cm.
Comments	Moderately tolerant of desiccation; susceptible to herbivory by waterfowl and nutria; will tolerate depths of 1.2m once established.

Softstem Bulrush

Scientific name	*Schoenoplectus tabernaemontani* [*Scirpus validus*]
Common names	Softstem bulrush, great bulrush
Growth form	Rhizomatous emergent sedge.
Reproduction	Produces new shoots along rhizomes; also reproduces by seed.
Perennation	Herbaceous perennial; overwinters as dormant rhizomes/root crowns.
Range	Throughout the U.S.
Use	Valuable for fish and waterfowl habitat and erosion control.

<u>Field Planting</u>

Propagule	Mature potted transplants.
Season	Early spring to midsummer.
Substrate	Sand to muck.
Depth	Moist soil to 91cm.
Comments	Highly tolerant of desiccation; susceptible to herbivory by nutria and beavers; will tolerate depths of 1.5m once established.

White Water Lily

Scientific name	*Nymphaea odorata*
Common names	White water lily, fragrant water lily
Growth form	Rooted floating-leaved; leaves produced at apical tips of branching rhizomes.
Reproduction	Produces new shoots along rhizomes; also reproduces by seed.
Perennation	Herbaceous perennial; overwinters as dormant rhizomes and/or tubers.
Range	Throughout the U.S.
Use	Valuable for fish habitat and waterfowl food. Floating leaves are adapted for shallow, turbid waters.

<u>Field Planting</u>

Propagule	Mature potted transplants.
Season	Late spring to midsummer.
Substrate	Sand to muck.
Depth	50 – 91cm.
Comments	Tolerant of desiccation; susceptible to herbivory by beavers and nutria; will tolerate depths of 1.8m once established.

Spatterdock

Scientific name	*Nuphar advena* [*N. lutea*]
Common names	Spatterdock, yellow pond lily, cow lily
Growth form	Rooted floating-leaved; leaves produced at apical tips of branching rhizomes.
Reproduction	Produces new shoots along rhizomes; also reproduces by seed.
Perennation	Herbaceous perennial; overwinters as dormant rhizomes.
Range	Eastern U.S.
Use	Valuable for fish habitat. Floating leaves are adapted for shallow, turbid waters.

<u>Field Planting</u>

Propagule	Mature potted transplants.
Season	Late spring to midsummer.
Substrate	Sand to muck.
Depth	50 – 91cm.
Comments	Tolerant of desiccation once established; susceptible to herbivory by turtles and nutria; will tolerate depths of 1.8m once established.

American Pondweed

Scientific name	*Potamogeton nodosus*
Common name	American pondweed
Growth form	Rooted submersed; produces submersed and floating leaves.
Reproduction	Produces new shoots along stolons; also reproduces by fragmentation and seed.
Perennation	Herbaceous perennial; overwinters as dormant winter buds.
Range	Throughout the U.S.
Use	Valuable for fish habitat and waterfowl food; floating leaves are adapted for shallow, turbid waters.
<u>Field Planting</u>	
Propagule	Mature potted transplants.
Season	Spring to late summer.
Substrate	Sand to muck.
Depth	30 – 122cm.
Comments	Tolerant of desiccation; susceptible to herbivory by carp, turtles and waterfowl; will tolerate depths of 3.0m once established.

Eelgrass

Scientific name	*Vallisneria americana*
Common names	Wild celery, eelgrass, tapegrass, ribbon grass, Vallisneria
Growth form	Rooted submersed; rosette form with a basal meristem and ribbon-like leaves.
Reproduction	Produces daughter plants along stolons; sexual reproduction by seed.
Perennation	Evergreen (southern ecotype) or winter bud forming (northern ecotype) perennial.
Range	Throughout the U.S. (absent from parts of the Midwest).
Use	Valuable for fish habitat and waterfowl food. In the south, evergreen habit allows planting over an extended period.
<u>Field Planting</u>	
Propagule	Mature potted transplants.
Season	Early spring to early fall (southern ecotype); early to late summer (northern ecotype).
Substrate	Sand to muck.
Depth	30 – 122cm.
Comments	Transplants must be planted deep enough to cover the root mass and anchor the plant, but care must be taken not to bury the basal rosettes. Not resistant to desiccation; highly susceptible to herbivory by carp, turtles and waterfowl; will tolerate water up to 3.0m deep once established.