Report

DUNKIRK DAM POOL AQUATIC PLANT SURVEY, MANAGEMENT PLAN, AND BATHYMETRIC SURVEY

FOR THE TOWN OF DUNKIRK, DANE COUNTY, WISCONSIN
PREPARED FOR DUNKIRK DAM LAKE DISTRICT
PARTIALLY FUNDED BY A SURFACE WATER PLANNING GRANT FROM WDNR

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INTRODUCTION

The study area is an approximate 2-mile stretch of the Yahara River, between the Stoughton Dam downstream to the Dunkirk Dam (Exhibit 1). The pool is a shallow impoundment that is created by the Dunkirk Dam, originally built in 1894. The dam currently supports a hydroelectric production facility. The area receives drainage from a watershed that starts north of the Madison Pools. The watershed is composed of a combination of urban uses including transportation networks, agricultural uses, and natural areas.

The Yahara River flows to the Rock River and eventually the Mississippi River. The waterbody is a Priority Navigable Waterway but not an Area of Natural Scientific Research Interest (ANSRI). There is an approved Total Maximum Daily Loading (TMDL) report for the Yahara River. The river is an Impaired Water for low dissolved oxygen and degraded habitat associated with high total phosphorous (TP) and sediment/total suspended solids. The study reach is not listed as Critical Habitat for any rare species.

Currently there is limited public access for electric motor use and canoe and kayak use only. The entire study area is no-wake. The pool is very shallow, only 1-2 feet deep along the shorelines with a maximum depth of approximately 9 feet in the old river channel that is under the normal water level pool. The river is frequently used for recreation by area residents although predictable access is often impacted by shallow water depths and excessive aquatic plant growth.

In recent years, recreational use of the Dunkirk Dam Pool on the Yahara River has been severely compromised by shallow water levels and excessive aquatic plant growth. The plant growth even hinders fishing efforts and electric trolling motor usage. The Dunkirk Dam Lake District (DDLD) endeavors to study the relative depth of the Millpond (specific subsection of the Pool) near the dam and conduct an aquatic plant survey and prepare an aquatic plant management plan.

Problem Statement

The shallow water depths and excessive aquatic plant growth greatly hinders recreational uses of this impounded stretch of river. Also, the accumulated sediments in the pool likely contribute to impaired water quality conditions including elevated water temperatures and algal blooms. Currently, there is essentially no baseline data for water depths and aquatic plant community composition of the study area. Therefore, this study has been designed to provide baseline planning data to develop an informed aquatic plant management plan that would be responsive to the recreational uses while being cognizant of any sensitive natural resources.

Watershed

The tributary watershed to the Dunkirk Dam Pool is very large at 412.78 square miles. The landcover and landuses consist of a mosaic typical of south-central Wisconsin. (Appendix X). The primary landcover is agriculture at 60% with urban uses at 28%. Over 100,000 pounds of phosphorus is estimated to enter the system from the upper watershed.

Fishery

There is limited fishery data for the Dunkirk Dam Pool and directly upstream. A large number of spawning common carp (Cyprinus carpio) were observed during the vegetation sampling visits. Other expected fish species would be the usual suspects for a warmwater fishery in southcentral Wisconsin. The dam pool shoreline is relatively undeveloped and should provide reasonable shoreline habitat for local fish for spawning and nursery habitat. Landowners should be encouraged to plant or allow emergent native vegetation to grow along the shoreline to improve the spawning habitat available for game fish.

Non-Native Species

Non-nativespecies are those organisms introduced by people into habitats where they are not native. Invasive, exotic species are organisms that are not native to a region and whose introduction causes ecological harm. In their natural habitats, these species are part of stable populations and form complex relationships with other species. When they are removed from natural predators, parasites, diseases, and other competitors that have kept the populations in check, species introduced into new habitats can overrun their new home and crowd out native species. Once established, these species can be very hard to control and eradicate.

Invasive exotic species can be spread in a number of ways but spreading by humans is one method that can easily be prevented. Ways to reduce the potential for the spread of invasive species include:

- Learn to identify invasive exotic species.
- Know who should be contacted if an invasive species is observed.
- Control invasive, exotic species on your property.
- Do not release plants or animals into the environment.
- Inspect and wash all boat surfaces including the boat, motor, and trailer with hot water after use in other bodies of water.
- Interpretive signage at public boat launches
- Get involved in volunteer efforts to remove invasive species in the Dunkirk Dam pool watershed.

Minor amounts of the invasive species curly leaf pond weed (*Potamogeton crispus*) and Eurasian water milfoil (*Myriophyllum sibiricum*) were observed during the aquatic plant survey for this project. Zebra mussels (*Dreissena polymorpha*) are known from the Yahara River, but none were observed during this study. The terrestrial invasive species Japanese knotweed (*Polygonum cuspidatum*) is known to occur on the Dunkirk Dam proper.

Educational programs should focus on the preventative actions that can be taken by Pool users to prevent the introduction of invasive, exotic species. This can include newsletters and boat launch signage and programs that explain how exotics are transferred from Pool to Pool and what actions can be undertaken by individuals to prevent infestations. The WDNR-Wisconsin Sea Grant program has materials and information available to assist with educational efforts.

SEDIMENT DEPTHS AND BATHYMETRY OF THE MILLPOND

Consistent with the grant, the Dunkirk Dam Millpond was surveyed for water and sediment depths on XX.

A bathymetric survey of the 17-acre Millpond just upstream of the Dunkirk Dam was completed. The bathymetric and soft sediment survey used side-scan and down-scan sonar-derived soft and hard sediment elevations. The water and sediment depths were spatially mapped. This digital information did not result in much useful information due to the water clarity and shallow depths which resulted in inconsistent data collection. The main data set was achieved by using manual measurements of depth to both hard and soft sediment using a graduated rod with a “foot” and survey-grade GPS equipment. The collected data was used to estimate relative sediment depths. Figure X displays field sediment depth sampling points.

Results

Figure X is a graphical representation of the sediment field data. The soft sediment survey resulted in an estimated 34,774.28 cubic yards of soft material. This data and map will also be a resource for future recreational planning efforts including enhanced access options along the eastern riverbank near the dam.

AQUATIC PLANT COMMUNITY

Background

Aquatic plants are very important to the health of the Dunkirk Dam Pool. Aquatic plants provide food and habitat for fish and wildlife. Invertebrates, which fish depend on for food, spend most of their life in or near aquatic plants. Young fish and wildlife use the plants for shelter and protection from predators. Plants are spawning areas for fish and amphibians. Plants also stabilize sediments and reduce the potential for shoreline and bottom erosion. Without nutrient uptake by plants, nutrients are readily available in the water column and can lead to harmful and unsightly algae blooms.

Exotic plants do not provide all of these fish and wildlife benefits as well as the native plant species. Invasive plants tend to grow more densely and often grow to the surface where they also can interfere with recreational activities. Some exotic plant species will also create “canopies” that prevent light from reaching the native plants underneath causing stress to the native plants. Protection of native species is an important consideration in the management of invasive species.

Littoral Zone and Types of Aquatic Plants

The area in which plants grow within a Pool is referred to as the littoral zone. There are four types of aquatic plants: emergent, floating-leaved, submergents, and free-floating.

Emergent: Emergent plants are rooted in the pool bed or shoreline with the tops of the plant potentially extending out of the water. The roots of the emergent plants are submersed or partially inundated with water. Common emergent species include bulrushes, cattails, and reeds.

Floating-leaved: Floating-leaved plants are rooted in the Poolbed and their leaves float on the water surface. These plants usually have larger rhizomes (rootstalks) than the emergent plants. The floating-leaved plants are typically found in quieter, protected areas of the Pool. Common floating-leaved species include waterlilies.

Submergent: Submergent plants grow completely under the water, although, flowering or seed portions may extend out of the water at certain times of year. The growth of these plants is related to the amount/depth of light penetration in the Pool. Common submergent plants include pondweeds and Eurasian watermilfoil.

Freefloating: Free-floating plants are entirely dependent on the water movements in the Pool. These plants are found wherever the wind and water takes them. Common free-floating species include coontail and duckweed.

Photos from: Minnesota DNR, https://www.dnr.state.mn.us/aquatic_plants/submerged_plants/coontail.html

Observed Native Plant Descriptions

Coontail

Coontail or hornwort (*Ceratophyllum demersum*) is a submerged, free-floating, native, bushy plant. Both the seeds and foliage of the coontail species are used by waterfowl and fish as a source of food. It also provides good spawning habitat and cover for juvenile fish. Coontail can also help reduce the potential for algae blooms through its uptake of nutrients. However, coontail often grows in nuisance levels in southern Wisconsin.

Common Waterweed

Photo Provided from: Minnesota DNR, https://www.dnr.state.mn.us/aquatic_plants/submerged_plants/canada_waterweed.html

Common waterweed (*Elodea canadensis*) is a native species that is often found in areas that are rich in nutrients including calcium. Such environments consist of slow-moving fresh waters, and sometimes brackish waters too. It is a common food source for many waterfowl, including ducks, and is also used by muskrats and beavers. The species also acts as habitat for many fish, amphibians, and aquatic invertebrates.

White Water Lily

Photos Provided from: Minnesota DNR, https://www.dnr.state.mn.us/aquatic_plants/floatingleaf_plants/white_water_lily.html

White water lily (*Nymphaea odorata*) is a native plant that grows well when rooted in mucky or silty bottoms, usually up to 5-feet in water depth. The plant provides more than adequate habitat for largemouth bass and the seeds are eaten by many waterfowl species. Since the species provides many benefits for wildlife, and also is considered to be highly decorative, it is highly suggested that it is not removed from an environment because more undesirable plants may move in.

Water Stargrass

Photo from: https://www.lakerestoration.com/p-108-water-stargrass.aspx

Water stargrass (*Heteranthera dubia*) is a native, submergent plant. The leaves and stems of water stargrass are eaten by waterfowl. The plant also serves as a habitat for numerous species of invertebrates which in turn are food for other animals including, amphibians, reptiles, and ducks. In addition, water stargrass provides an increased oxygen supply for aquatic animals and acts as a nutrient buffer by using dissolved nitrogen and phosphorus for growth. This helps reduce algae blooms by making the nutrients unavailable for the algae.

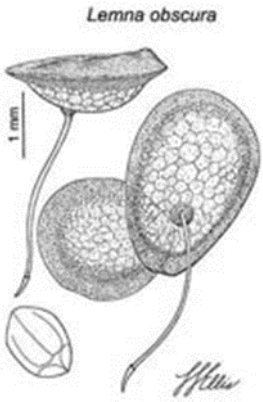


Photo from: Wisconsin DNR, https://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PMLEM01040

Small Duckweed

Small duckweed (*Lemna minor*) is a free-floating native plant found within the family Lemnaceae, the smallest flowering plants that are known. The plant is perennial and is found in colonies within aquatic environments. This fast-growing species can become a nuisance very fast if left unattended. The roots act as a food source for many smaller fish species. The leaves are able to float on the surface of water because of small air pockets underneath the leaves themselves.

Sago Pondweed

Photo Provided from: NRCS- USDA, https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/kspmcfs10102.pdf

Sago Pondweed (*Stuckenia pectinata*) is a native aquatic plant that is generally submergent except for its reproductive stalks that peak above the water. These stalks flower in June to September. Sago pondweed has narrow leaves that create an open structure which reduces their potential to become a nuisance plant. The plant is used extensively as a food source for various waterfowl and can also help reduce the potential for algae blooms through its uptake of phosphorus.

Photos Provided from: Minnesota DNR, https://www.dnr.state.mn.us/aquatic_plants/submerged_plants/wild_celery.html

Wild Celery

Wild celery or eelgrass (*Vallisneria americana*) is a native, perennial plant that prefers hard substrates. The seeds and foliage are utilized by waterfowl as a food source. Additionally, wild celery provides prime spawning habitat for fish including the northern pike and provides cover for juvenile fish. It should be noted that wild celery can grow to nuisance levels. When there are large areas covered by wild celery, problems occur when the plants release from the sediment in July and August. The released plants can act as large floating mats that can clog shorelines and boating lanes.

OBSERVED INVASIVE PLANT DESCRIPTIONS

Curlyleaf Pondweed

Curlyleaf pondweed (*Potamogeton crispus*) is a non-native, invasive aquatic plant. It gains an advantage over the native plant populations by becoming established very early in the growing season. Curlyleaf pondweed tends to be more dominant in the early summer, dying off in mid-July and August. In late June and early July, the plant produces a dormant structure called a turion. The turions will rest on the Pool bottom until fall when they begin to germinate and produce small plants. As temperatures increase in the spring, the curly-leaf pondweed is poised to grow and can quickly out-compete other plant species that germinate from seeds or re-established rootstalks. After reaching peak growth in June and July, itbegins to die back in mid-July, just as other aquatic plants are reaching their peak growth cycle. If a Pool has large populations of curly-leaf, the die back can lead to algal blooms as the decaying plants releases a significant input of nutrients into the Pool.

Small amounts of curly-leaf pondweed have been identified in Dunkirk Dam Pool. Given the growth cycle of curly-leaf pondweed, early treatment and targeting of curly-leaf is important. Two of the most important treatment considerations for curly-leaf pondweed are to 1) protect the native plants and 2) prevent turion production on the existing plants. Turions can be controlled by early season, low dose chemical treatments. However, the herbicide applications must be selected and applied in a manner which does not harm the existing native vegetation.

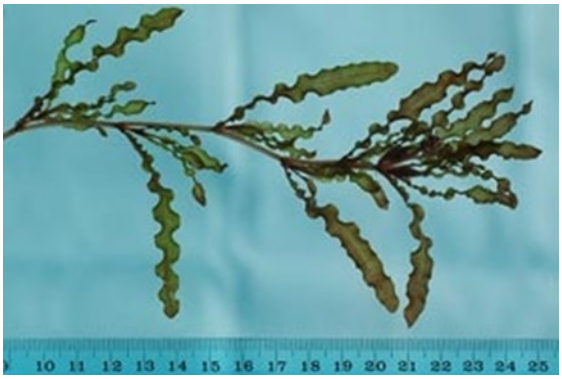


Photo Provided from: Wisconsin DNR, https://dnr.wisconsin.gov/topic/Invasives/fact/

Eurasian Watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*) is a non-native, exotic aquatic plant that quickly takes advantages of opportunities for growth and can easily become a dominant plant species in a Pool. In many Pools, Eurasian watermilfoil is a severe nuisance, creating dense stands of vegetation with large canopies on the water surface that can choke out the desirable native plants. The Eurasian watermilfoil mats can restrict boating and fishing, and make swimming difficult.

Recently, a hybrid form of Eurasian watermilfoil has been identified. When a species hybridizes, it undergoes a process of genetic combination where genes from each plant strain are transferred to the new plant generation. This transfer of genes often allows for a robust plant that can withstand more adverse environmental conditions than the original species. The hybrid Eurasian watermilfoil has been shown to have a distinct advantage to earlier growth, faster growth rates, and increased robustness in harsh environmental conditions making it a serious problem for Pools.

AQUATIC PLANT SURVEY

As discussed throughout the report, aquatic plants are very important to the health of a Pool's ecosystem. These provide food and cover for fish and wildlife as well as help maintain good water quality. An aquatic plant monitoring program serves as an early warning signal that a lake is reacting negatively to impacts from the watershed.

Photo Provided from: Wisconsin DNR, https://dnr.wisconsin.gov/topic/Invasives/fact/

An aquatic plant survey was conducted on XX, XX and XX. The survey utilized the methodologies established in the WDNR's Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications, dated March 2010. This point intercept method uses a double-sided rake to sample extant aquatic plants on a pre-established grid. All observed aquatic plants were identified to species and with overall and relative densities recorded. The figure

below is the sampled grid pattern with GPS points marked for sample locations.

According to conversations with local residents, the encountered densities of aquatic macrophytes during the survey in 2021 were much less than in past years. From their anecdotes, the residents describe near impossible navigation even in small crafts due to extensive vegetation. These plant beds were observed to cover essentially the entire Millpond with submerged and floating leaved plants.

FIGURE X. Stand of white water lily in the Millpond

The summary statistics for the aquatic plant sampling is detailed in the table below. The aquatic plant growth is located roughly equally throughout the study area, although plant densities were generally higher in the Millpond area. Coontail was by far the most encountered species, found in nearly 88% of all rake samples. Water stargrass (32%) and white water lilly (16%) round out the top three most observed plant species. All other species were observed in single digit densities.

Surprisingly little Eurasian (or native) milfoil was encountered and was observed in only a few locations. Although the plant densities appear to be lower than expected in 2021, species composition from year to year would be expected to be similar. No high quality or rare plant communities were observed during the study. No aquatic plant data is available to conduct a year-to-year comparison.

Aquatic Plant Survey Summary Statistics (2021):	
Total Number of Sites Visited	486
Total Number of Sites with Vegetation	333
Species Richness	9
Number of Native Species	7
Average Conservatism	4.428571 4
Floristic Quality Index	11.716899
Simpson's Diversity Index	0.65
Maximum Water Depth of Plants (ft)	9
Average Number of Species per Site (Veg. Sites Only)	1.62
Average Number of Native Species per Site (Veg. Sites Only)	1.61

Species	Frequency of occurrence within vegetated areas (%)	Frequency of occurrence at sites shallower than maximum depth of plants	Relative Frequency (%)	Number of sites where species found	Average Rake Fullness
Myriophyllum spicatum,Eurasian water milfoil	0.60	0.41	0.4	2	1.00
Potamogeton crispus,Curly-leaf pondweed	0.30	0.21	0.2	1	1.00
Ceratophyllum demersum, Coontail	87.69	60.21	54.3	292	1.57
Elodea canadensis, Common waterweed	6.01	4.12	3.7	20	1.00
Heteranthera dubia, Water star-grass	32.43	22.27	20.1	108	1.12
Lemna minor, Small duckweed	0.60	0.41	0.4	2	1.50
Nymphaea odorata, White water lily	6.61	4.54	4.1	22	1.09
Stuckenia pectinata, Sago pondweed	9.61	6.60	5.9	32	1.13
Vallisneria americana, Wild celery	17.72	12.16	11.0	59	1.27

PLANT MANAGEMENT ALTERNATIVES

The control of invasive plants is an uphill battle. In order to survive, it is the nature of aquatic plants to spread. And for invasive aquatic plants, this spreading and growth is more prolific. As such, realistic expectations are very important to the management of both native and invasive plants. It is impractical to think that all aquatic plants can be completely removed from a Pool. A properly designed aquatic management plan will use a variety of Pool management techniques, along with public education, to minimize the long-term impacts of invasive plants and encourage a growth of healthy native plants.

A discussion on various plant management alternatives follows.

No Management

The "no management" alternative is just as it sounds: the aquatic plants will be left alone to do what they will naturally do with no active management from people. Under this alternative, it should be expected that Eurasian watermilfoil and curly-leaf pond leaf populations will continue to expand their range within Dunkirk Dam Pool. As their populations increase, fish and wildlife habitat and water quality will be negatively impacted.

Conclusion: Although no management is technically feasible for Dunkirk Dam Pool, it should not be considered. Aggressively managing invasive species will protect the native plants, water quality, recreational uses, and aesthetics within the Pool.

Drawdown

Drawdown of a waterbody can sometimes be used to control some plant growth and silt deposits. Drawdown includes dropping the lake level a certain number of feet for a period of time. The exposure of the plants to extreme temperatures and dry and freezing conditions causes plant death. Additionally, drawdown may also kill native and desirable plants, fish, and wildlife and negatively impact, on at least on a temporary basis, the use of the Pool for recreation.

Costs associated with drawdown depend on the outlet control structure. For example, if pumping to lower the Pool is required, it can be expensive as it requires the cost of equipment, electricity, and labor while costs can be minimal if drawdown can be done by lowering a gate. However, the Dunkirk Dam Pool is controlled by a hydroelectric dam and likely could be manipulated to lower the water to an adequate level to help control aquatic plants. Ideally, any proposed drawdown should be planned during a period of planned maintenance on the dam facility to limit impacts to electrical production.

Conclusion:

A planned drawdown of several feet of water, especially in winter, could be a viable control measure for aquatic plants. The drawdown would be nearly free, although it would have to be evaluated in terms of potential electrical production from the dam. Discussions would need to take place with the owner of the dam, Dunkirk Dam Water Power Company LLC whether they would cooperate with a planned drawdown and its implications. Perhaps the drawdown for aquatic plant management purposes could be coupled with any scheduled maintenance of the dam and its facilities to limit power generation impacts.

Watershed Controls

Like all drainage Pools, Dunkirk Dam is highly susceptible to any pollutants that can be present in local runoff. The large contributory watershed makes it difficult for DDLD to control non-point source pollutants on their own. The most important of the non-point sources pollutants are nitrogen and phosphorus compounds for surface water quality. However, suspended sediment and road salt can also have adverse effects on the health of the Pool. From a long-term management perspective, controlling nutrient pollution from the contributing watershed will likely have the best chance on limiting nuisance plant and algal growth in Dunkirk Dam Pool. However, existing sediment quantities also influence plant growth.

The DDLD is encouraged to explore watershed initiatives and on-the-ground projects that will limit non-point pollution. These controls could include stream and shoreline stabilization, nutrient management plans, and native landscaping. The DDLD should work with area stakeholders and major property owners to identify projects that would have the most impact on limiting polluted runoff. At this time, projects have not been identified. Therefore, it is not possible to formulate a legitimate plan and implementation budget at this time.

Nutrient Inactivation

Nutrient inactivation is the use of a substance to control the release of nutrients, primarily phosphorus, from bottom sediments. The substance commonly used for nutrient inactivation is aluminum sulfate or alum. The alum treatment creates a flocculant that covers the bottom sediments and prevents them from releasing phosphorus. It is important to note that upstream sources of phosphorus in the watershed need to be controlled prior to the placement of the flocculant.

The use of nutrient inactivation will not prevent plant growth but will reduce the potential for algae blooms. In fact, the improved water quality and clarity from the control of algae could potentially increase the growth of both desirable and nuisance plants.

Conclusion: Nutrient inactivation is not a viable option for controlling aquatic plants on Dunkirk Dam Pool due to the significant amount of chronic nutrient loadings from the tributary watershed.

Dredging for Aquatic Plant Control

Dredging is typically utilized in rivers and streams to increase the depth for navigation in shallow waters. It can also be used in detention basins and Pools to increase water depths. The use of dredging to control nuisance aquatic plants has historically resulted in mixed success. For dredging to be used successfully to control aquatic plants, the Pool would need to be dredged to depths of greater than 6 feet and to a hard layer of bottom sediments. Dredging causes a significant impact to the aquatic ecosystem and will negatively impact wildlife and fish habitat. Hydraulic dredging would be the only viable option but would have significant constraints including water quality impacts and the identification of an upland disposal site. Also, although currently unstudied, the Dunkirk Dam Pool would likely have sediment quality similar to the Stoughton Dam pool. Several types of contaminants were identified by the City of Stoughton (Interfluve, 2019) which could complicate spoil disposal options and costs.

Dredging is the most expensive of the aquatic plant management options and can range from $15-$30 per cubic yard of removed material plus engineering and permitting which could run $50-100,000.

Conclusion: Dredging is not a viable option for controlling aquatic plants on Dunkirk Dam Pool.

Screens

Screens are similar to window screens that are placed on the Pool bottom to limit plant growth. Screens are beneficial for controlling aquatic plants in small areas that are not important to fish or wildlife habitat such as near individual homeowners' shorelines or piers to create swimming areas. Screens are typically installed in the spring and removed in the fall. As the screens will prohibit the growth of both beneficial and nuisance plant species, they are not typically recommended for installation throughout a Pool. The screens may be difficult to keep secure during heavy flows in the river.

Screens cost approximately $1-1.25 per square foot of material. Any installation and removal costs would be additional.

Conclusion: As screens will limit the growth of native, beneficial aquatic species and may be difficult to keep in place, screens are not a viable option for controlling aquatic plants on Dunkirk Dam Pool. The screens may have some limited value in specific locations between piers where flow velocities are limited to facilitate recreational activities.

Aeration

Aeration includes the installation, operation, and maintenance of a system that will artificially pump oxygen into the Pool. Historically, aeriation has been successful in correcting oxygen deficiency problems in Pools that have numerous algae blooms and fish kills due to elevated in-Pool nutrient levels. There is limited research available on the success of aeration on macrophytic plant growth.

Initial costs for an aeration unit are hard to establish since it is difficult to assess what level of equipment needs would be necessary to have any meaningful contribution to enhance the Pool conditions.

Conclusion: Aeration on Dunkirk Dam Pool would have limited benefits to control aquatic plants and should not be considered at this time.

Biomanipulation

Biomanipulation or the use of biological controls for aquatic plant management is currently limited to grass carp and a few insects. While the use of biomanipulation is theoretically possible, it has very limited applications. Non-native biological control agents are risky as they introduce a species into a new environment where predators may not be present which can easily create a new problem rather than a solution. They also often produce slower, are less reliable, and provide less complete control of aquatic plants that other established methods.

Grass carp is an exotic species originally imported from Malaysia and is considered a voracious eater of aquatic plants. Grass carp can reduce or eliminate all vegetation at low densities. However, the grass carp will tend to eat beneficial plants prior to consuming the Eurasian watermilfoil. Also, grass carp are illegal to possess, transport or sell in Wisconsin.

A weevil, *Eurhychiopsis lecontei*, has been found to help control Eurasian watermilfoil in some Pools in Illinois and Wisconsin. The weevil is effective at managing Eurasian watermilfoil as it is closely associated with the plant from egg to pupation to adult causing damage at all stages. The weevils do not like other plants, so it does not affect other plant species. However, while the use of the weevil can reduce the quantity of milfoil beds, their use is unlikely to completely control the nuisance growth. The use of weevils is also costly ($1.00 per weevil). A natural population of weevil already exists in many Wisconsin water bodies, though it is not known if it is present in the Dunkirk Pool.

Conclusion: The use of grass carp and the milfoil weevil are not viable alternatives and are not recommended for Dunkirk Dam at this time.

Weed Rollers

Weed rollers are a mechanical device that can control weed growth in small, shallow areas. A weed roller includes a post that is attached to a dock. At the end of the post is a roller than moves in a slow arc detaching existing weeds and agitating the Pool bed.

This prevents continued weed growth, for a clean, sandy Pool bottom and a pleasant swimming area.

Conclusion: The weed roller may be a viable alternative for riparian landowners along Dunkirk Dam Pool in selected locations near private piers.

Native Species Introduction on Shorelines

Native plants can be re-introduced into the Pool to try to expand native plant growth and diminish the spread of exotics through competition, and try to reduce the need for other more expensive aquatic management options. Benefits of re-introducing native plants include biodiversity, shoreline stabilization, and enhanced esthetics.

Conclusion: Shoreline owners should be encouraged to plan native vegetation along the waterline where feasible.

Hand Controls

Hand controls are methods of aquatic plant removal on a small-scale. Typically, hand controls include the hand pulling and/or raking of plants. A rake with a rope attached is thrown into the water and dragged back to the shore or boat. The collected plants are removed and disposed of properly. Skimmers or nets are also a hand control method used to scrape algae and duckweed off the Pool surface. As these methods are labor intensive, they are commonly utilized by residents to control aquatic weeds in small, localized areas such as around piers and swimming areas. Hand controls cannot use auxiliary power.

Hand controls can be cost effective as many rakes can be purchased for less than $100. Labor costs could be an additional cost.

Conclusion: Hand controls may be utilized by shoreline landowners to clear swimming areas. The clearing should be selective, focusing on invasive species such as Eurasian watermilfoil and curly-leaf pondweed. Landowners should also be encouraged to maintain an area of native vegetation along the shoreline both on land and in the water.

Chemical Treatment

The effective use of chemical treatments for aquatic management has greatly improved in recent years. Instead of broadcast spraying, treatments now target specific areas or species. The half-life of the herbicides has also decreased from months and years to days and weeks. Additionally, the herbicides used for chemical treatments have been tested extensively to confirm that the herbicides are not toxic to humans, animals, and fish, that the chemicals do not bioaccumulate in fish or other organisms and that their persistence in the environment is low. The WDNR governs the application of herbicide in Pools and requires a permit for all herbicide application over waters. The herbicide permit requires that all herbicides to be used are approved by the WDNR, applied within the concentrations and applications included on the label, and applied by a licensed applicator.

The selection of the proper herbicide and the timing of the herbicide application are extremely important in the management of aquatic vegetation. For example, when plants are treated, the decaying process of the plants uses oxygen. If the plants are treated when oxygen levels in the Pool are already low, such as during the warm summer months, the additional oxygen depletion by the decaying plants can lead to stress on fish and other aquatic life. Another concern is that if the herbicide kills all of the plants in the Pool, the Pool can shift from being dominated by aquatic plants to a Pool that is dominated by algae. The killing of both native and invasive vegetation could also give opportunities for new invaders to establish and cause additional problems. As such, it is important to identify the target species for treatment and the proper dosage for the selected herbicide utilized for treatment. Care should also be taken to alternate the chemicals used whenever possible. This will help minimize the chance of a nuisance species from developing a resistance to the chemical.

Large area or deep-water treatments are an effective management tool for the reduction of Eurasian watermilfoil and curly-leaf pondweed. These treatments should be conducted early in the season, just as the plants begin to grow, usually in mid-April through early June.

Categories of Herbicide

Systemic Herbicides – Systemic herbicides are translocated through the entire plant, including the roots. These include 2,4-D, fluridone, and trichlopyr. 2,4-D and trichlpyr are used to control Eurasian watermilfoil in localized areas. Fluridone is primarily used to control Eurasian watermilfoil in whole-Pool or large area applications.

Contact Herbicides – Contact herbicides kill the exposed portions of the plant they come in contact with. They are not translocated into the roots and will only rarely kill the entire plant. These typically provide short-term nuisance relief. Herbicides with the active ingredients of diquat and endothall are contact herbicides.

Copper Compounds – Copper sulfate is used for the control of algae, most commonly filamentous green and blue-green algae.

Conclusion: Herbicide application is not a recommended treatment for the Dunkirk Dam Pool. Due to the flowing waters of the Yahara River, it would likely be difficult to keep the active ingredients of the herbicide within the target locations and WDNR would likely to be reluctant to issue permits for such activities.

HARVESTING

Harvesting is another Pool management tool that is frequently used to control aquatic plants. With harvesting the vegetation is cut off about 5 feet below the water surface and is conveyed to the shore where they are then trucked to a disposal site. The remaining plant materials below the cutting depth will continue its normal life cycle. Harvesting should only be conducted in waters that are deeper than 3 feet as harvesting in shallower areas can increase the damage to equipment, will disrupt bottom sediments and plants, and will open the Pool bottom up to the invasion of other exotic species. It should also be noted that with this physical removal method, one must pay particular attention to avoid removing desired native aquatic plant and animal species. Skimming may be conducted in shallower areas if care is taken to minimize the disturbance. Skimming is a variation of harvesting where the plant is removed at the surface, leaving the bulk of the submerged material in place.

The removal of any floating plant material and debris from the harvesting and skimming operations is necessary to prevent the spread of the invasive species being cut. Plant fragments that are not removed from the Pool can settle into new areas, regrow, and spread the problems.

Conclusion: Harvesting has been shown to be effective at improving recreational use and aquatic plant diversity by controlling nuisance species. As such, harvesting is a recommended aquatic plant management practice for Dunkirk Dam Pool.

- The harvesting program should emphasize reducing nuisance species rather than clear cutting,
- Harvesting should be primarily utilized to remove stands of Eurasian watermilfoil and curly-leaf pond weed when at nuisance levels.
- Harvesting may be used to cut boat lanes through dense vegetation to provide access.
- Harvesting should begin with boat lanes to ensure access and then move its focus to large stands of invasive aquatic plants (if applicable).
- Mechanical harvesting should be limited to that necessary to open and maintain access lanes and will be primarily conducted in depths greater than those favored by the listed species list (4 feet or less). Standard operating procedure should be for the equipment operator to harvest only in water depths greater than 4-feet and keeping the cutter head no closer than 3-feet above the Pool bottom in order to avoid fish seeking shelter. Depths shallower than 4-feet are encountered mainly in near-shore areas where harvesting needs to be done to create Pool access for specific piers, launches, or channels. To minimize potential impact to spawning fish, no harvesting should be conducted until late-June of each year.
- It is hard to estimate the cost of harvesting since plant densities vary from year to year. However, it is expected that it will cost approximately $500-$600 per acre for harvesting and disposal of vegetation under a subcontractor scenario. Appropriately sized equipment for Dunkirk Dam Pool could cost approximately $150,000 for a harvester and shore conveyor/ trailer.

Figure X. Typical mechanical aquatic plant harvester (Photo provided by Inland Lake Harvesters, Inc.)

PLAN GOALS AND STRATEGIES

GOALS

The goals and objectives for Dunkirk Dam Pool should focus on balancing the various uses and needs. The most difficult task facing resource managers is balancing the needs and desires of all uses which often conflict. Fish and wildlife need aquatic plants to live. Boaters and swimmers desire relief from nuisance aquatic plants. And those depending on the Pool for "aesthetic viewing" desire an undisturbed Pool surface.

The invasive plants and very dense native plants restrict boating use in some areas of the Pool. Controlling the invasive plants and protecting the diversity of the native plant communities is crucial to the ecological balance of Dunkirk Dam Pool.

The Goals and Objectives of the Dunkirk Dam Pool Aquatic Plant Management Plan are:

- Minimize fragments of aquatic plants that are caused by boating traffic and natural processes.
- Control invasive and nuisance plant species and maintain recreational access for the Pool by:
  - Mechanical Harvesting
  - Encouraging landowners to protect native species
- Preserve and enhance the Pool's natural environment by:
  - Educating landowners and Pool users in Pool ecology.
  - Continue to protect the Dunkirk Dam Pool watershed.
- Maintain navigational access:
  - Maintain navigation access by controlling plants as necessary.
  - Control/remove vegetation mats that collect on the surface.
  - Control/remove floating plant debris.
- Identify and expand local educational efforts that may be undertaken to improve the public's understanding of Pool issues by:
  - Encouraging community participation in Pool management activities
  - Increasing participation in the Dunkirk Dam Pool Preservation Association
- Conduct in-Pool management activities with the long-range goals of minimizing the management by:
  - Conduct year-end evaluations as to the success of plant management activities and the community reaction to these activities.
  - Track the annual progress of Pool management activities.
  - Conduct a water quality monitoring effort.
  - Develop a quick response to new invasive species.

Aquatic Plant Management Guidelines

Currently, Dunkirk Dam Pool has nuisance populations of Eurasian watermilfoil, curly-leaf pondweed, and coontail. Weed control will need to be conducted to limit the spread of undesirable submerged species and keep the Pool useable for boaters and other stakeholders. The goal of the aquatic management plan should be centered on control of the most undesirable species. Eradication is not realistic for the priority species given their proclivity to move locations from year to year and they can re-enter the Pool from various sources. Balancing acceptable Pool use while protecting the diversity of native plant populations is also critical to any management plan.

Prior to plant control activities, a "weed scout" should conduct a survey in late May each year to assess the extant populations of the priority control species (or new invaders) and map the locations and densities. This initial survey will help prioritize control efforts and control protocols for any given year. Herbiciding efforts should concentrate on hybrid and Eurasian watermilfoil species and curly leaf pondweed populations.

Realistically, coontail populations, while a native species, will need to be controlled in certain areas. However, control should be specific to high Pool use areas and should not aim at killing large stands of this species. Unfortunately, controlling the coontail could leave voids that could encourage the growth of different species. The new species have a fair probability of being undesirable given the tendencies of weedy species to invade disturbed areas.

DDLD should consider utilizing an aquatic weed harvester in certain situations to provide a level of control of coontail to promote better Pool usage.. Harvesting should be used in areas infested with near surface coontail beds and possible beds of other desirable native species. This will reduce cover of submerged plants, creating channels for navigation while limiting damage to the native plant populations. Harvesting of milfoil beds can lead fragmentation of the plant which may lead to population expansions in other parts of the Pool system. However, since milfoil is at such low levels now, it is not a current concern here. All harvested material should be removed from the Pool using one of the public access points and disposed of in an appropriate location.

Education and Information

DDLD should take steps to educate property owners regarding their activities and how they may affect the plant communities of Dunkirk Dam Pool. Informational materials should be distributed regularly to residents, landowners, Pool users and government officials. Topics could include information related to Pool use impacts, the importance and value of aquatic plants, shoreline restoration and plantings, fertilizer use, and erosion control. Regular communication with residents will improve their understanding of the Pool ecosystem and should lead to better long term protection.

Local schools could also be engaged in the educational programs. The schools could use Dunkirk Dam Pool as a base for their environmental education programs. Additionally, some schools may require a mandatory community service requirement that may be tapped to assist with Pool management activities.

The residents should also be made aware of all aquatic plant management activities including chemical treatment and harvesting and the reasons behind these activities. Notices could be made through public meetings, written notices, signs, etc.

Costs, associated with this component of the Dunkirk Dam Pool Aquatic Plant Management Plan, are variable. Grants may be available to offset some of the costs of education programming.

Boat Launch Activities

Residents, landowners, and users should be encouraged to help remove the debris from the near-shore and shorelines, especially the boat launch. This will help minimize the amount of plant fragments that are moved by boats and trailers and

will increase the chance of identifying new invaders. Signs should also be posted at the boat launch notifying users to clean off their boats prior to removal and/or placement in the water.

NEW INFESTATIONS OF EXOTIC SPECIES

New infestations of aquatic invasive plants should be aggressively managed to eradicate the species from Dunkirk Dam Pool. Dunkirk Dam Pool should be surveyed continuously to identify the potential invasion of new species and any invasion should warrant a "top level" response of treatment.

DDLD and other Pool users should work with Dane County, WDNR and the State Legislators to facilitate a rapid response:

- The Legislature should be approached to develop state laws to allow local rapid response to take place.
- The WDNR should be approached to develop an emergency access plan should an infestation be found.
- Materials should be developed and produced in the event of an invasion. These could include press releases, public information materials and access site notices.

If a new exotic species is found, the following steps should be taken immediately:

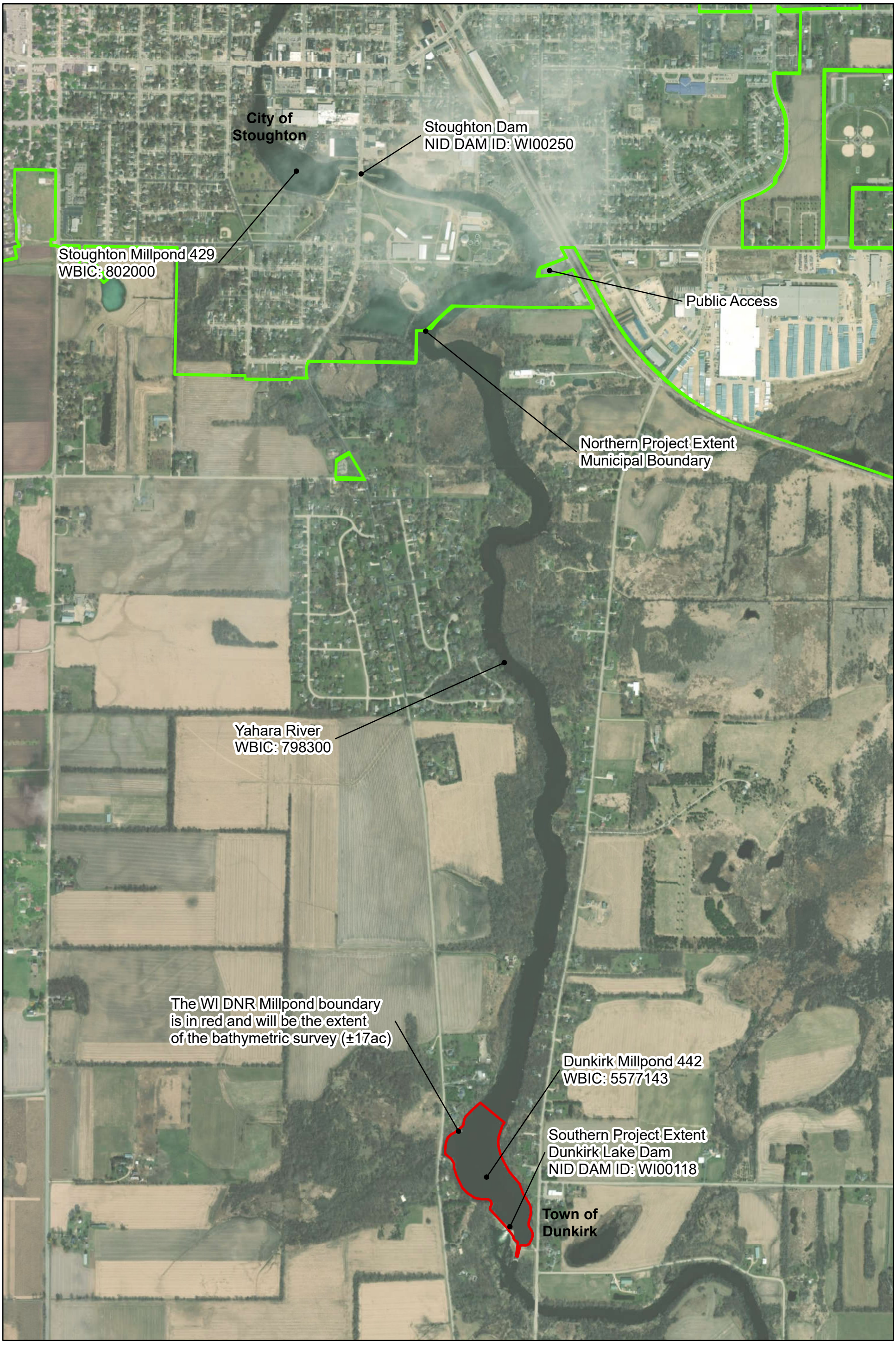
- Notify WDNR.
- Take a digital photo of the plant in the setting in which it was found and mark with a GPS location. If possible, collect 5 to 10 intact specimens including the roots. Place the plants in a Ziploc bag with water and on ice. Collected samples should be delivered to WDNR staff.
- Upon determination of a species, a coordinated response plan should be developed in consultation with the WDNR and Pool consultants as needed.

PLAN REASSESSMENT

The Dunkirk Dam Pool Aquatic Plant Management Plan provides options for plant management from which the DDLD and other Pool users may select to accomplish their goals. Further evaluation of the effectiveness of this plan and subsequent management efforts undertaken by Pool users should be based on whether the Pool is in "better condition" from an aquatic plant nuisance perspective.

This management plan should also be reviewed every 3 to 5 years.

STUDY AREA



Project Name:
Bathymetric Survey and APMP

Information about exhibit:
WDNR Surface Water Grant 2020

Scale:
0 1,000 Feet

Orientation:

Prepared for:
Dunkirk Lake District

Exhibit Title:
Overall Project Area

Exhibit:
1

Date: 10/29/2020

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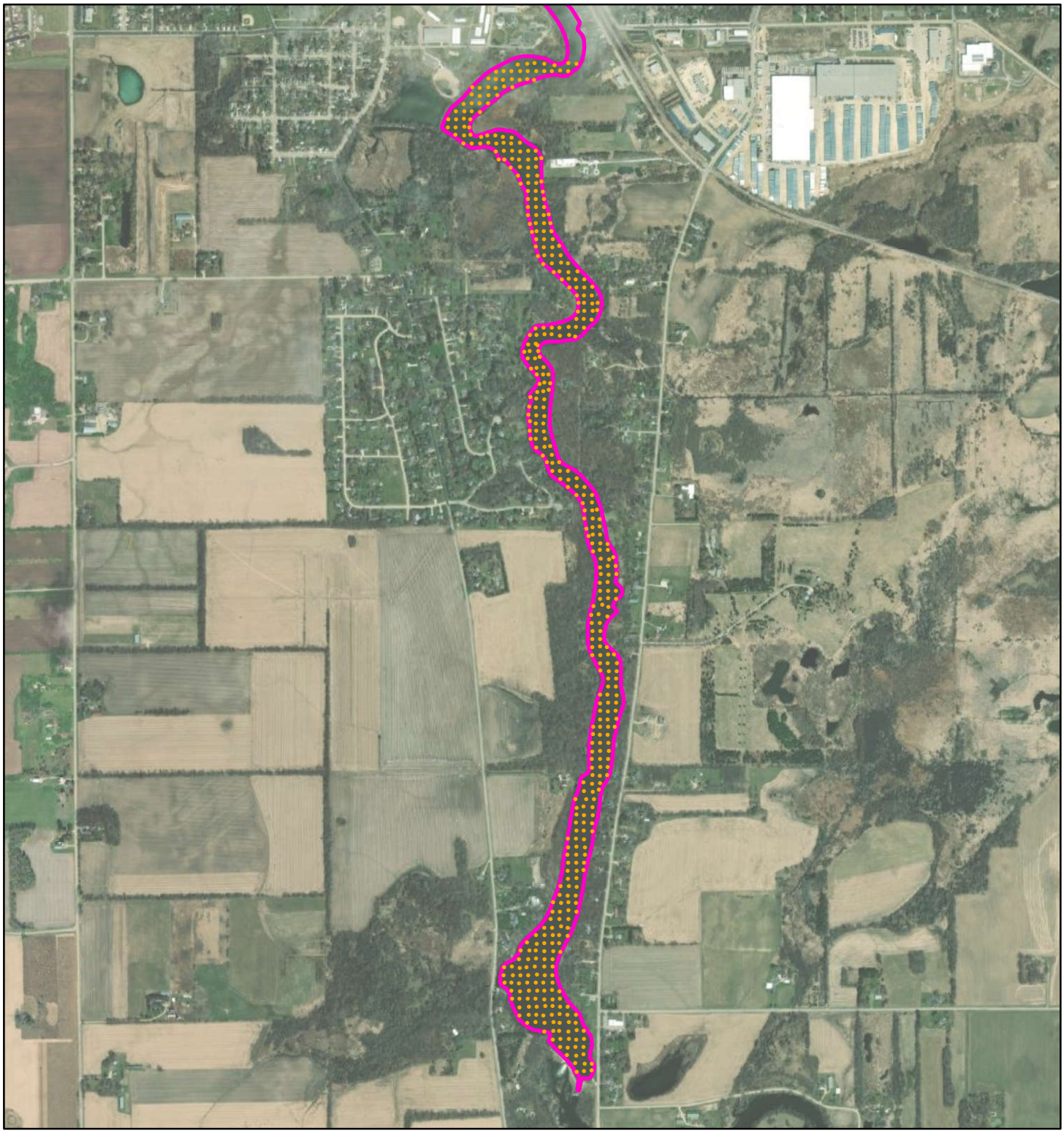
AQUATIC PLANTS



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Orientation:

Legend:

- Survey Point
- Survey Boundary

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Project Number: 20-0315

Date: 10/4/2021

Exhibit Title:

Aquatic Plant Survey Point Locations

Exhibit:

X

Prepared by:

Hey and Associates, Inc.
Engineering, Ecology and Landscape Architecture

Legend Plate 1:

Composite Rake Fullness

- None
- 1
- 2
- 3

Legend Plate 2:

Myriophyllum spicatum Rake Fullness

- None
- 1

Scale:

0 1,500 Feet

Project Number: 20-0315

Date: 9/30/2021

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Exhibit Title:

Composite Rake Fullness & EWM Rake Fullness

Exhibit:

X

Orientation:

Legend Plate 1:

Elodea canadensis Rake Fullness

- 1

Legend Plate 2:

Heteranthera dubia Rake Fullness

- None
- 1
- 2

Scale:

0 1,500 Feet

Project Number: 20-0315

Date: 9/30/2021

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Exhibit Title:

E. canadensis Rake Fullness & H. dubia Rake Fullness

Exhibit:

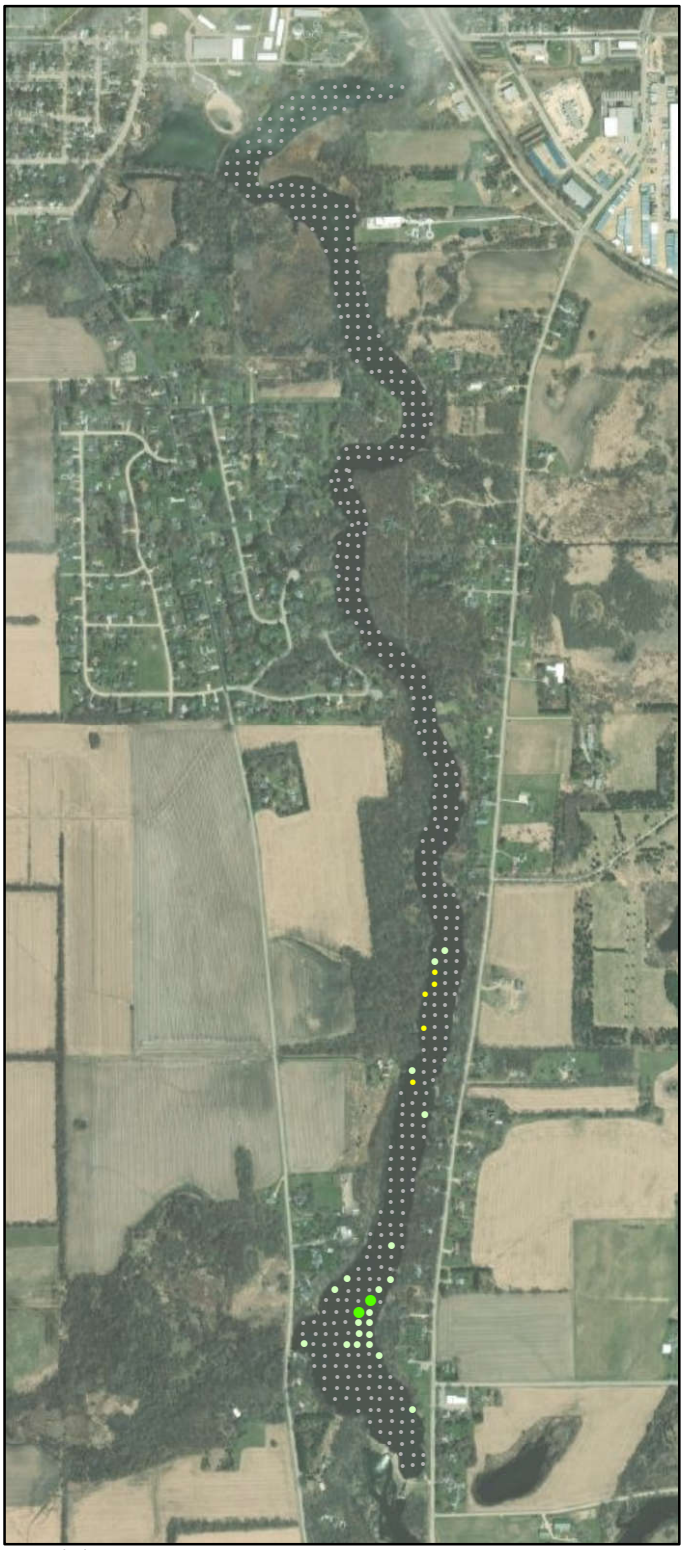
X

Orientation:

Legend Plate 1:

Lemna minor Rake Fullness

- None
- 1
- 2



Legend Plate 2:

Nymphaea ondinea Rake Fullness

- None
- Visible
- 1
- 2

Scale:

0 1,500 Feet

Project Number: 20-0315

Date: 9/30/2021

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Exhibit Title:

L. minor Rake Fullness &
N. ondinea Rake Fullness

Exhibit:

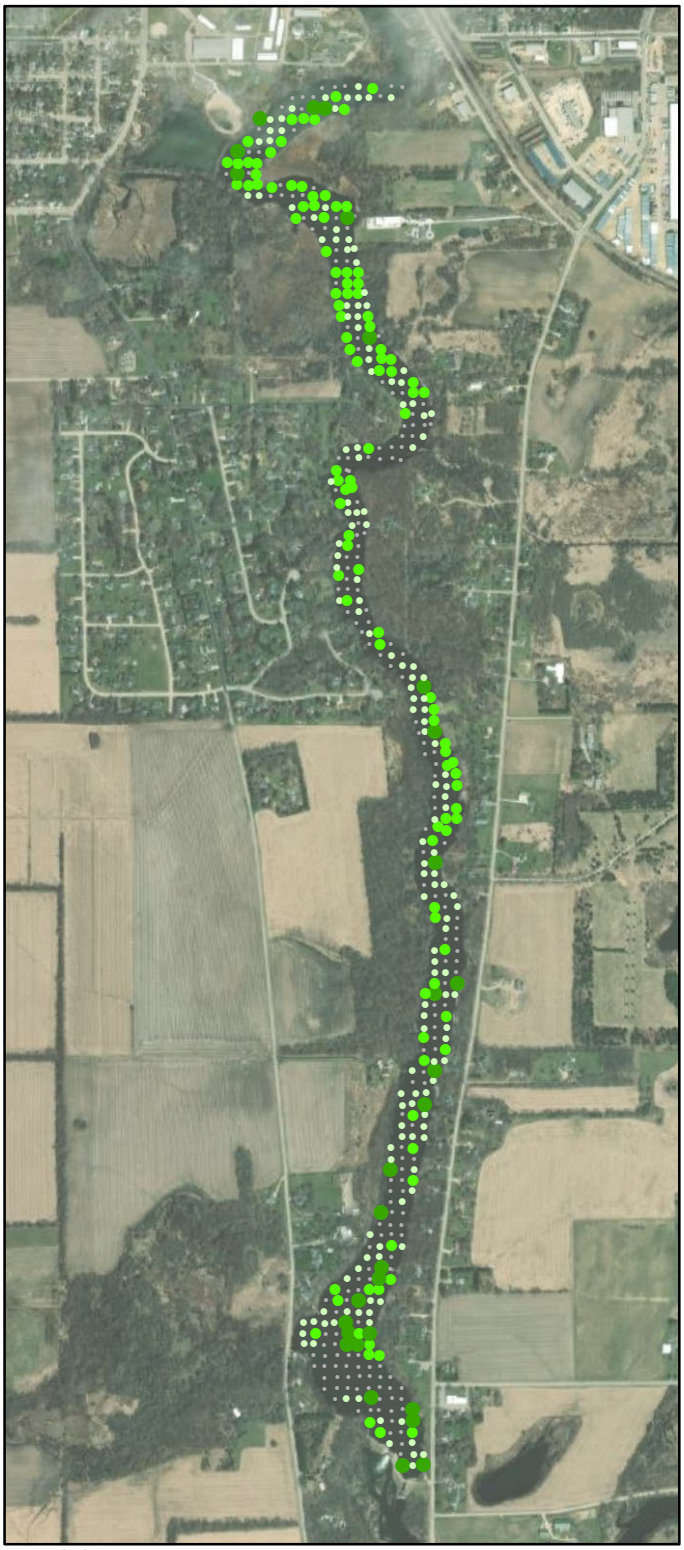
X

Orientation:

Legend Plate 1:

Potamogeton crispus Rake Fullness

- None
- 1



Legend Plate 2:

Ceratophyllum demersum Rake Fullness

- None
- 1
- 2
- 3

Scale:

0 1,500 Feet

Project Number: 20-0315

Date: 9/30/2021

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Exhibit Title:

P. crispus Rake Fullness & C. demersum Rake Fullness

Exhibit:

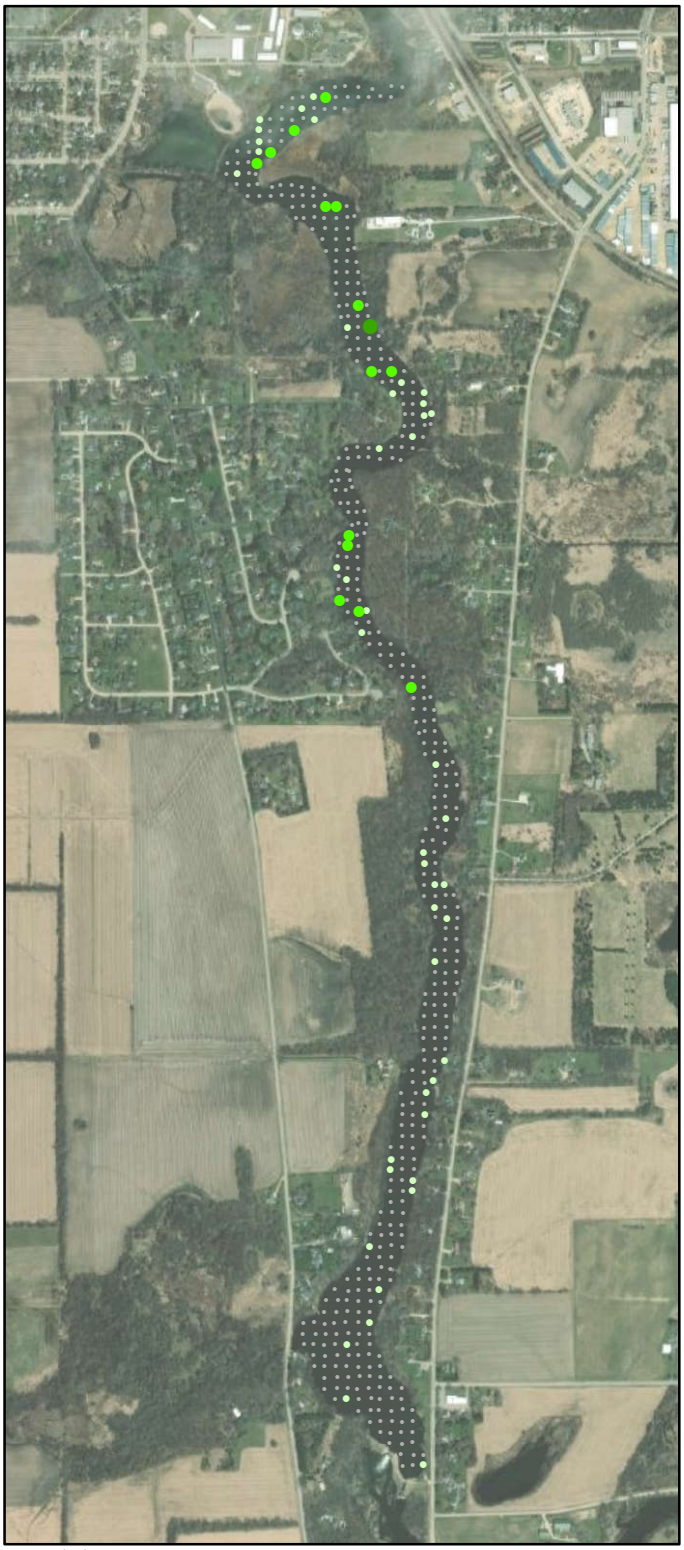
X

Orientation:

Legend Plate 1:

Stuckenia pectinata Rake Fullness

- None
- 1
- 2



Legend Plate 2:

Vallisneria americana Rake Fullness

- None
- 1
- 2
- 3

Scale:

0 1,500 Feet

Project Number: 20-0315

Date: 9/30/2021

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

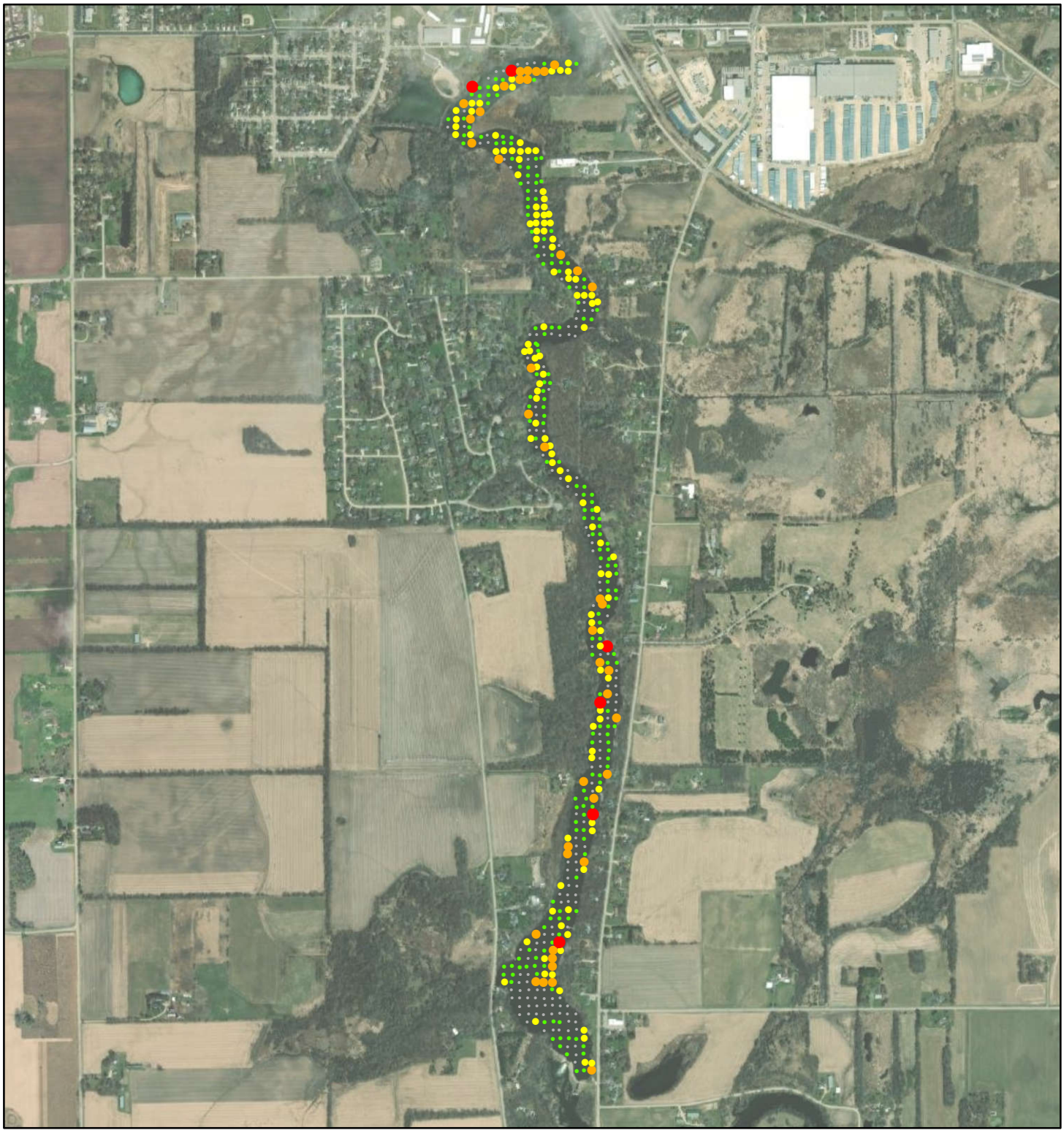
Exhibit Title:

S. pectinata Rake Fullness & V. americana Rake Fullness

Exhibit:

X

Orientation:



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Orientation:

Legend:

Species Richness

- 0
- 1
- 2
- 3
- 4

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Project Number: 20-0315

Date: 9/30/2021

Exhibit Title:

Species Richness

Exhibit:

X

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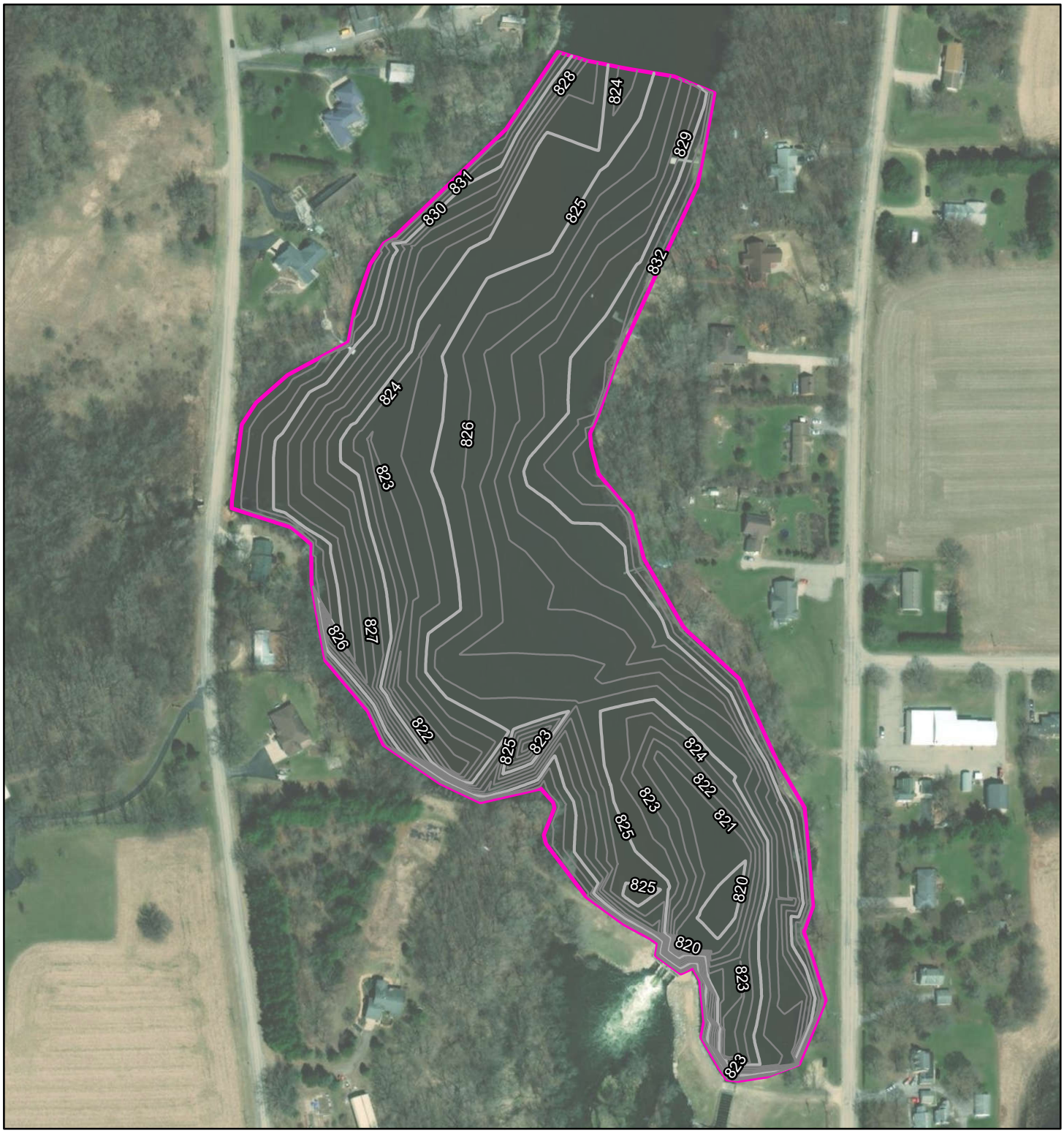
BATHYMETRY



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Orientation:

Legend:

Index

Intermediate

Survey Boundary

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Project Number: 20-0315

Date: 10/4/2021

Prepared by:

Exhibit Informantion:

Shoreline Elevation 826.31 ft.

Exhibit Title:

Hard Sediment Bathymetry

Exhibit:

X

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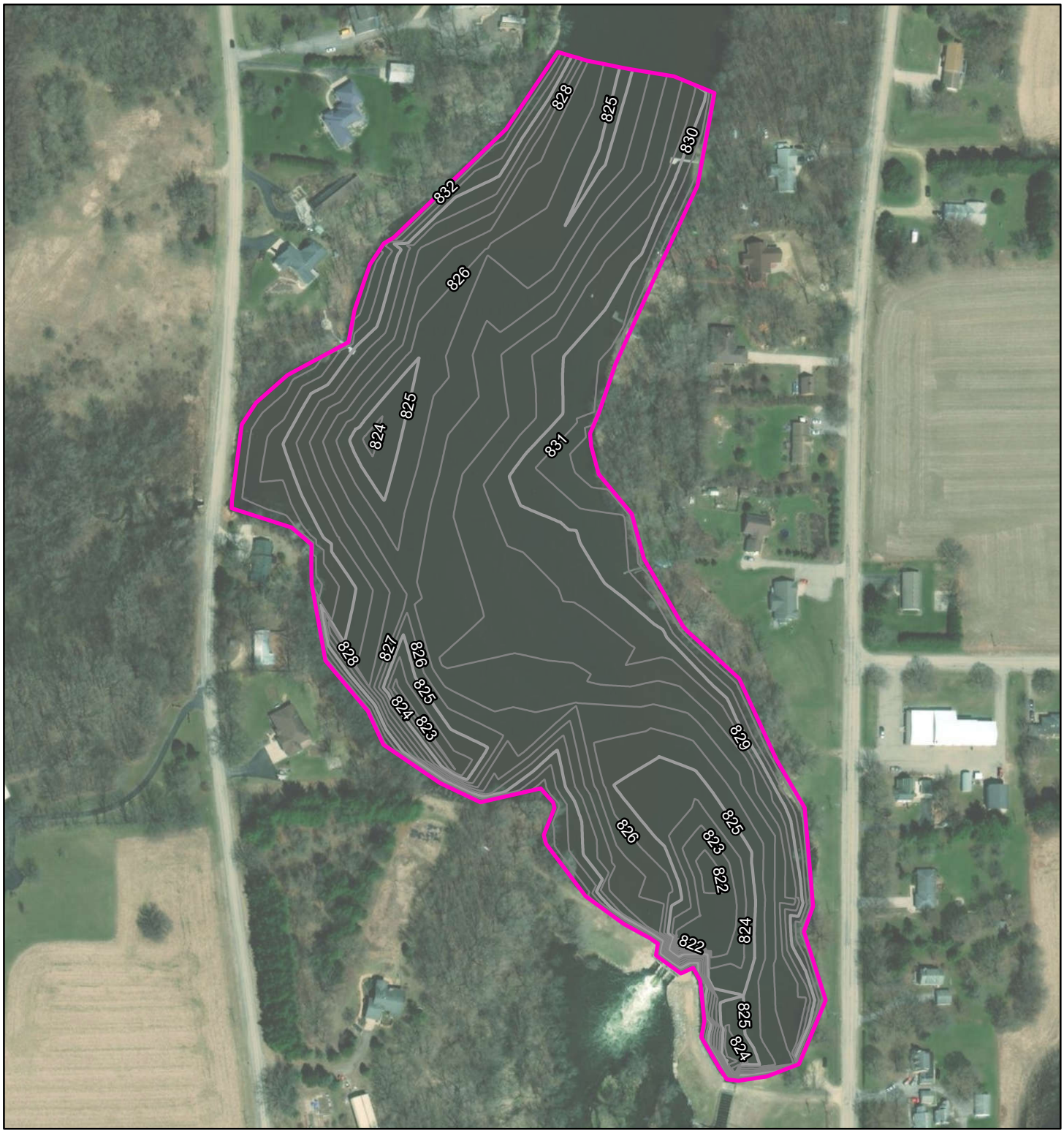

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Orientation:

Legend:

Index

Intermediate

Survey Boundary

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Project Number: 20-0315

Date: 10/4/2021

Prepared by:

Exhibit Informantion:

Shoreline Elevation 826.31 ft.

Exhibit Title:

Soft Sediment Bathymetry

Exhibit:

X

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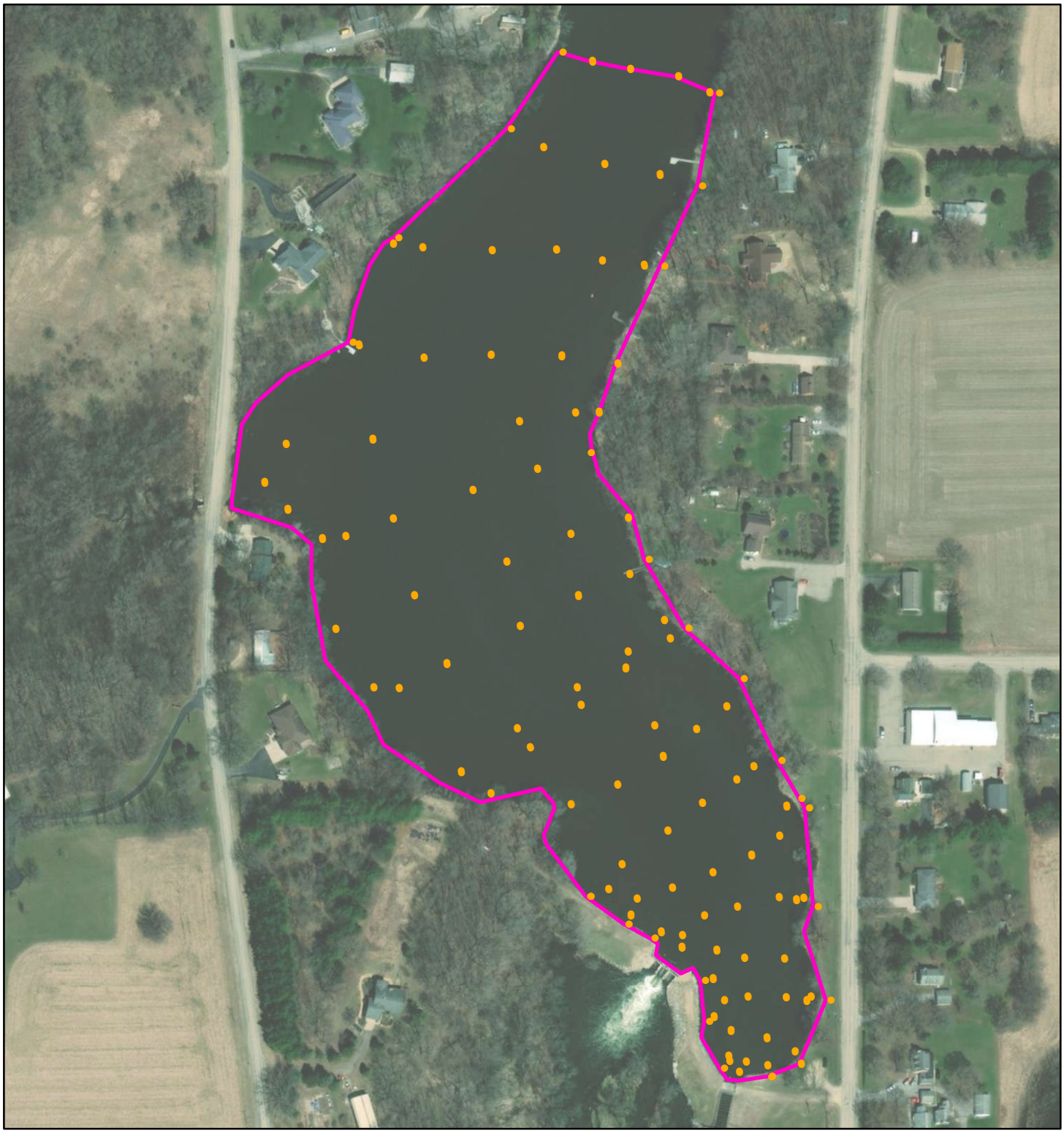

Scale:

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Orientation:

Legend:

- Survey Point
- Survey Boundary

Project Name:

Bathymetric Survey and APMP

Prepared for:

Dunkirk Dam Lake District

Project Number: 20-0315

Date: 10/4/2021

Prepared by:

Exhibit Informantion:

Shoreline Elevation 826.31 ft.

Exhibit Title:

Bathymetric Survey Locations

Exhibit:

X

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