PENN 7 OPERATIONS AND MAINTENANCE PLAN

FOR THE:

ENGINEERING AND SITE DESIGN ACTIVITIES FOR RESTORATION OF EMERGENT COASTAL/FLOODPLAIN WETLANDS AT PENN 7 TOLEDO, OHIO

PREPARED FOR:

CITY OF TOLEDO

PREPARED BY:

HULL & ASSOCIATES, LLC
219 S. ERIE STREET
TOLEDO, OHIO 43604

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HULL

Environment / Energy / Infrastructure

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1.0 EXECUTIVE SUMMARY

The Site consists of a 58.86-acre property on the lower Maumee River located at 3300 N Summit Street R, Toledo, Lucas County, Ohio and is designed to operate passively with minimal O&M requirements. Below is a summary of the anticipated required O&M activities:

- Mow and clear identified portions of the Site annually (at a minimum)
- Inspect the Site annually, at a minimum. This inspection involves the following:
  - Perimeter site walk
  - Inspection of trees/shrubs for needed maintenance
  - Inspection of site features
  - Identification of invasive species
  - Completion of the Site Inspection Form (Appendix A)
- Management of invasive species, as needed

Additional operation requirements for the water control structures would be needed if active management of the Site is desired. The above O&M activities and potential active management activities are discussed in detail in subsequent sections of this report.

2.0 BACKGROUND

The City of Toledo (City) was a subawardee for a grant the Great Lakes Commission (GLC) received from the National Oceanic and Atmospheric Administration (NOAA) to complete engineering and site design activities for the restoration of 15.2 acres of emergent coastal/floodplain wetland habitat at a 58.86-acre property (Site) on the lower Maumee River located at 3300 N Summit Street R, Toledo, Ohio.

The Site includes Penn 7, which is a historic confined disposal facility (CDF) containing sediments dredged from the Maumee River, an open water embayment area, and an additional area of fill located north of the embayment adjacent to the CSX railroad bridge (Figure 1). Prior to the implementation of the restoration project, the existing perimeter containment berms, which range from approximately 3 feet to 12 feet (height from river bottom), surrounded the perimeter of Penn 7 and created a low interior with hydric soils that supported some wetland vegetation. The wetland was usually isolated from the river, dried completely for at least a portion of the year, and had little value as wildlife habitat, as the wetland area was dominated almost completely by invasive Reed Canary Grass. Constructing a hydrologic connection between Penn 7 and the lower Maumee River restored emergent coastal/floodplain wetlands and created essential fish and wildlife habitat.

The completed restoration project resulted in the restoration of emergent coastal/floodplain wetland habitat at this location by creating a wetland area within the CDF and a forebay and open water habitat in the open water embayment area, which is connected to the wetland area by a new channel. A dike across the open water embayment area was constructed to create protected and enhanced open water habitat, and three water control structures were installed to permit management of water levels and assist in control of invasive species in the wetland and open water embayment. The remainder of the CDF consists of a forested upland area. The site improvements overlaying the pre-restoration conditions are shown on Figure 2.

This operations and maintenance (O&M) plan was prepared by Hull & Associates, LLC (Hull) for the City based on the project team's identification of the anticipated inspection and maintenance needs to support the completed restoration of the Penn 7 Emergent Coastal Floodplain Wetlands Restoration Project. The subsequent sections discuss general O&M requirements for the Site (Section 3.0), O&M requirements for the new site features (i.e., water control structures, dikes, etc.) (Section 4.0), and methods for controlling invasive plant species within the Site (Section 5.0).

3.0 GENERAL SITE O&M

3.1 Annual Inspection

Upon completion of construction, annual inspections of the Site should be performed during the growing season by a trained inspector (i.e., familiar with this O&M plan and can identify invasive species). It is recommended to conduct the annual inspection around July 1st, when the fish grates are recommended to be raised (see Section 4.1.1). A perimeter site walk should be completed to check for indications of trespassing and damage to the perimeter fence and gates and to inspect the trees and shrubs for needed maintenance as described in Section 3.3. To verify that the site features are appropriately operating, water levels should be measured utilizing the staff gauges located within the water control structures on-site, and photographs should be taken showing the water level within the Site at the designated photo locations. Each of the site features should also be inspected as described in Section 4.0. Any invasive plant species observed during the perimeter site walk should be noted so the appropriate removal and control measures may be implemented as soon as possible or when appropriate as described in Section 5.0. Findings of the annual inspection should be reported to the Commissioner of the City's Division of Parks, Recreation and Forestry and any necessary maintenance activities should be implemented as soon as possible. See Figures 3 and 4 for the potential perimeter site walk route and designated photo locations.

During the annual inspection and any additional inspections that may be performed, the Site Inspection Form (Appendix A) should be completed by a trained inspector. A hardcopy of the Site map (Figures 3 and 4) is recommended to be taken on all inspections and included as an attachment to the Site Inspection Form so the locations of any issues identified during the inspection may be noted. The Site Inspection Form shall be submitted to the Commissioner of the City's Division of Parks, Recreation and Forestry following completion of the inspection.

3.2 Mowing and Clearing

The Summit Street edge of the Site/property shall be mowed at least annually to keep an area along the perimeter fence line cleared. In addition, the path used to conduct the perimeter site walk shall be cleared at least annually to permit access around the entire Site, and a path to the forebay and channel shall be cleared as needed to permit removal of debris and dredging of sediment. If feasible, it is recommended to mow these areas once in the spring and once in the fall. See Figures 3 and 4 for approximate mowing and clearing locations.

3.3 Tree and Shrub Maintenance

The following sections related to tree and shrub maintenance have been provided by Deitering Landscaping, the landscape subcontractor for the wetland restoration activities at the Site, for inclusion in this O&M plan. Minor modifications were made by Hull for clarification purposes.

3.3.1 Staking of Trees

Trees that have been staked should remain staked for one year (until July 2022 for trees planted during construction), and then tree stakes and ties should be removed.

3.3.2 Herbicides

Trees and shrubs may be sensitive to the herbicides applied to nearby fields or lawns. Multiple exposures each year to these damaging chemicals may cause stress, increasing the risk of insect damage or disease and reducing the effective life of a tree. Be aware of wind conditions that may cause herbicides to drift and exercise caution when applying herbicides in or near your trees.

3.3.3 Pruning

Branches damaged by ice, wind, animal grazing, or bird roosting should be removed. Damage to the central leader causes the lateral branches to assume the role of the central leader and begin to grow upward. If left to grow, a double leader may develop, creating a weak spot in the trunk as the tree matures. Forked and multi-stemmed trees are prone to wind breakage, and don't grow as tall as single stem trees.

When done properly, pruning can improve a tree's healthy appearance, as well as increase the life expectancy of the tree. Proper pruning opens the canopy of the tree to permit more air movement and sunlight penetration.

Done improperly, pruning can decrease the tree's life expectancy or even kill it. Because trees are living organisms, they can be profoundly affected by pruning practices. Tree care professionals adhere to accepted standard of practices when pruning trees.

The American National Standard for tree pruning, designated as ANSI A300, has been in existence since 1995. Its development was approved by the American National Standards Institute. This pruning standard should be followed in all pruning situations and all geographic areas. Knowing how certain tree species grow within a given environment may alter how the recommendations of A300 are interpreted.

The following information is designed to help you understand exactly what will be accomplished in a pruning operation.

3.3.3.1 Making Cuts

Branches should be removed with thinning cuts. A thinning cut either removes a branch at its point of origin or shortens it back to a lateral branch that is large enough to assume the terminal role.

Branches should not be removed with heading or topping cuts. A heading cut is when a currently growing or one-year-old shoot is cut back to a bud, or when a larger limb is cut back to a stub or a lateral that is not big enough to assume the terminal role. Heading should rarely be used in shade and ornamental tree pruning, since it forces the growth of multiple upright sprouts that are weakly attached to the parent stem. Drastic heading can kill the tree outright.

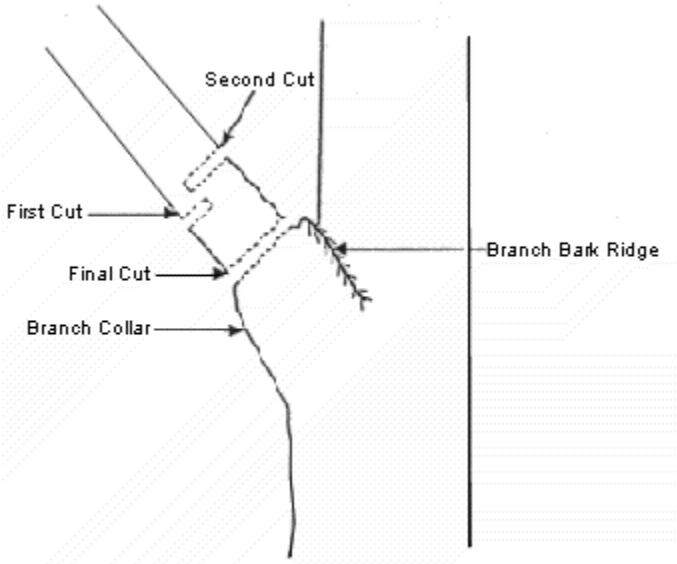


Figure 1 - Removing a large lateral branch requires two preliminary cuts before the final cut

3.3.3.2 Hazard Reduction Pruning

Hazard reduction pruning is recommended when the primary objective is to reduce the danger to a specific target caused by visibly defined hazards in a tree. For example, hazard reduction pruning may be the primary objective if a tree had many dead limbs over a park bench.

3.3.3.3 Maintenance Pruning

Maintenance pruning is recommended when the primary objective is to maintain or improve tree health and structure and includes hazard-reduction pruning. An example here might be to perform a maintenance pruning operation on trees along the edge of the property or trails that may be more visible to the public.

3.3.3.4 Pruning Types

Hazard reduction pruning and maintenance pruning should consist of one or more of the pruning types noted below.

- **Crown cleaning** consists of the selective removal of one or more of the following items: dead, dying, or diseased branches, weak branches and waterspouts.
- **Crown thinning** is the selective removal of branches to increase light penetration, air movement, and reduce weight.
- **Crown raising** consists of the removal of the lower branches of a tree to provide clearance.
- **Crown reduction**, also called crown shaping, decreases the height and/or spread of a tree. Consideration should be given to the ability of a species to sustain this type of pruning.
- **Vista pruning** is selective thinning of framework limbs or specific areas of the crown to allow a view of an object from a predetermined point.
- **Crown restoration** pruning should improve the structure, form and appearance of trees which have been severely headed, vandalized, or storm damaged.

When you contract a company to prune trees, you should obtain a verbal or written commitment that, "All pruning shall be done in accordance with the ANSI A300 standard for tree pruning." This means that the overall pruning operation is going to stay within specific bounds, which includes the following:

- Proper cuts will be made,
- Not more than one-fourth, or 25 percent, of the foliage of the canopy or individual limbs should be removed in any one season, and
- When pruning is completed, at least half the foliage should remain evenly distributed in the lower two-thirds of the canopy.

4.0 O&M OF SITE FEATURES

4.1 Water Control Structures

4.1.1 Operations

The Site is designed to operate passively, however, water control structures with stoplogs and fish grates have been incorporated to permit active management and facilitate maintenance. These water control structures are located at the wetland inlet/outlet, within the connecting channel and within the dike at the open water embayment inlet/outlet (Figures 3 and 4). See Appendix B for photos of the water control structures.

Water levels within the Site shall be managed through either passive or active management. Under passive management, the water level within the Site will be controlled by the water level of the Maumee River and Lake Erie. While it is anticipated that passive management of water levels will be the preferred default long-term practice, active management may be appropriate to address specific conditions or goals. Examples of situations where active management may be appropriate include for the management of invasive species, to perform required repairs, during extreme water levels in Lake Erie, or during harmful algal blooms (HABs).

If active management is desired to help manage invasive species more effectively, it is recommended to vary the water depth in the Site depending on the season and year. During the first year of active management, stoplogs should be inserted during late spring to flood the target area(s) 12 to 18 inches (see Table 1 for required number of stoplogs). In three (3) to five (5) years, the stoplogs should be removed, except for the bottom stoplog, during May or June to allow drawdown to encourage native plant establishment. Stoplogs should then be inserted to reestablish the 12 to 18-inch water depth in the target area(s) during early Autumn. The drawdown should again occur in three (3) to five (5) years and this process should be continued as long as active management is desired to manage invasive species, or in accordance with a specific active management plan that is developed in the future. Note that after flooding to manage invasive species, it may be necessary to reseed/plant the flooded areas. The as-built planting plan provided by the Contractor is provided in Appendix C for reference to appropriate species to plant in each area.

PENN 7 OPERATIONS AND MAINTENANCE

TABLE 1

ACTIVE MANAGEMENT FOR INVASIVE SPECIES CONTROL

Wetland and Channel WCS		Open Water Embayment WCS[4]	
Target Elevation (feet)[1,3]	Number of Stoplogs[2,3]	Target Elevation (feet)[1,3]	Number of Stoplogs[2,3]
571	4-5	570	4-5
572	6-7	571	6-7
573	8-9	572	8-9
574	10-11	573	10-11
575	12-13	574	12-13
>575	14	575	14

[1] See Figures 3 and 4 to determine the target elevation based on the identified target area(s). Use the higher bounding contour as the target elevation.

[2] The number of stoplogs includes the bottom stoplog, which should always remain within the water control structures, and should flood the area approximately 12 to 18 inches above the target elevation.

[3] Each WCS has a staff gauge that can be used to check current water levels and as a reference to manage the stoplogs. The Wetland and Channel WCS have an interior bottom elevation of approximately 570' while the Open Water Embayment WCS has an interior bottom elevation of approximately 569'.

[4] The embayment water control structure has a maximum number of 14 stoplogs. Note that there is low permeability material installed on the embayment side of the dike up to an elevation of 574'. Water levels may be temporarily managed above this elevation, but note there maybe seepage through dike over the long-term.

If repairs are needed that require water levels within the Site to be controlled, the maximum number of stoplogs should be installed in the appropriate WCSs and the weekly forecast from the United States Army Corps of Engineers (USACE) should be checked for Lake Erie to verify that water levels are not anticipated to exceed the maximum stoplog elevation (i.e., 576 feet for the open water embayment and 577 feet for the wetland area) during the proposed repair work. Weekly forecasts are available at the following link: https://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Great-Lakes-Water-Levels/Water-Level-Forecast/Weekly-Great-Lakes-Water-Levels/

Active management for extreme water levels in Lake Erie would involve installing stoplogs to either prevent the raising or lowering of water levels in the Site as the Maumee River and Lake Erie water levels fluctuate. In general, when extreme low-water levels are forecasted, stoplogs may be recommended to be installed to prevent the drawdown of water within the Site and when extreme high-water levels are forecasted, stoplogs may be installed to prevent the raising of water levels. If this type of active management is desired, it is recommended to develop an active management plan that considers the anticipated low- and high-water levels as well as the probable seiche events.

When HABs are present in Lake Erie and/or the Maumee River, the HABs may enter the Site when the Maumee River flows upstream due to changes in weather conditions. To prevent this, the maximum number of stoplogs could be inserted to hydraulically disconnect the Site from the Maumee River. However, the Site

should be inspected for evidence of HABs already within the Site prior to installing the stoplogs and the stoplogs are recommended to be removed after flow in the Maumee River changes direction again (i.e., resumes flowing downstream). A decision to install stoplogs for this situation may be made based on the weather forecast and if the Maumee River flow direction is anticipated to quickly change back to flowing downstream. The NOAA National Centers for Coastal Ocean Science maintains a Lake Erie Harmful Algal Bloom Forecast website that may be monitored to help make decisions for when to hydraulically disconnect the Site due to HABs. This forecast is available at the following link: https://coastalscience.noaa.gov/research/stressor-impacts-mitigation/hab-forecasts/lake-erie/

Note that under some conditions (e.g., extreme low- and high-water levels, etc.) temporary pumping of water (i.e., with a portable pump) from the Maumee River into the Site or from the Site into the Maumee River may be required to achieve the required water depth for invasive species management or repair work during active management. Note that water levels within the wetland and embayment areas may be controlled separately by utilizing the water control structure within the connecting channel, as desired.

When preventing Carp from entering the Site, the fish grates should be lowered into place when water temperatures are between 50 to 73 degrees Fahrenheit to reduce their use of the wetland for spawning. This temperature range generally corresponds to the time period between April 1st and July 1st. It is suggested that these dates be used as a rough guide on when to lower and raise the fish grates to ensure they are being used most effectively.

A more detailed active management plan may be developed based on this information and the installed structures, as desired.

4.1.2 Maintenance

The water control structures shall be inspected by a trained inspector as part of the annual inspection described in Section 3.1 for seepage through stop logs, sloughing of revetment, damage, and excessive piling of debris and/or sediment deposition at the culvert inlet/outlet and on the trash racks. The water level at the time of inspection should also be noted

Signs of sloughing may include slumping or displacement of the revetment on either side of the water control structure and visual signs of embankment erosion due to low spots creating concentrated stormwater flow, such as visible scour or cuts in the embankment exposing earth fill, aggregate fill (recycled concrete) or geotextile fabric. If any sloughing is observed, the observation shall be documented and photographed and provided to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall

consult with an engineer as needed, determine if any corrective measures are required and implement the identified corrective measures.

The inspector should visually inspect all components of the water control structure (i.e., culvert pipe, catch basin, stoplogs, and fish grate) that are visible or accessible at the time of the inspection. Any components that are not able to be visually inspected at the time of inspection should be noted. It may be necessary to perform another inspection when the water level has lowered if there is reason to expect these components may be damaged. Any damage observed should be documented, photographed and reported to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall consult with an engineer as needed, determine if any corrective measures are required and implement the identified corrective measures.

The water control structures should also be inspected for excessive piling of debris and/or sediment deposition at the culvert inlet/outlet that would restrict stormwater flows. Note that there are trash racks on both culverts for the Wetland, Channel, and Open Water Embayment WCSs to minimize clogging of the WCSs. If excessive piling of debris and/or sediment deposition appear to be concentrating stormwater flow to a certain area of the structure, the inspector shall document and photograph the restriction and report it to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall prepare and implement a suitable plan for removing debris or sediment, as needed, from the forebay.

4.2 Dikes/Embankments

The dikes and embankments, which includes the channel crossing, (see Figures 3 and 4 for location) shall be inspected by a trained inspector as part of the annual inspection described in Section 3.1 for seepage, settlement, erosion, sloughing of revetment, and excessive piling of debris.

Signs of sloughing may include slumping or displacement of the revetment on either side of the dike or channel crossing and visual signs of embankment erosion due to low spots creating concentrated stormwater flow, such as visible scour or cuts in the embankment exposing earth fill, aggregate fill (recycled concrete) or geotextile fabric. If any sloughing is observed, the observation shall be documented and photographed and provided to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall consult with an engineer as needed, determine if any corrective measures are required and implement the identified corrective measures.

Note that there is low permeability material (AquaBlok®) installed under the revetment stone on the sideslope on the embayment side of the dike from the toe to an elevation of 574' to support management of water levels over the long-term. This material is also located on the interior (Wetland) side sideslope of the

perimeter dike around the Wetland Water Control Structure pipe to prevent seepage along this pipe. If this material appears disturbed or if seepage is observed through these locations, the observation shall be documented and photographed and provided to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall consult with an engineer as needed, determine if any corrective measures are required and implement the identified corrective measures.

Signs of settlement may include low spots along the pathway where stormwater may accumulate. If any settlement is observed, the observation shall be documented and photographed and provided to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall consult with an engineer as needed, determine if any corrective measures are required and implement the identified corrective measures.

The inspector shall visually inspect all portions of the dike and channel crossing that are visible at the time of the inspection for signs of erosion. It may be necessary to perform a follow up inspection when the water level has lowered if a significant portion of the dike or channel crossing is not visible and there is reason to believe it may be damaged. Signs of erosion include displacement of the revetment on either side of the dike or channel crossing and exposed aggregate fill (recycled concrete) or geotextile fabric. If any significant erosion is observed, the observation shall be documented and photographed and provided to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall consult with an engineer as needed, determine if any corrective measures are required and implement the identified corrective measures.

The dikes and channel crossing should also be inspected for excessive piling of debris and/or sediment deposition. If excessive piling of debris and/or sediment deposition appear to be concentrating stormwater flow to a certain area of the dike or channel crossing, the inspector shall document and photograph the restriction and report it to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall prepare and implement a suitable plan for removing debris or sediment, as needed, from the dikes or channel crossing.

4.3 Forebay

The forebay (see Figure 4 for location) shall be inspected by a trained inspector as part of the annual inspection described in Section 3.1 to monitor the piling of debris and sediment. Debris should be removed from the forebay when it is preventing the forebay from operating as designed. It is recommended to remove accumulated sediment before sediment overtops the forebay. Excessive piling of debris or sediment, particularly areas that are causing flow restrictions, should be documented, photographed and reported to

the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall prepare and implement a suitable plan for removing debris or sediment, as needed, from the forebay.

4.4 Channel

The channel (see Figure 3 for location) shall be inspected by a trained inspector as part of the annual inspection described in Section 3.1 to monitor the piling of debris and sediment. Debris and sediment should be removed from the channel when it is obstructing flow and fish passage through the channel. Excessive piling of debris or sediment, particularly areas that are causing flow restrictions, should be documented, photographed and reported to the Commissioner of the City's Division of Parks, Recreation and Forestry. The Commissioner shall prepare and implement a suitable plan for removing debris or sediment, as needed, from the channel.

5.0 INVASIVE PLANT SPECIES CONTROL

Invasive plant species that are common to the Site or are known to be within the vicinity of the Site and may translocate in the future, include but are not limited to cattail (*Typha Spp.*), common reed (*Phragmites Australis*), garlic mustard (*Alliaria Petiolata*), reed canary grass (*Phalaris Arundinacea*), honeysuckle (*Lonicera Spp.*), Japanese knotweed (*Polygonum Cuspidatum* or *Fallopia Japonica*), and flowering rush (*Butomus umbellatus*). Invasive species are recommended to be monitored and controlled so that no single species achieves greater than 5% coverage or alters the desired community structure of the Site. During the annual inspection described in Section 3.1, the location and approximate coverage of all observed invasive species should be documented, photographed and reported to the Commissioner of the City's Division of Parks, Recreation and Forestry by a trained inspector. The Commissioner shall prepare and implement a suitable plan for controlling all observed invasive species, as needed. Control measures include herbicides, mowing, flooding, burning, and mechanical methods (cutting and pulling), among others. Herbicide application can be used in conjunction with mechanical methods to reduce the amount of herbicide applied. Any herbicide application must be conducted by a licensed applicator.

Removal and control methods for each of the above-mentioned species are discussed in Sections 5.1 through 5.7 below. Note that Deitering Landscaping, the landscape subcontractor for the wetland restoration activities at the Site, recommended the use of Liberty Herbicide or similar and that invasive species application should start in June and be continued through the remainder of the year, as needed. Fact sheets from the Ohio Invasive Plants Council (OIPC) and Minnesota Department of Natural Resources are provided in Appendix D to assist in the identification of these invasive plant species (other fact sheets are available online). For species not listed here, or for additional identification resources of the listed species, visit these websites: Ohio Department of Natural Resources (https://ohiodnr.gov/wps/portal/gov/odnr/discover-and-learn/safety-conservation/fish-management/aquatic-invasive-species/links-pubs-aquatic-invasives), Ohio Administrative Code 901:5-30-01 (http://codes.ohio.gov/oac/901%3A5-30), OIPC (https://www.oipc.info/), and United States Geological Survey NAS - Nonindigenous Aquatic Species (https://nas.er.usgs.gov/). In addition, free applications (e.g., PictureThis and PlantSnap) that may help with plant identification in the field are available for download to mobile devices.

5.1 Cattail (*Typha Spp.*)

Cattail species are very aggressive colonizers with an extensive rhizomatous root system that if it becomes established can be extremely difficult to eliminate. Hand pulling or digging may be effective on small or very young plants. This will be very labor intensive particularly if the plant becomes well established. Care should be given to removing the entire root structure or regrowth from broken roots may occur. However, once a stand becomes established, the extensive root system will make hand pulling or digging very difficult

and potentially ineffective. Seed head removal can be conducted but treatment should take place before seed head establishment. Seed heads should be bagged immediately and removed from the Site. Many control measures have been tried in the past including mowing, flooding, and burning but the most effective control method has been herbicide application. Glyphosate has been shown to be an effective control measure but usually takes two or three seasons of applications to eliminate dense stands. The most effective means of control of cattail has been application of herbicides such as glyphosate that can be sprayed or applied by a wicking device. Herbicide application is recommended to occur in August.

5.2 Common Reed (*Phragmites Australis*)

Common reed is a very aggressive grass with an extensive rhizomatous root system that if it becomes established can be extremely difficult to eliminate. Hand pulling or digging may be effective on small or very young plants. This will be very labor intensive particularly if the plant becomes well established. However, once a stand becomes established, the extensive root system will make hand pulling or digging very difficult and potentially ineffective. Many control measures have been tried in the past including mowing, flooding, burning, and covering with black plastic but the most effective control method has been herbicide application. Glyphosate has been shown to be an effective control measure but usually takes two or three seasons of applications to eliminate dense stands. The most effective means of control of common reed has been application of herbicides such as glyphosate that can be sprayed or applied by a wicking device. Herbicide application is recommended to occur in August. Common reed is shade intolerant and once the planted shrub and forested species provide a canopy that shades the replacement or restoration areas, common reed should not be a concern in mature forested areas. Periodic mowing may provide some control, but will likely not eliminate the plants. Other measures will likely be needed for long term control.

5.3 Garlic Mustard (*Alliaria Petiolata*)

Garlic mustard is a biannual plant that can form dense monotypic stands to the exclusion of native species. This plant grows in dense shade and can become established as a ground cover under upland forest canopy. Hand pulling and herbicides are the best management methodologies. Small infestations of garlic mustard can be controlled by hand pulling second year plants when they have started to flower. All the root must be removed since the roots can resprout. Collected plants should be placed in plastic bags and landfilled and not left on the ground or composted as they may remain alive and may yet produce seed.

5.4 Reed Canary Grass (*Phalaris Arundinacea*)

Reed canary grass is an aggressive wetland species that forms dense monotypic stands to the exclusion of other wetland species. It spreads by rhizomatous growth and seeds. Once established it can be difficult to adequately control due to resprouting from the soil seed bank. However, this herbaceous species should not be a problem once the shade canopy of the tree and shrub species become established in the replacement

wetland area. Several methods of control are available each with moderate effectiveness. No one methodology will be fully effective if the reed canary grass is well established. Control methods include herbicides, burning, mowing or mechanical removal. Use of glyphosate has shown to have some success, being effective for up to two years. After two years, regrowth from the seed bank may reestablish the stand. Spraying large stands and or wicking small stands or individual plants will provide the best options. Repeated application will likely be needed and herbicides are recommended to be applied in June or July. Burning and twice-yearly mowing have also shown some success, but again resprouting from the seed bank will require management over multiple years. Removal using heavy construction equipment has not been shown to be effective due to rapid regrowth from rhizomes and seeds left in the soil.

5.5 Honeysuckle (*Lonicera Spp.*)

Bush honeysuckles, when established, exclude all other ground covers and shrubs. Honeysuckle produces fruits that are eaten by birds and disperse the seeds. They have a wide range of tolerance from partial to full sun. They are extremely invasive and can easily dominate a habitat.

Removal of small plants can be accomplished by pulling the seedlings and allow to desiccate. This will likely be the preferred control method, as any large shrubs should not be pulled. Control of large shrubs will require a combination of mechanical cutting and herbicide treatment of the stump. Shrubs should be cut with loppers, hand saw, or chainsaw. A smooth flat cut of the stem should be left. Each stump should then be treated with a dyed 20 percent solution of glyphosate. Cutting and treatment can be done any time of year. Cutting and herbicide treatment to the stump is very effective and the stumps should not resprout. However, cutting should not be done unless herbicide is also used. Cutting without herbicide will only result in dense resprouting. Reseeding the area after removal of the honeysuckle will help to reestablish a native herbaceous community.

5.6 Japanese Knotweed (*Polygonum Cuspidatum* or *Fallopia Japonica*)

Japanese knotweed is an aggressive perennial plant that sprouts from an extensive root and rhizome system. Roots can extend 20 feet from the plant and down 7 feet into the soil. Vegetative reproduction is likely the reason it is so successful at creating dense stands. Mechanical control means may be used, but any roots left in the soil will resprout. Herbicide applications will likely be required to control this species if it becomes established. Note that Japanese knotweed was identified on the southwest portion of Warrick Holdings, LLC property, along the northwest side of the channel. This area in particular should be monitored to confirm the Japanese knotweed is not spreading onto the site.

Herbicides should be used as a foliar application or injected into the plant stems. Foliar applications should be conducted in July to September, from flower bud to seeding stage. Foliar applications include risk of drift

of herbicide to non-target species. Herbicides suitable for knotweed include glyphosate, imazapyr, and triclorpyr. Multiple years of treatment will be needed to fully eradicate the stand. In addition, the amount of herbicide that can be applied per acre is limited, typically 2 gallons per (2500 stems) per acre.

Hand pulling can be used on individual plants. This can be done when individual plants are in a small area, and must be repeated often during the growing season. When observed, plants should be pulled and bagged for disposal in a landfill. Do not leave on the ground as stems and stem fragments can root. Cutting can be effective on small patches, but requires repeated events. Stems must be cut twice a month from April to August and then once a month until frost. Cutting will stimulate growth and tends to produce numerous small shoots. Repeated cutting when the plants are small, six inches or less, deprives the plants of energy. When cut all fragments must be collected and bagged for disposal. Using herbicides on the final resprouts after a season of hand pulling is recommended as an effective control method.

5.7 Flowering Rush (*Butomus umbellatus*)

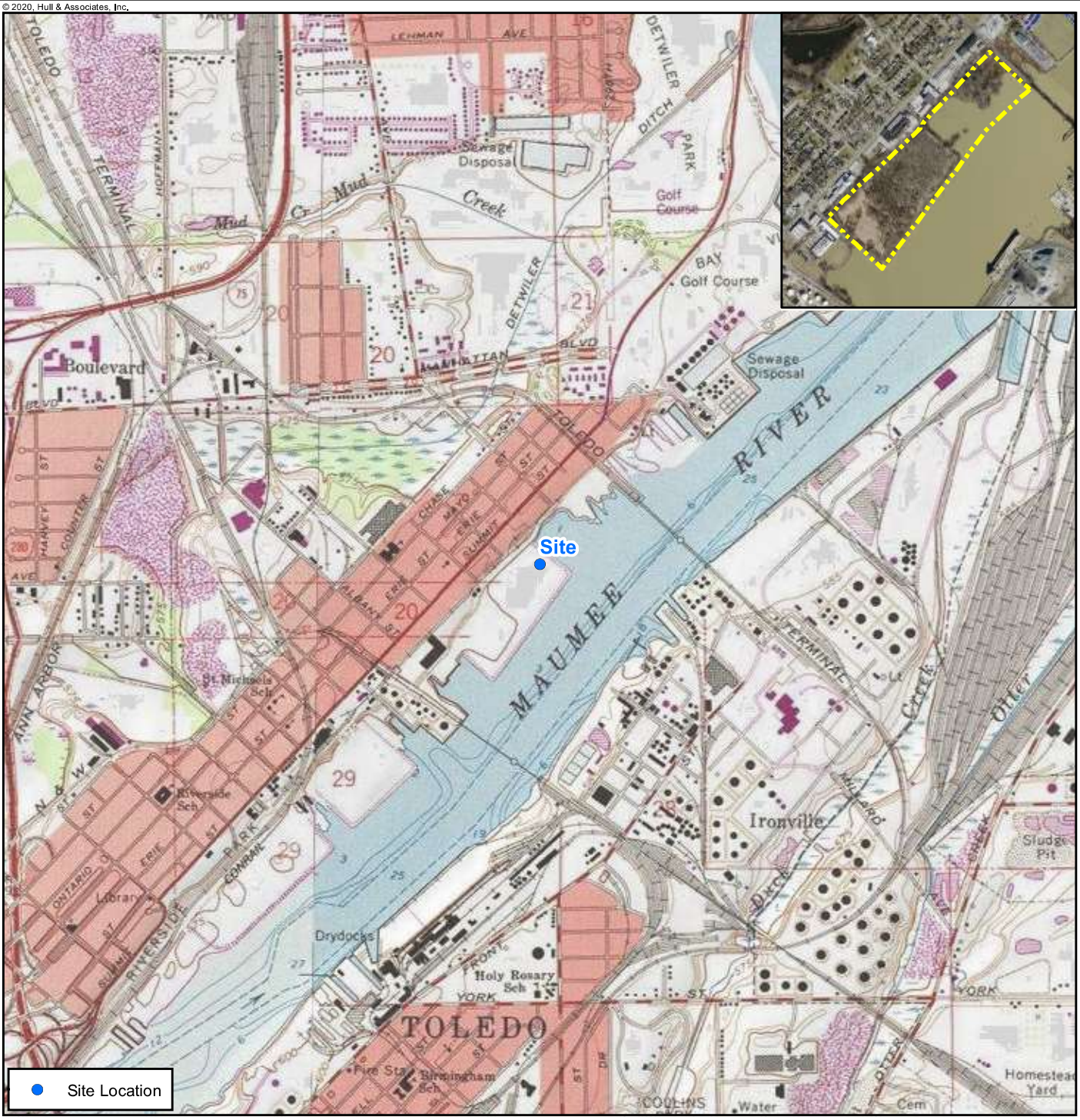
According to "Status and Strategy for Flowering Rush (*Butomus umbellatus L.*) Management" by R.A. Hackett and A.K. Monfils in 2014, flowering rush is an exotic plant that grows as an emergent along shorelines and submersed in lakes and rivers. It spreads by rhizome making removal and management difficult. This exotic can grow in thick stands and interfere with boating and recreation. This plant can also crowd out native plants, which fish and wildlife often rely on. The flowers grow in umbrella shaped clusters and the leaves can grow up to three feet in height. It can closely resemble native rushes if the plant is not in flower. Species that are often mistaken for flowering rush include *Sparangium spp.* and species of *Schoenoplectus* with triangular stems.

Flowering rush is sensitive to changes in water level and can easily invade areas not previously occupied by plants following water level changes. There were few effective methods found to control flowering rush and most research has been conducted on the infertile (triploid) populations, whereas fertile (diploid) populations are found more frequently in the Great Lakes basin. It is possible that the control methods for infertile populations may not be as effective with fertile populations. Control methods include cutting, hand digging, and herbicides (e.g., glyphosate, penoxsulam). No herbicide is selective to flowering rush and the chemicals often wash off the narrow leaves of this plant making herbicide treatment difficult (Hackett and Monfils, 2014). Should herbicides be applied, mid-summer is the most ideal application time. An aquatically registered surfactant should be added to help the herbicide adhere to the plant. Prevention, early detection, and rapid response is the best management technique for flowering rush.

6.0 CONCLUSION

The Site is designed to operate passively with minimal O&M requirements. If more active management is desired, such as for extreme water levels or HABs, it is recommended to develop an active management plan for the Site. It is difficult to project future water levels so this potential future active management plan may provide detailed guidance to achieve the particular objectives desired.

FIGURES



DISCLAIMER
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0 1,000 2,000 4,000 Feet

1:24,000

Quad: Oregon, Ohio

Source: The topographic map was acquired through the USGS Topographic Map web service.

The aerial photo in the inset was acquired through the ESRI Imagery web service. Aerial photography dated 2017.

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Toledo, Ohio 43604

Phone: (419) 385-2018
Fax: (419) 385-5487
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Penn 7 Operations and Maintenance Plan

Site Location Map

Toledo, Lucas County, Ohio

Date:
February 2020

File Name:
COT303_04_Fig01_SLM.mxd

Edited: 2/14/2020 By: dreed

Figure
1

Produced using ArcGIS 10.7

0 150 300 600 Feet

1:3,600

NEW YORK AVE
BASSETT ST
PONTIAC ST
ERIE ST
ADRIAN ST
MAYO ST
SUDER AVE
LAPIER ST
LASALLE ST
SUMMIT ST
HAYNES AVE

Channel Water Control Structure

Channel

Forested Upland Area

Wetland Area

Open Water Embayment Area

Dike

Open Water Embayment Water Control Structure

Wetland Water Control Structure

Norfolk Southern Corporation

CSX Transportation, Inc.

- Site Boundary
- Active Railroad
- Channel
- Dike
- Forested Upland Area
- Open Water Embayment Area
- Wetland Area
- Drainage Pipe

Note:
The aerial photo was acquired from the Ohio Statewide Imagery Program (OSIP). Aerial photography dated 2020.

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August 2021

Penn 7 Existing Conditions Report

Figure 2

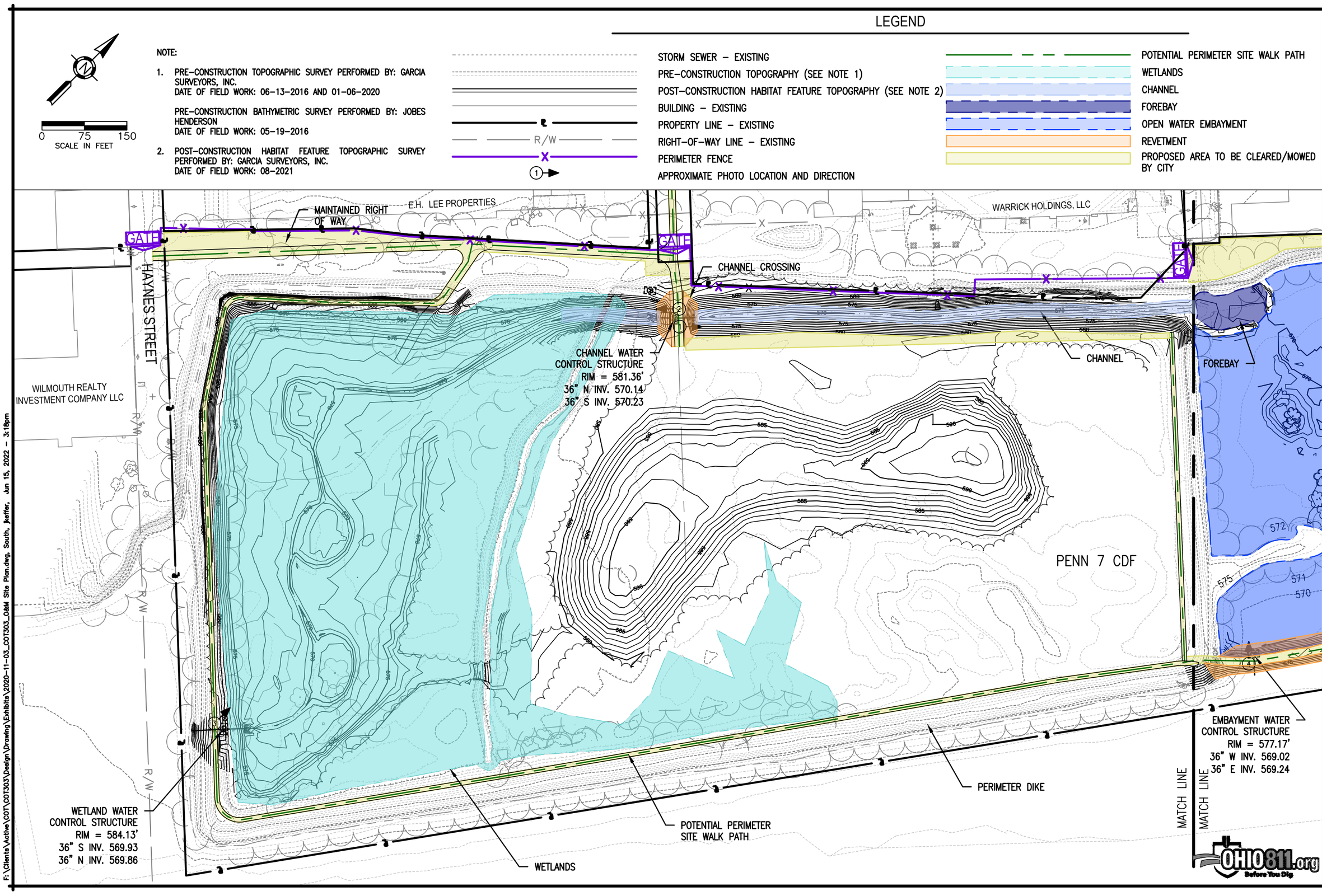
Site Layout with Improvements

Toledo, Lucas County, Ohio

Produced Using Esri's ArcGIS Software

File Name: COT303_04_Fig02_SiteLayout.mxd

Edited: 8/6/2021 By: dreed



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219 S. ERIE STREET
TOLEDO, OHIO 43604
PHONE: (419) 385-2018
FAX: (419) 243-1881
www.hullinc.com

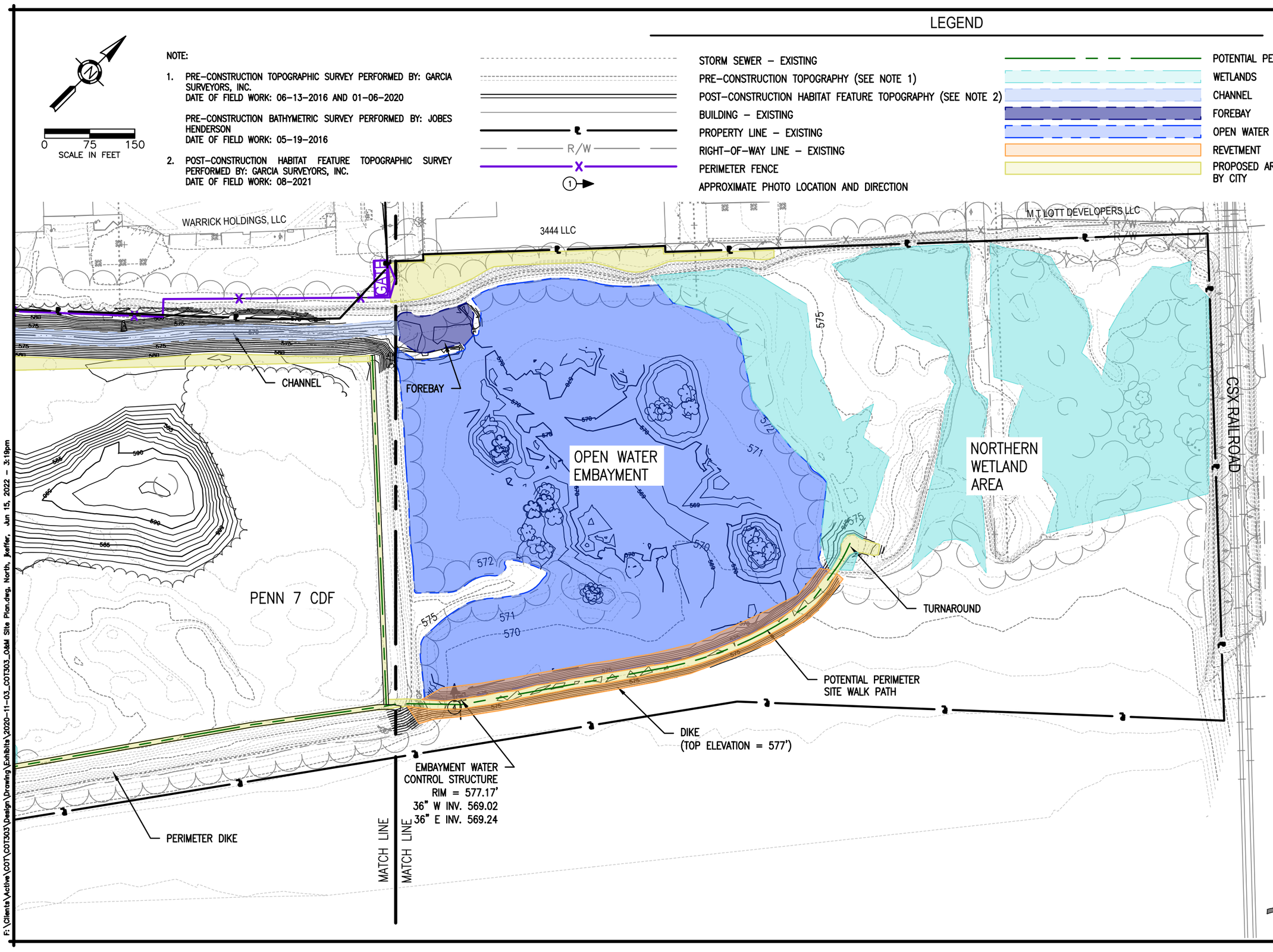
OPERATIONS AND MAINTENANCE PLAN

SITE MAP

PENN 7 EMERGENT COASTAL FLOODPLAIN WETLANDS RESTORATION PROJECT

LAYOUT BY:	CWS/JMC/SAH
CHECKED BY:	JMC
DRAWN BY:	SAH
DATE:	6/15/2022
PROJECT NO.	COT303
FIGURE NO.	3

OHIO811.org Before You Dig



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219 S. ERIE STREET
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OPERATIONS AND MAINTENANCE PLAN

SITE MAP

PENN 7 EMERGENT COASTAL FLOODPLAIN WETLANDS RESTORATION PROJECT

LAYOUT BY:	CWS/JMC/SAH
CHECKED BY:	JMC
DRAWN BY:	SAH
DATE:	6/15/2022
PROJECT NO.	COT303
FIGURE NO.	4

OHIO811.org Before You Dig

APPENDIX A

Site Inspection Form

HULL
Environment / Energy / Infrastructure

SITE INSPECTION FORM

Operation and Maintenance (O&M) Plan for Penn 7 Wetland Restoration

Entity: City of Toledo **Inspection Type:** Annual/Other **Inspector:**_____ **Date:**____/____/____

The inspector shall complete entire Site Inspection Form, and return original copy to the Commissioner of the City of Toledo's Division of Parks, Recreation and Forestry. If unable to inspect an item, or cannot clearly conclude an answer, select no answer **(NA);** and include reason for selection in comments/notes column. Use Figures 3 and 4 of O&M Plan for reference.

YES = May Need Further Evaluation **No = No Evaluation Needed**

PERIMETER FENCE AND GATES INSPECTION:

Inspection Item	Lee Portion (south/west):	Warrick Portion (north/east):	Comments/Notes:
Perimeter fence compromised?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Excess gaps or holes in fence material?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Damage to gates, locks, or fence posts?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Gate locks inoperable or unlocked?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Excess vegetative growth within fence or debris against fence?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Documentation: If potential impacts to perimeter fence or gates, document location, take picture, provide information to Commissioner for evaluation. Commissioner will consult with an engineer, if needed. Excessive piling of debris shall be removed and relocated per Commissioner.			

WATER CONTROL STRUCTURE (WCS) INSPECTION:

Inspection Item:	Wetland WCS:	Connecting Channel WCS:	Embayment WCS:	Comments/Notes:
Record Water Level				
Water seeping through stop logs?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Excessive debris/sediment within the WCS?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Damage to the WCS or internal components (stop logs, fish grate, staff gauge, etc.)?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Sloughing of revetment?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Erosion around or adjacent to the WCS?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Excessive piling of debris/sediment at outlets or trash racks?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Documentation: If potential impacts to structural integrity of WCS, document location, take picture, provide information to Commissioner for evaluation. Commissioner will consult with an engineer, if needed. Excessive piling of debris/sediment shall be removed and relocated per Commissioner.				

DIKES/EMBANKMENT INSPECTION:

Inspection Item:	Perimeter CDF Dike:	Channel Crossing:	Embayment Dike :	Comments/Notes:
Water seeping through the dike or embankments?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Portions of side slope eroded?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Portions of pathway settled?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Sloughing of revetment materials?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Excessive piling of debris/sediment on side slopes?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Documentation: If potential impacts to dikes or embankments, document location, take picture, provide information to Commissioner for evaluation. Commissioner will consult with an engineer, if needed. Excessive piling of debris/sediment shall be removed and relocated per Commissioner.				

CHANNEL/FOREBAY INSPECTION:

Inspection Item:	Channel:	Forebay:	Comments/Notes:
Excessive piling of debris?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Excessive piling of sediment?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Documentation: If potential flow restrictions or impacts to channel or forebay, document location, take picture, provide information to Commissioner for evaluation. Commissioner will consult with an engineer, if needed. Excessive piling of debris/sediment shall be removed and relocated per Commissioner.			

VEGETATION INSPECTION:

Inspection Item:	Wetland:	Upland:	Embayment:	Comments/Notes:
Established vegetative growth unhealthy?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Invasive species present?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Damage to any trees or plants?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
Trees or shrubs requiring maintenance?	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	☐ NA ☐ YES ☐ NO	
List invasive species observed:				
Documentation: If vegetation concerns are present, document location, take picture, provide information to Commissioner for evaluation. Commissioner will consult with an ecologist, if needed.				

General Notes/Comments (indicate if additional sheets were required for notes):
Summary of Potential Action Items (indicate if additional sheets were required):

Inspection Completed By: _____ Date: _____

Inspection Report Reviewer Verification:

Commissioner or Designated Employer/Agent

_____ _____

APPENDIX B

Water Control Structure Photo Pages

PHOTO 1: Overview of the Wetland Water Control Structure (WCS).

PHOTO 2: Overview of the Channel WCS.

HULL Environment / Energy / Infrastructure	Penn 7 Operations and Maintenance Plan City of Toledo Water Control Structure Photographs 3300 N Summit Street R Toledo, Lucas County, Ohio	Date: June 2022 Project Number: COT303 File Name: COT303.0020.XLS

PHOTO 3: Overview of Open Water Embayment WCS.

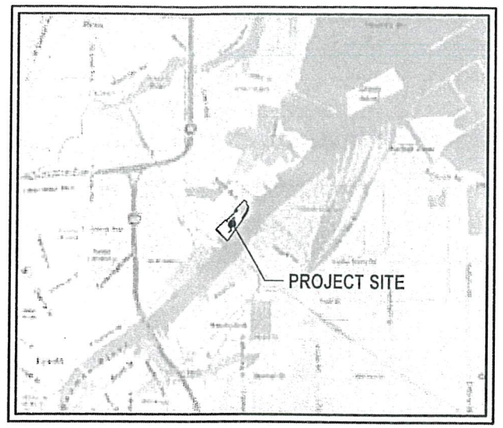
PHOTO 4: Overview of stop logs for the WCSs.

PHOTO 5: Interior of the Wetland WCS showing, from left to right, the staff gauge, stop log guides, steps, and fish grate.

PHOTO 6: Removal of stop log from the Wetland WCS using lifting hooks.

APPENDIX C

As-Built Planting Plan



LOCATION MAP

CONSTRUCTION DRAWINGS FOR:

PENN 7 EMERGENT COASTAL FLOODPLAIN WETLANDS RESTORATION PROJECT

CITY OF TOLEDO
LUCAS COUNTY, OHIO

SHEET INDEX

SURVEYOR NOTES:

THE LOCATIONS OF UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON ABOVE GROUND STRUCTURES AND RECORD DRAWINGS PROVIDED TO THE SURVEYOR. LOCATIONS OF UNDERGROUND UTILITIES/STRUCTURES MAY VARY FROM LOCATIONS SHOWN HEREON. ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE MADE DURING THE PROGRESS OF THIS SURVEY TO LOCATE BURIED UTILITIES/STRUCTURES.

TOPOGRAPHIC SURVEY PERFORMED BY: GARCIA SURVEYORS, INC
DATE OF FIELD WORK: 06-13-2016 AND 01-06-2020
EVERY DOCUMENT OF RECORD REVIEWED AND CONSIDERED AS A PART OF THIS SURVEY IS NOTED HEREON.

BATHYMETRIC SURVEY PERFORMED BY: JOBES HENDERSON
DATE OF FIELD WORK: 05-19-2016
EVERY DOCUMENT OF RECORD REVIEW AND CONSIDERED AS PART OF THIS SURVEY IS NOTED HEREON

ELECTRONIC TOPOGRAPHIC AND BATHYMETRIC SURVEYS ARE AVAILABLE UPON REQUEST.

ALL ELEVATIONS ARE IN FEET AND REFER TO THE INTERNATIONAL GREAT LAKES DATUM OF 1985 (IGLD85). ORDINARY HIGH WATER MARK (OHWM) IS 573.40. ANTICIPATED AVERAGE LAKE LEVEL RANGE IS 570.00 TO 573.00.

BASIS OF BEARINGS:

THE BEARINGS SHOWN HEREIN ARE BASED ON OHIO STATE PLANE COORDINATE SYSTEM. NORTH SYSTEM, NAD83, GEOID12A.

BENCHMARKS:

AS PER THE TOPOGRAPHIC SURVEY PREPARED BY GARCIA SURVEYORS, INC. THE CONTRACTOR AND/OR HIS SURVEYOR SHALL BE RESPONSIBLE TO CROSS CHECK ALL CONTROL FOR DISTURBANCE PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.

FLOODZONE INFORMATION

THE SITE IS LOCATED IN ZONE A , AREAS DETERMINED TO BE WITHIN 1% ANNUAL CHANCE FLOOD (100-YEAR FLOOD), BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY ON FLOOD INSURANCE RATE MAP, MAP NO. 39095C0115E, WITH AN EFFECTIVE DATE OF AUGUST 6, 2011 IN LUCAS COUNTY, OHIO.

PRE-CONSTRUCTION NOTICE

THESE PLANS HAVE BEEN PREPARED USING THE MOST ACCURATE INFORMATION AND DATA AVAILABLE AT THE TIME OF PREPARATION. FIELD CONDITIONS MAY BE ENCOUNTERED DURING CONSTRUCTION WHICH VARY FROM THOSE DEPICTED HEREIN. MODIFICATIONS TO THE DESIGN AS SHOWN MAY BE REQUIRED BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION. IN ANY EVENT, THE ENGINEERING OBJECTIVES OF THE DESIGN SHALL BE MET. IF FIELD CONDITIONS ARE ENCOUNTERED PRIOR TO CONSTRUCTION OR DURING CONSTRUCTION THAT DIFFER SIGNIFICANTLY FROM THE CONDITIONS SHOWN ON THE PLANS, THE CONTRACTOR MUST STOP WORK AND NOTIFY THE OWNER AND ENGINEER IMMEDIATELY.

Mesic to Dry Mix - Area's disturbed by Construction, not on plan

ODOT Roadside MIX - Area's disturbed by Construction, not on plan

OHIO811.org Before You Dig

F:\Clients\Active\COT\COT303\Design\Drawing\Sheets\Final design - 100%\COT303_Title.dwg, C1.0 TITLE, shansen, Mar 10, 2020 - 9:52am

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210 S. Erie Street
Toledo, OH 43604
Phone: (419) 385-2018
Fax: (419) 243-1881
www.hullinc.com

Professional Seal:

Project Title:

CONSTRUCTION DRAWINGS
PENN 7 EMERGENT COASTAL/FLOODPLAIN WETLANDS RESTORATION PROJECT
CITY OF TOLEDO
LUCAS COUNTY, OHIO

Owner:

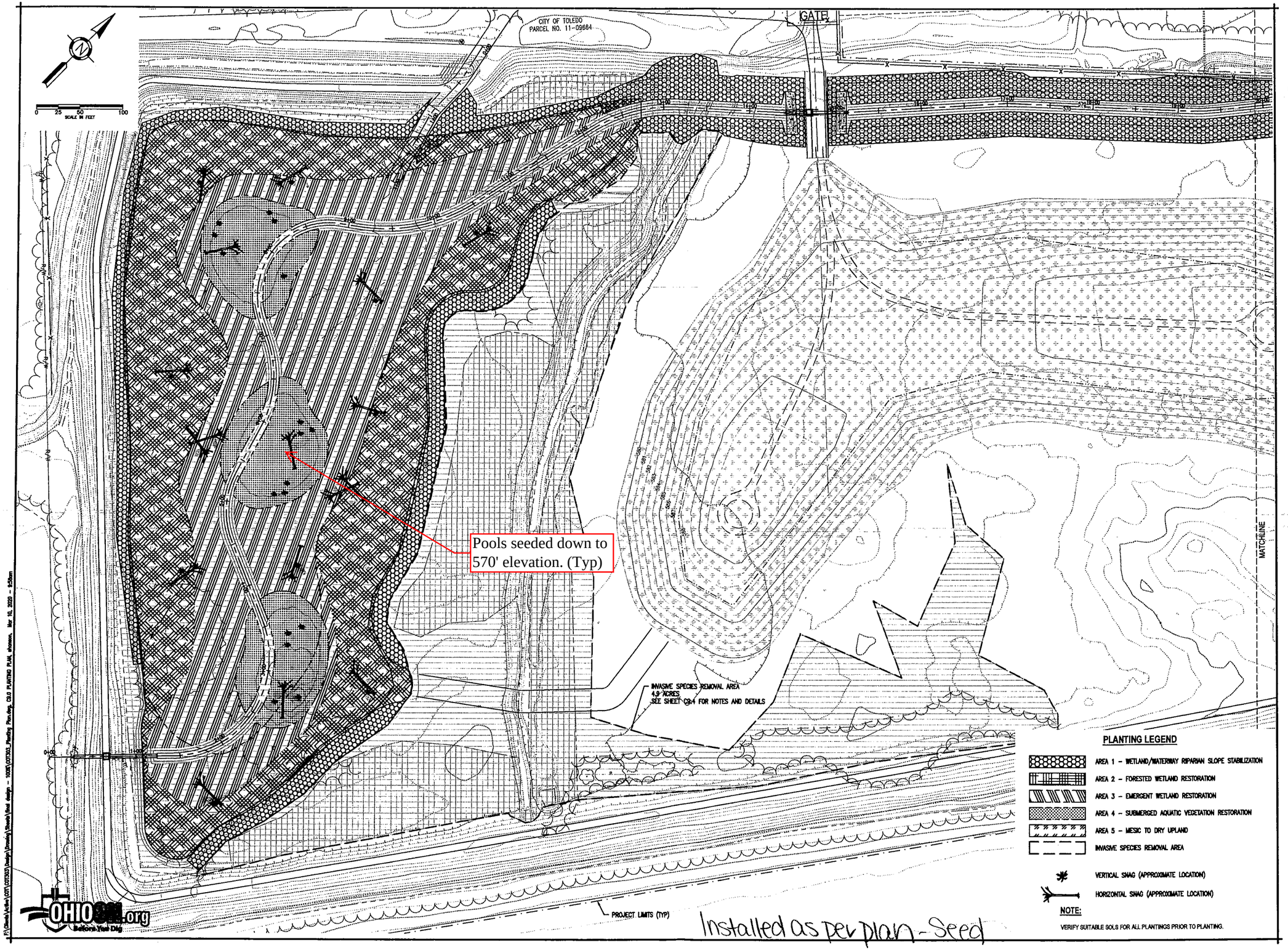
600 JEFFERSON AVENUE,
SUITE 300
TOLEDO, OH 43604

Mark	Description	Date
	CONCEPTUAL DESIGN	10/29/19
	PRELIMINARY DESIGN (30%)	11/12/19
	SCHEMATIC DESIGN (60%)	12/06/19
	PRE-FINAL DESIGN (90%)	01/30/20
	FINAL DESIGN (100%)	02/21/20
	CONSTRUCTION DRAWINGS	02/28/20

Project No.:	COT303
Plot Date:	3/10/20
Layout By:	CWS
Drawn By:	CWS/SAH
Check By:	PAH/DHH
Scale:	AS NOTED
Issue Date:	MARCH 2020
Sheet Title:	TITLE

Sheet Number: 1 OF 22

C1.0



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810 S. Erie Street
Toledo, OH 43604
Phone: (419) 385-2018
Fax: (419) 243-1941
www.hullinc.com

Professional Seal:

STATE OF OHIO
PHILIP A. NICAS
7362
REGISTERED PROFESSIONAL ENGINEER
3/10/20

Project Title:

CONSTRUCTION DRAWINGS

PENN 7 EMERGENT COASTAL/FLOODPLAIN WETLANDS RESTORATION PROJECT

CITY OF TOLEDO
LUCAS COUNTY, OHIO

Owner:

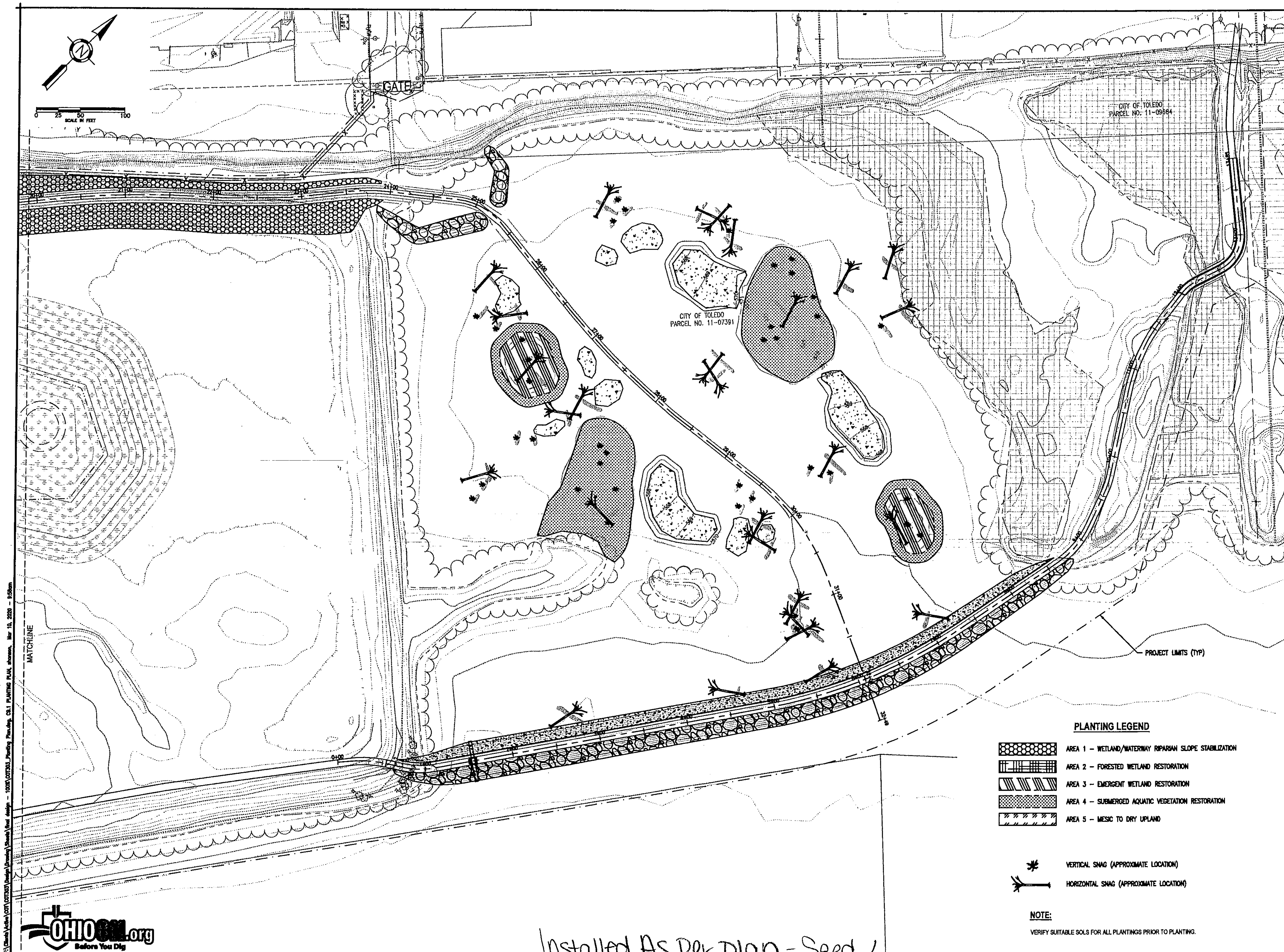
600 JEFFERSON AVENUE,
SUITE 300
TOLEDO, OH 43604

Mark	Description	Date
	CONCEPTUAL DESIGN	10/29/19
	PRELIMINARY DESIGN (30%)	11/12/19
	SCHEMATIC DESIGN (90%)	12/06/19
	PRE-FINAL DESIGN (90%)	01/29/20
	FINAL DESIGN (100%)	02/21/20
	CONSTRUCTION DRAWINGS	02/28/20

Project No.:	C07303
Plot Date:	3/10/20
Layout By:	CWS
Drawn By:	CWS/SAH
Check By:	PAN/JRH
Scale:	AS NOTED
Issue Date:	MARCH 2020
Sheet Title:	

PLANTING PLAN

Sheet Number: 16 OF 22
C9.0



Installed As per plan - Seed

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219 S. Erie Street
Toledo, OH 43604
Phone: (419) 385-2018
Fax: (419) 243-1861
www.hullinc.com

Professional Seal:

STATE OF OHIO

3/10/20

Project Title:

CONSTRUCTION DRAWINGS

PENN 7 EMERGENT COASTAL/FLOODPLAIN WETLANDS RESTORATION PROJECT

CITY OF TOLEDO
LUCAS COUNTY, OHIO

Owner:

600 JEFFERSON AVENUE,
SUITE 300
TOLEDO, OH 43604

Mark	Description	Date
	CONCEPTUAL DESIGN	10/29/19
	PRELIMINARY DESIGN (30%)	11/12/19
	SCHEMATIC DESIGN (60%)	12/06/19
	PRE-FINAL DESIGN (90%)	01/30/20
	FINAL DESIGN (100%)	02/21/20
	CONSTRUCTION DRAWINGS	02/26/20

Project No.:	COT303
Plot Date:	3/10/20
Layout By:	CNS
Drawn By:	CNS/SAH
Check By:	PAH/JHH
Scale:	AS NOTED
Issue Date:	MARCH 2020

Sheet Title:

PLANTING PLAN

Sheet Number: 19 OF 22

C9.1

SEEDING AND MULCHING

1. SEEDING AND MULCHING SHALL BE PERFORMED WITHIN THE APPLICATION TIME FRAMES SPECIFIED IN ODNR RAINWATER AND LAND DEVELOPMENT MANUAL. SEED SCHEDULE SHALL BE AS FOLLOWS:

   PERMANENT SEEDING EROSION CONTROL MIXTURE:
   REFER TO THE TABLES ON THIS SHEET AND THE PLANTING PLAN ON SHEET C9.2

   TEMPORARY EROSION CONTROL MIXTURE:
   MARCH 1 TO AUGUST 15
   OATS: 60% OF WEIGHT
   CANADIAN WILDRYE: 20% OF WEIGHT
   VIRGINIA WILDRYE: 20% OF WEIGHT
   APPLICATION RATE: 5 lbs. PER 1,000 SQ. FT.

   AUGUST 16 TO NOVEMBER 1
   CEREAL RYEGRASS: 60% OF WEIGHT
   CANADIAN WILDRYE: 20% OF WEIGHT
   VIRGINIA WILDRYE: 20% OF WEIGHT
   APPLICATION RATE: 5 LBS. PER 1,000 SQ. FT.

   NOVEMBER 2 TO FEBRUARY 28
   USE MULCH ONLY OR PERMANENT SEEDING

2. PERFORM THIS WORK IN ALL AREAS OF SOIL DISTURBANCE THAT WILL NOT HAVE SOME OTHER TYPE OF PERMANENT EROSION CONTROL BARRIER AS SHOWN ON THE PLANS (E.G., GRAVEL COVER, PAVEMENT, ETC.).

3. PERFORM THIS WORK IN THE TIMEFRAMES IDENTIFIED IN THE SWPPP AND WITHIN 7 DAYS OF OBTAINING FINAL GRADE. IF IT IS ANTICIPATED THAT FUTURE WORK MAY DISTURB AN AREA, PLACE TEMPORARY SEED AND MULCH.

4. MULCHING MATERIAL SHALL BE APPLIED AT A RATE OF 90 lbs. PER 2 TONS/ACRE. MULCHING SHALL CONSIST OF OAT OR WHEAT STRAW, HAY OR WOOD FIBER FREE FROM WEEDS AND FOREIGN MATTER DETRIMENTAL TO PLANT LIFE. TACKIFIER SHALL BE APPLIED TO WOOD MULCH. TACKIFIER APPLICATION RATE 3 LBS PER ACRE LAND TACK SCE-TAK OR ENGINEER APPROVED EQUAL. FOR AREAS LESS STEEP THAN 4:1 SLOPE, DIRECT DRILL OF SEEDS WITHOUT MULCH IS ACCEPTABLE AS LONG AS THE CONTRACTOR ENSURES THE SITE REACHES FINAL STABILIZATION.

5. APPLY WATER IN ACCORDANCE WITH ODOT ITEM 659. WATER SHALL BE CLEAN, FRESH AND FREE OF SUBSTANCES OR MATTER WHICH COULD INHIBIT VIGOROUS GROWTH OF GRASS.

6. SEEDED AREAS SHALL BE MAINTAINED BY THE CONTRACTOR UNTIL THE SITE REACHES FINAL STABILIZATION. FINAL STABILIZATION MEANS THE VEGETATION HAS ESTABLISHED UNIFORM PERENNIAL VEGETATIVE COVER (E.G., EVENLY DISTRIBUTED, WITHOUT LARGE BARE AREAS) WITH A DENSITY OF AT LEAST 70 PERCENT VEGETATIVE COVER FOR A PERIOD OF 1 YEAR FROM THE TIME OF PLANTING. IN ADDITION, ALL TEMPORARY EROSION AND SEDIMENT CONTROL PRACTICES ARE REMOVED AND DISPOSED OF AND ALL TRAPPED SEDIMENT IS PERMANENTLY STABILIZED TO PREVENT FURTHER EROSION. CONTRACTOR SHALL WATER TO PREVENT GRASS AND SOIL FROM DRYING OUT.

7. SEEDED AREAS THAT DO NOT HAVE A UNIFORM DENSITY OF AT LEAST 70 PERCENT VEGETATIVE COVER, SHALL BE REPAIR SEEDED OR INTER-SEEDED AND MULCHED. COMPOST MAY NOT BE USED TO REPAIR AREAS.

GENERAL PLANTING NOTES

PLANTING PROCEDURE

1. THIS WORK SHALL BE DONE IN CONFORMANCE WITH THE REQUIREMENTS OF ODOT CMS 661. PLANTS SHALL BE PLANTED CAREFULLY AND FIRMLY IN PLACE AT THE SPECIFIED PLANTING DENSITIES TO THE MINIMUM DEPTH NECESSARY TO ANCHOR THEM IN THE SOIL.

2. REFER TO THIS SHEET FOR PLANTING SCHEDULES.

PLANTING MAINTENANCE

1. DURING THE LIFE OF THE CONTRACT AND PERIOD OF ESTABLISHMENT, THE CONTRACTOR WILL BE RESPONSIBLE TO MAINTAIN THE PLANTED AREAS AND KEEP THIS AREA FREE FROM WEEDS AND DEBRIS.

INSPECTIONS

1. PERIODIC INSPECTIONS OF THE PLANTING AREA SHALL OCCUR ON A MONTHLY BASIS DURING THE PERIOD OF ESTABLISHMENT TO ENSURE THAT THE SITE IS BEING MAINTAINED AS SPECIFIED. THE CONTRACTOR IS RESPONSIBLE TO MAKE ARRANGEMENTS WITH THE ENGINEER TO ESTABLISH A SCHEDULE FOR THESE INSPECTIONS.

2. THE PERIOD OF ESTABLISHMENT WILL BE AS SPECIFIED IN THE 2010 ODOT CMS 661.17.

3. THE NUMBER OF PERENNIALS, AS PER PLAN OF EACH SPECIES AND SIZE WILL BE THOSE PLANTED, COMPLETE IN PLACE AND ACCEPTED.

TABLE 1: SEED MIX FOR FORESTED WETLAND RESTORATION AND ENHANCEMENT AND EMERGENT WETLAND RESTORATION AND ENHANCEMENT

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	DENSITY	LBS PER ACRE	PLANTING AREA 2 ACRES: 3.0 QUANTITY (LBS)	PLANTING AREA 3 ACRES: 2.2 QUANTITY (LBS)
Carex vulpinoidea	Fox Sedge	OBL	33.2%	6.64	19.8	14.7
Elymus virginicus	Virginia Wildrye	FACW	20.0%	4	11.9	8.9
Carex scoparia	Blunt Broom Sedge	FACW	9.2%	1.84	5.5	4.1
Carex lurida	Lurid Sedge	OBL	8.0%	1.6	4.8	3.5
Carex lupulina	Hop Sedge	OBL	8.0%	1.6	4.8	3.5
Verbena hastata	Blue Vervain	FACW	4.0%	0.8	2.4	1.8
Juncus effusus	Soft Rush	OBL	3.0%	0.6	1.8	1.3
Asclepias incarnata	Swamp Milkweed	OBL	3.0%	0.6	1.8	1.3
Cinna arundinacea	Wood Reedgrass	FACW	3.0%	0.6	1.8	1.3
Doellingeria umbellata	Flat-Topped White Aster	FACW	2.4%	0.48	1.4	1.1
Heliopsis helianthoides	Oxeye Sunflower	FACU	2.0%	0.4	1.2	0.9
Helenium autumnale	Common Sneezeweed	FACW	1.0%	0.2	0.6	0.4
Eupatorium perfoliatum	Boneset	FACW	1.0%	0.2	0.6	0.4
Penthorum sedoides	Ditch Stonecrop	OBL	0.6%	0.12	0.4	0.3
Alisma subcordatum	Water Plantain	OBL	0.5%	0.1	0.3	0.2
Lobelia siphilitica	Great Blue Lobelia	FACW	0.5%	0.1	0.3	0.2
Scirpus cyperinus	Woolgrass	OBL	0.5%	0.1	0.3	0.2
Chelone glabra	Turtlehead	OBL	0.1%	0.02	0.1	0.0
		TOTAL:	100.0%	20	59.6	44.4

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
- Seed mixed based on ERNST Seed mix for wet meadows and wetlands (ERNMX-122).
- Substitutions may be made based upon availability and coordination with engineer.
- Round total quantity up to nearest pound for estimating and purchasing purposes.

TABLE 2: SEED MIX FOR MESIC TO DRY UPLAND AREA DISTURBED BY CONSTRUCTION

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	DENSITY	LBS PER ACRE	PLANTING AREA 5 ACRES: 6.0 QUANTITY (LBS)
Schizachyrium scoparium	Little Bluestem	FACU	27.5%	5.50	32.9
Elymus virginicus	Virginia Wildrye	FACW	20%	4.00	23.9
Sorghastrum nutans	Indiangrass	FAC	15%	3.00	17.9
Tridens flavus	Purpletop	UPL	5%	1.00	6.0
Verbena hastata	Blue Vervain	FACW	5%	1.00	6.0
Panicum clandestinum	Deertongue	FACW	5%	1.00	6.0
Coreopsis lanceolata	Lanceleaf Coreopsis	FACU	4%	0.80	4.8
Rudbeckia hirta	Blackeye Susan	FACU	3%	0.60	3.6
Echinacea purpurea	Purple Coneflower	FACU	3%	0.60	3.6
Chamaecrista fasciculata	Partridge Pea	FACU	3%	0.60	3.6
Heliopsis helianthoides	Smooth Oxeye	FACU	2%	0.40	2.4
Liatris spicata	Marsh Blazing Star	FAC	1.6%	0.32	1.9
Zizia aurea	Golden Alexanders	FAC	1%	0.20	1.2
Asclepias incarnata	Swamp Milkweed	OBL	1%	0.20	1.2
Symphyotrichum laeve	Smoth Blue Aster	FACU	0.7%	0.14	0.8
Senna marilandica	Maryland Senna	FACW	0.5%	0.10	0.6
Baptisia australis	Blue False Indigo	FACU	0.5%	0.10	0.6
Eupatorium perfoliatum	Boneset	FACW	0.50%	0.10	0.6
Geum canadense	White Avens	FAC	0.5%	0.10	0.6
Monarda fistulosa	Wild Bergamont	FACU	0.4%	0.08	0.5
Lespedeza capitata	Roundhead Lespedeza	FACU	0.3%	0.06	0.4
Asclepias syriaca	Common Milkweed	UPL	0.3%	0.06	0.4
Solidago juncea	Early Goldenrod	n/a	0.2%	0.04	0.2
		TOTAL:	100%	20	119.6

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
- Substitutions may be made based upon availability and coordination with engineer.
- Seed mixed based on ERNST Seed mix for wet meadows and wetlands (ERNMX-105).
- Round total quantity up to nearest pound for estimating and purchasing purposes.

TABLE 3: SEED MIX FOR WETLAND/WATERWAY RIPARIAN SLOPE STABILIZATION

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	DENSITY	LBS PER ACRE	PLANTING AREA 1 ACRES: 1.4 QUANTITY (LBS)
Elymus riparius	Riverbank Wildrye	FACW	32.0%	6.4	8.9
Elymus virginicus	Virginia Wildrye	FACW	32.0%	6.4	8.9
Elymus hystrix	Bottlebrush Grass	FACU	18.0%	3.6	5.0
Elymus villosus	Silky Wildrye	FACU	18.0%	3.6	5.0
		TOTAL:	100.0%	20	27.7

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
- Substitutions may be made based upon availability and coordination with engineer
- Round total quantity up to nearest pound for estimating and purchasing purposes.

AREA 1 – WETLAND/WATERWAY RIPARIAN SLOPE STABILIZATION
AREA 2 – FORESTED WETLAND RESTORATION
AREA 3 – EMERGENT WETLAND RESTORATION
AREA 4 – SUBMERGED AQUATIC VEGETATION RESTORATION
AREA 5 – MESIC TO DRY UPLAND

TABLE 4: WOODY STEM PLANTING FOR FORESTED WETLAND HABITAT

	SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	PLANTING AREA 2 ACRES 3.0 QUANTITY (STEMS†)
CANOPY TREES	*Acer rubrum*	Red Maple	FAC	30
	Acer saccharinum	Siver Maple	FACW	30
	Salix nigra	Black Willow	OBL	30
	Platanus occidentalis	American Sycamore	FACW	30
	Quercus bicolor	Swamp White Oak	FACW	30
			TOTAL:	150
SHRUBS	*Aronia melanocarpa*	Black chokeberry	FAC	30
	Cephalanthus occidentalis	Buttonbush	FACW	30
	Cornus amomum	Silky dogwood	FACW	30
	Cornus sericea	Red-osier dogwood	FAC	30
	Sambucus canadensis	Elderberry	FACW	30
			TOTAL:	150

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
† Canopy trees shall be 1-inch calipers and shrubs shall be bareroot 2-year seedlings.
- Quantity based on 100 stems/acre
- Substitutions may be made based upon availability and coordination with engineer
- No single species may comprise more than 40% of habitat, trees and shrubs should be randomly planted throughout respective habitat areas.

TABLE 5: WOODY STEM PLANTING FOR MESIC TO DRY FORESTED UPLAND

	SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	PLANTING AREA 5 ACRES 6.0 QUANTITY (STEMS†)
CANOPY TREES	*Quercus rubra*	Red Oak	FACU	48
	Quercus alba	White Oak	FACU	48
	Liriodendron tulipifera	Tuliptree	FACU	48
	Quercus macrocarpa	Burr Oak	FACU	48
	Juglans nigra	Black Walnut	FACU	48
			TOTAL:	240
SHRUBS	*Amelanchier arborea*	Common Serviceberry	FACU	48
	Cercis canadensis	Redbud	FACU	48
	Corylus americana	Hazelnut	FACU	48
	Crataegus mollis	Hawthorn	FACU	48
	Viburnum prunifolium	Blackhaw SUB	FACU	48 Arrowwood
			TOTAL:	240

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
† Canopy trees shall be 1-inch calipers and shrubs shall be bareroot 2-year seedlings.
- Quantity based on 80 stems/acre
- Substitutions may be made based upon availability and coordination with engineer
- No single species may comprise more than 40% of habitat, trees and shrubs should be randomly planted throughout respective habitat areas.

TABLE 6: LIVE STAKE PLANTING FOR WETLAND/WATERWAY RIPARIAN SLOPE STABILIZATION

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	PLANTING AREA 1 ACRES: 1.4 QUANTITY (STAKES)
Salix discolor	Pussy Willow	FACW	1220
Salix interior/exigua	Sandbar Willow	FACW	1220
		TOTAL:	2440

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
- Quantity based on 1742 stems/acre
- Substitutions may be made based upon availability and coordination with engineer
- Space live stakes 5-foot on center

TABLE 7: SEED MIX (SUBMERSEED-AQUABLOK) FOR AREA 4 - SUBMERGED AQUATIC VEGETATION FOR POND PERIMETERS.

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS*	DENSITY	LBS PER ACRE	PLANTING AREA 4 ACRES: 0.82 WETLAND INTER-CHANNEL POOL QUANTITY (LBS)	ACRES: 0.62 EMBAYMENT QUANTITY (LBS)
Sparganium eurycarpum	Broadfruit Bur-Reed	OBL	15%	2.25	1.84	1.39
Schoenoplectus tabernaemontani	Softstem Bulrush	OBL	5%	0.75	0.61	0.46
Scirpus cyperinus	Woolgrass	OBL	5%	0.75	0.61	0.46
Alisma subcordatum	American Water Plantain	OBL	5%	0.75	0.61	0.46
Pontederia cordata	Pickerelweed	OBL	10%	1.50	1.23	0.93
Carex comosa	Longhair Sedge	OBL	5%	0.75	0.61	0.46
Carex crinita	Fringed Sedge	OBL	15%	2.25	1.84	1.39
Leersia oryzoides	Rice Cutgrass	OBL	15%	2.25	1.84	1.39
Iris versicolor	Harlequin Blueflag	OBL	5%	0.75	0.61	0.46
Ludwigia palustris	Marsh Seedbox	OBL	5%	0.75	0.61	0.46
Sagittaria latifolia	Broadleaf Arrowhead	OBL	10%	1.50	1.23	0.93
Sium suave	Hemlock Waterparsnip	OBL	5%	0.75	0.61	0.46
		TOTAL:	100%	15	12.28	9.28

* Wetland indicator status based on Northcentral and Northeast USDA and USACE subregion.
- Seed Quantity weight based on weight of Seed only, total Submerseed-Aquablok Quantity required shall be determined by manufacturerer.
- Substitutions may be made based upon availability and coordination with engineer.
- Round total quantity up to nearest pound for estimating and purchasing purposes.

HULL
Environment / Energy / Infrastructure

Hull & Associates, Inc.
210 S. Erie Street
Toledo, OH 43604
Phone: (419) 385-2018
Fax: (419) 243-1881
www.hullinc.com

Professional Seal:

Project Title:

CONSTRUCTION DRAWINGS
PENN 7 EMERGENT COASTAL/FLOODPLAIN WETLANDS RESTORATION PROJECT
CITY OF TOLEDO
LUCAS COUNTY, OHIO

Owner:

600 JEFFERSON AVENUE,
SUITE 300
TOLEDO, OH 43604

Mark	Description	Date
	CONCEPTUAL DESIGN	10/29/19
	PRELIMINARY DESIGN (30%)	11/12/19
	SCHEMATIC DESIGN (60%)	12/06/19
	PRE-FINAL DESIGN (90%)	01/30/20
	FINAL DESIGN (100%)	02/21/20
	CONSTRUCTION DRAWINGS	02/28/20

Project No.:	C0T303
Plot Date:	3/10/20
Layout By:	CWS
Drawn By:	CWS/SAH
Check By:	PAH/JHH
Scale:	AS NOTED
Issue Date:	MARCH 2020

Sheet Title:

PLANTING NOTES & TABLES

Sheet Number: 20 OF 22
C9.2

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CITY OF TOLEDO
PARCEL NO. 11-09651

GATE

0 25 50 100
SCALE IN FEET

Area 1- installed APP pg C9.2

Pussy Willow, live stakes
Sandbar willow, live stakes

Area 5- APP C9.2

Red Oak 1" Cal
White Oak 1" Cal
Tuliptree 1" Cal
Burr Oak, 1" Cal
Black Walnut 1" Cal
Common Serviceberry, BR 2 year
Redbud, BR 2 year
Hazelnut, BR 2 year
Hawthorn, BR 2 year
Arrowwood, BR 2 yea

Area 2 - APP C9.2

Red Maple 1" cal
Silver Maple 1" Cal
Black willow 1" Cal
American Sycamore 1" Cal
Swamp White Oak 1" cal
Black Chokeberry, bareroot 2 year
Buttonbush, bareroot 2 year
Silky Dogwood, bareroot 2 year
Red Osier Dogwood, bareroot 2 year
Elderberry, bareroot 2 year

INVASIVE SPECIES REMOVAL AREA
4.9 ACRES
SEE SHEET C9.4 FOR NOTES AND DETAILS

MATCHLINE

PROJECT LIMITS (TYP)

PLANTING LEGEND

- AREA 1 – WETLAND/WATERWAY RIPARIAN SLOPE STABILIZATION
- AREA 2 – FORESTED WETLAND RESTORATION
- AREA 3 – EMERGENT WETLAND RESTORATION
- AREA 4 – SUBMERGED AQUATIC VEGETATION RESTORATION
- AREA 5 – MESIC TO DRY UPLAND
- INVASIVE SPECIES REMOVAL AREA
- VERTICAL SNAG (APPROXIMATE LOCATION)
- HORIZONTAL SNAG (APPROXIMATE LOCATION)

NOTE:
VERIFY SUITABLE SOILS FOR ALL PLANTINGS PRIOR TO PLANTING.

OHIO811.org Before You Dig

F:\Clients\Active\COT\COT303\Design\Drawing\Sheets\final design - 100%\COT303_Planting Plans.dwg, C9.0 PLANTING PLAN, shannon, Mar 10, 2020 - 9:58am

HULL
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Check By:	PAH/JHH
Scale:	AS NOTED
Issue Date:	MARCH 2020

Sheet Title:

PLANTING PLAN

Sheet Number: 18 OF 22

C9.0

APPENDIX D

Invasive Plants Fact Sheets

Fact Sheet Index

INVASIVE PLANTS OF OHIO

Fact Sheet 1 Amur, Morrow's & Tatarian Honeysuckle

Lonicera maackii, L. morrowii, L. tatarica

AMUR HONEYSUCKLE

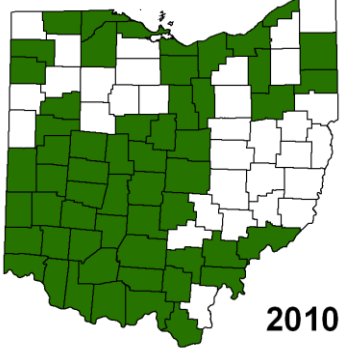
DESCRIPTION:

Amur, Morrow's and Tatarian bush honeysuckles are upright, deciduous shrubs that range from 6 to 15 feet in height at maturity. Older stems have hollow pith (center). Two native bush honeysuckles, bush honeysuckle (*Diervilla lonicera*) and Canada fly honeysuckle *(Lonicera canadensis)* may be confused with these non-natives; proper identification is necessary. Branches of the native species have solid stems, while the non-natives have hollow pith.

The 1-2½ inch leaves are opposite along the stem and short-stalked. Amur honeysuckle has dark green leaves that end in a sharp long-pointed tip; the leaf underside has hair along the veins. Morrow's and Tatarian both have oval to egg-shaped leaves. The underside of Morrow's leaves is consistently hairy, while Tatarian lacks hair.

Pairs of tubular flowers less than an inch long are borne along the stem in the leaf axils. Amur flowers have very short, pubescent peduncles (stems). Morrow's peduncles are long and pubescent, while Tatarian's are long and glabrous (smooth). Flowering generally occurs from early to late spring. Yellow to dark-red berries mature from late August to October. Showy pink honeysuckle (*L. x bella)* is an invasive hybrid of Morrow's and Tatarian with showy pink flowers.

AMUR HONEYSUCKLE



Amur honeysuckle is native to China, Russian Far East, Korea, and Japan. Morrow's honeysuckle is native to Korea and Japan. Tatarian honeysuckle is native to Russia, Central Asia, and China. Tatarian honeysuckle was introduced into North America in 1752; Amur and Morrow's honeysuckles came in the late 1800s, as ornamental plants. Subsequently, they were promoted for wildlife cover and soil erosion control, in addition to landscaping.

MORROW'S HONEYSUCKLE

HABITAT:

These non-native bush honeysuckles are relatively shade-tolerant, invading mesic to moist woods as well as forest edges, abandoned fields, prairie remnants, pastures, and other open, upland habitats. Woods that have been grazed or disturbed are more susceptible to invasion. Morrow's honeysuckle is capable of invading bogs, fens, lakeshores, and sandy plains. Amur honeysuckle prefers limestone-based soils.

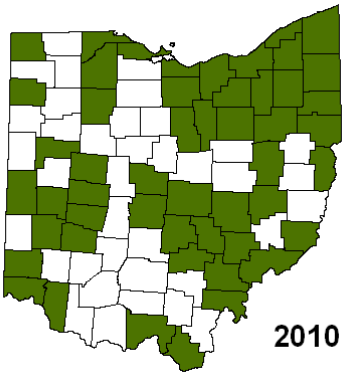
INVASIVE CHARACTERISTICS:

Amur, Morrow's, and Tatarian bush honeysuckles fruit prolifically and are highly attractive to birds, which widely disseminate seeds across the landscape. Deer also disperse seeds. Cut stems will resprout vigorously. These shrubs shade native vegetation since they leaf out earlier in the spring and drop their leaves later in the fall than native plants. It has been documented that birds nesting in honeysuckle suffer greater nest predation than those nesting in native shrubs.

CONTROL:

Mechanical: Hand removal of seedlings or small plants may be effective for light infestations, but care should be taken to remove the entire plant and minimize soil disturbance. In shaded forest habitats, where bush honeysuckles tend to be less resilient, repeated cutting to ground level, during the growing season, may result in high mortality. Cutting must be repeated at least once annually or bush honeysuckles will often form stands that are more dense and productive than they were prior to cutting. For thickets of seedlings or small saplings, repeated mowing or bush-hogging may be effective.

MORROW'S HONEYSUCKLE



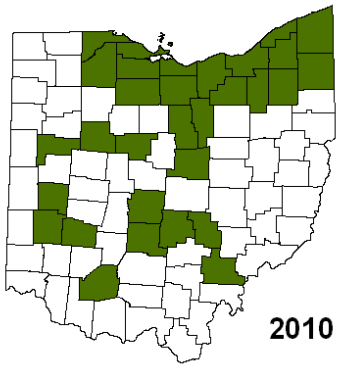
TATARIAN HONEYSUCKLE

Prescribed burning may be used to control bush honeysuckles growing in open habitats, if there is enough fuel. In all instances, control should be initiated prior to the seed dispersal period (late summer to early autumn) to minimize reinvasion of treated habitats.

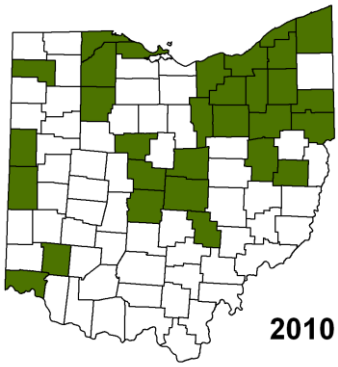
Chemical control:
Selective herbicide application is the most effective control method for woody invasive plants. Herbicides can be applied to the foliage (low volume or high volume during the growing season), cut stems (at the time of cutting), or to the bark of the lower portions of the stems/trunks. Herbicides for foliar application include Roundup, AquaNeat, Glypro, Rodeo, Razor, and Escort. Herbicides for cut stem or basal bark application include Garlon 4, Stalker, Pathfinder, and Pathway.

Well-established stands of bush honeysuckles are best managed by cutting the stems to ground level and painting or spraying the stumps. Foliar application should only be used when the ambient temperature is above 65 degrees F. All three bush honeysuckle species leaf out early in the spring and hold their leaves late into the fall, creating ideal times for foliar herbicide application particularly in large monotypic stands. To be most effective, many herbicides require a penetrating or sticking agent.

TATARIAN HONEYSUCKLE



SHOWY PINK HONEYSUCKLE, a hybrid



Biological: No biological control agents are currently available for these plants.

Note: Maps of species' ranges are based on records as of 2010.

Credits and additional information:
Plant Conservation Alliance-Alien Plant Working Group
Ohio Department of Natural Resources, www.ohiodnr.gov
The Nature Conservancy, Ohio Chapter
The Ohio State University Extension, http://woodlandstewards.osu.edu
OIPC website, www.oipc.info

INVASIVE PLANTS OF OHIO

Fact Sheet 3 — Garlic Mustard

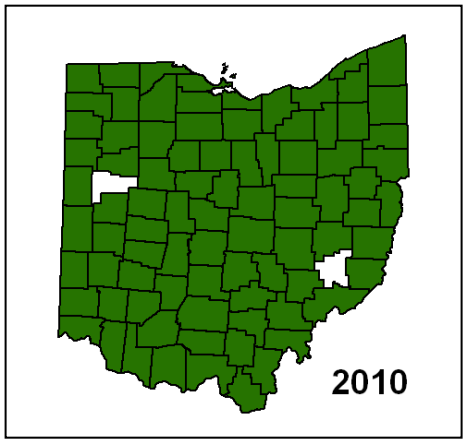
Alliaria petiolata

DESCRIPTION:
Garlic mustard is a biennial herb that emits a garlic-like odor from crushed leaves. In the first year, a rosette of kidney-shaped leaves hug the ground and remain green throughout the winter. Sharply-toothed, triangular leaves form on the 2-4 foot tall flower stem during the second year. White flowers with four petals bloom in clusters at the end of the stem from late April to mid June. The fruit is a long, green capsule that turns brown as the seeds mature. As the plant dies, the long, brown seed capsules at the end of a long naked stem split and release hundreds of seeds.

Garlic mustard was introduced from Europe for herbal and medicinal purposes. In 1868, it was first recorded in Long Island, New York. It is recorded from nearly every county in Ohio.

HABITAT:
Garlic mustard prefers some shade in mesic upland and floodplain forests, savannas, pastures, lawns, and along fencerows and roadsides. It invades forest edges and progresses into the interior along streams and trails.

INVASIVE CHARACTERISTICS:
In forests and woodlands, garlic mustard reduces growth of wildflowers in the early spring before canopy leaf out, and suppresses soil fungi that are mutualistic with trees. It produces large quantities of seeds that can remain viable for up to 10 years. Seeds are dispersed by water or transported by animals and humans.



Map based on records as of 2010.

CONTROL:

Mechanical: Hand-pulling is effective in small infestations. Care must be taken to insure that the entire plant, including the root system, is removed and all plant materials are bagged and taken off-site. The plant can continue to mature and produce seeds even after it has been pulled. Control should continue until the seed bank is exhausted (at least 7 years). Cutting stems when flowering can be effective in larger populations. The stems should be cut low to ensure that flowering is hampered. Cutting during flowering generally results in total mortality of the plant. However, seed heads will continue to mature and disperse seeds, so plants should either be cut into pieces or all cut materials should be removed from the site. Control in the spring, targeting first-year rosettes and second-year plants before they flower, is generally more effective than fall treatment of only first-year rosettes. Prescribed fire in late spring can be effective in large populations, particularly if conducted for several years.

Chemical: Foliar application of systemic herbicides, such as Roundup, Glypro, or AquaNeat, is effective, even in winter (to kill overwintering rosettes), as long as the temperature is at least 50 degrees F and the area remains dry for eight hours. Extreme care must be taken not to apply the herbicide on desirable plants as these products are non-selective. Herbicide application to the first-year rosettes in the late fall, winter, and early spring will minimize impacts to non-target species while they are dormant. It is crucial to spray all plants within the control area, otherwise the survivors will respond with greater growth and reproduction. If carried out in late fall or winter, it is essential to kill all rosettes in the treated areas, otherwise the survivors will grow large in the absence of competition and seed production will not be lower than in untreated areas. Spray shields may also be used to better direct herbicide and limit non-intentional drift.

Biological:
Researchers at Cornell University are investigating potential biological control agents for garlic mustard. Four weevil species that feed on stems, seeds, and root-crowns are being studied for bio-control of garlic mustard.

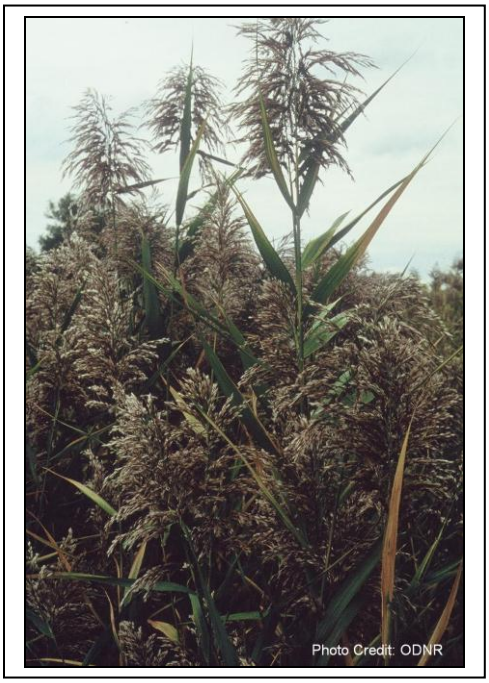
Credits and additional information:

Plant Conservation Alliance-Alien Plant Working Group
Ohio Department of Natural Resources, www.ohiodnr.gov
The Nature Conservancy, Ohio Chapter
Noxious Weed Control Board (WA), www.nwcb.wa.gov/siteFiles/Alliaria petiolata.pdf
The Ohio State University Extension, http://woodlandstewards.osu.edu
OIPC website, www.oipc.info

INVASIVE PLANTS OF OHIO

Fact Sheet 5 Common Reed Grass (Phragmites)

Phragmites australis ssp. *australis*

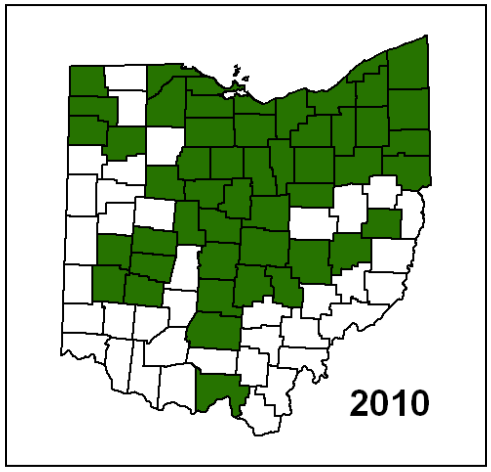


DESCRIPTION:

Common reed grass is a tall, perennial wetland grass, 5-10 feet in height. Both native and introduced Phragmites are found in the state. The introduced Phragmites forms a dense network of rhizomes with deep roots. Vertical stalks arise from the rhizomes forming dense colonies. The stiff, hollow stalks support elongate and flat 1 ½ to 2 inch wide leaves. Flowers form bushy panicles in late July and August and are usually purple or golden in color. As seeds mature, the panicles begin to look "fluffy" due to the hairs on the seeds and they take on a grey sheen.

It is difficult to distinguish native Phragmites from the introduced. However, a number of morphological characteristics have been identified that can be used to determine a population's type. Characteristics that separate the native from the introduced Phragmites include stems that are smooth, shiny and often purplish, and short ligules between 1-1.7 mm in length, for the native type.

Introduced common reed grass is thought to have arrived in North America accidentally, most likely in ballast material in the late 18th or early 19th centuries. It established itself along the Atlantic coast and over the course of the 20th century, spread across the continent. In Ohio, the introduced subspecies is found throughout the state with it being more common in northern half.



Map based on records as of 2010.

HABITAT:

Common reed grass is found in brackish and freshwater marshes, river edges, shores of lakes and ponds, roadsides, fens, swamps, wet meadows, and disturbed moist/wet areas.

INVASIVE CHARACTERISTICS:

Common reed grass quickly invades a site and can take over a marsh community, crowding out native plants, changing marsh hydrology, altering wildlife habitat, and increasing fire potential. Its tall stems and dense growth pattern block light to other plants and its rhizomes spread rapidly across the soil surface (10-20 feet in length), creating a monoculture stand. Phragmites can spread to new areas by seed dispersal and vegetative rhizome fragments. It had been thought for years that Phragmites did not produce many viable seeds, but recent research at The Ohio State University has documented that seeds are typically viable and germinate in mudflat conditions (Campbell 2010).

CONTROL:

Mechanical:
Cutting, pulling or mowing can be done in late July for several years. Prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, may be effective. Burning after herbicide treatment reduces standing dead stem and litter biomass which may help to encourage germination of native plants in the following growing season. Plants should not be burned in the spring or summer before flowering as this may stimulate growth.

Chemical:
Herbicide application using Rodeo, Accord, Glypro, AquaNeat, or Habitat/Polaris is most effective in the late summer or early fall, after tasseling, and should be applied at least 2 years in a row depending on the size of the population. Fusilade, a grass-specific herbicide, can be applied in non-aquatic habitats. Habitat/Polaris is best used for extensive monocultures as it is a residual herbicide, but is extremely effective on Phragmites. Be sure to use a non-ionic surfactant with the herbicide in wet areas. Application methods may include aerial spraying, hand-held or backpack sprayers, and hand-wicking. Extensive populations have rhizome networks and will require multiple applications to achieve effective control.

Biological: There are several native insects that feed on Phragmites as well as a few Eurasian insects that feed on Phragmites that have become naturalized in North America. Their impact and distribution are currently unknown.

Credits and additional information:

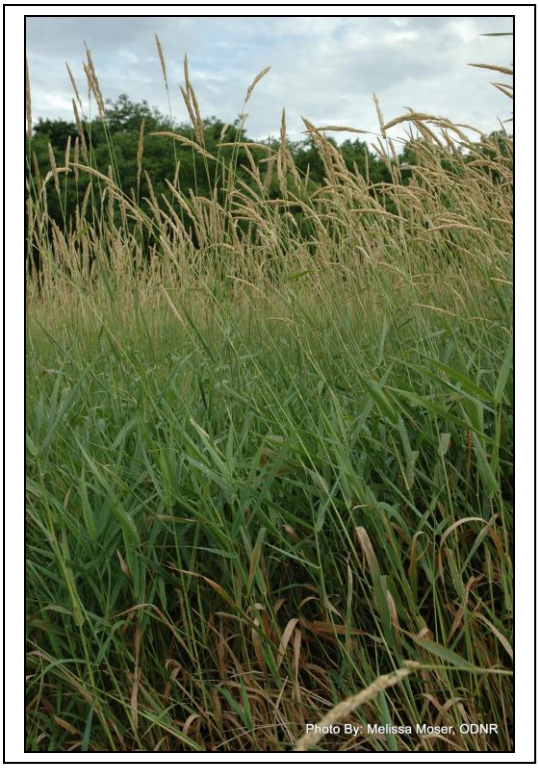
Plant Conservation Alliance-Alien Plant Working Group
Ohio Department of Natural Resources, www.ohiodnr.gov
The Nature Conservancy, Ohio Chapter
Cornell University, www.invasiveplants.net
OIPC website, www.oipc.info

INVASIVE PLANTS OF OHIO

Fact Sheet 6 — Reed Canary Grass

Phalaris arundinacea

DESCRIPTION:

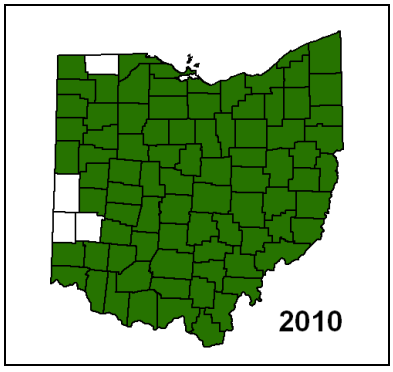


Reed canary grass is a large, coarse grass that attains a height of 2 to 7 feet. The erect, hairless stem supports rough-textured, tapering leaves of 3 ½ to 10 inches long and 1/4 to 3/4 inch wide. One of the first grasses to sprout in the spring, reed canary grass produces compact panicles that are erect or slightly spreading and range from 3 to 16 inches long. Flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. Shiny brown seeds ripen in late June and are dispersed by water, animals, humans and machines. This grass forms a thick rhizome system that quickly dominates a site.

Sources document native and non-native genotypes. The non-native strain is more invasive than the native strain. The non-native originates in temperate regions of Europe and Asia. Both strains have been planted throughout the U.S. since the 1800s for forage and erosion control.

HABITAT:

Reed canary grass grows best on fertile, moist organic soils in full sun. It can grow in standing water by producing special roots along the submersed portion of the stem. It also grows on dry soils in upland sites and under partial shade.



INVASIVE CHARACTERISTICS:

Reed canary grass reproduces prolifically vegetatively as well as by seed. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream and river banks, ditches and seasonally wet areas; it also grows in disturbed upland areas. Stands are difficult to eradicate because large seed banks and extensive root systems allow its re-colonization of sites.

CONTROL:

Mechanical:
Hand-pulling can be effective for small populations. Care must be taken to remove the entire plant, including the roots; all plant materials should be bagged and taken off-site. Removal is recommended as plants can continue to mature and produce seeds even after they are pulled. Small patches can also be covered with black plastic for at least one growing season. Plants can also be cut or mowed, but repeated cutting or mowing is usually needed for effective control. Discing or plowing can be used to control a well-established population, although this method basically reduces the density without killing the plants.

Chemical:
Foliar application of systemic herbicides such as AquaNeat, Accord, and Rodeo (approved for wetland/aquatic application) can be very effective, especially if applied in the early spring or late fall when other native vegetation is dormant (to minimize impacts on native plants). The most effective treatment time occurs after flowering/seed set and before the plant goes dormant for the winter. To be most effective, many herbicides require a penetrating or sticking agent such as Nu-Film-P; be sure to use a non-ionic surfactant in wet areas. Removal of the previous year's growth to expose the new green shoots increases the effectiveness of the herbicide. In the fall, herbicide can be applied after mowing reed canary grass.

Biological:
There are no biological control methods currently known for reed canary grass.

Credits and additional information:
Plant Conservation Alliance-Alien Plant Working Group
Ohio Department of Natural Resources, www.ohiodnr.gov
The Nature Conservancy, Ohio Chapter
USDA Forest Service, Forest Health Staff, Newtown Square, PA
OIPC website, www.oipc.info

Note: Map of species' range is based on records as of 2010.

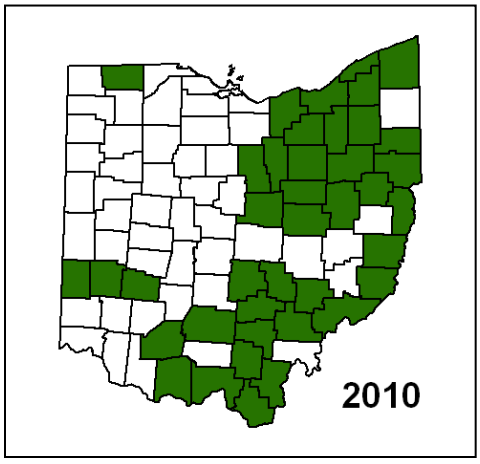
INVASIVE PLANTS OF OHIO

Fact Sheet 10 — Japanese Knotweed

Fallopia japonica

DESCRIPTION:
Japanese knotweed is an upright, shrub-like, herbaceous perennial that can grow to over 10 feet in height. The stout, hollow stems are reddish-brown and the nodes are swollen, giving them a bamboo-like appearance. Typical of the smartweed family, nodes are enclosed by a modified leaf-like structure. Leaves are alternate and egg-shaped (4-6 inches long and 3-4 inches wide), narrowing to a point at the tip. The minute greenish-white flowers are borne in plume-like clusters in the upper leaf axils in summer and are followed soon after by small shiny, black-winged fruits. There is an ornamental variety with pink flowers.

Japanese knotweed was probably introduced from Asia in the late 1800s. It was first introduced as an ornamental and has also been used for erosion control and for landscape screening. It is widely distributed in the U.S. and found throughout Ohio.



Map based on records as of 2010.

HABITAT:
Japanese knotweed occupies a wide variety of habitats in many soil types with a range of moisture conditions. It poses a significant threat to riparian areas, where it can survive severe flooding. It is also found along roadsides, low-lying areas, utility rights-of-way, old home sites and along woodland edges and openings.

INVASIVE CHARACTERISTICS:
Japanese knotweed grows aggressively by extensive rhizomes forming dense thickets. It is often transported to new sites as rhizome and seed contaminants in fill dirt. It is a threat to riparian areas as small pieces of rhizome washed downstream can establish new colonies. Neglected gardens and discarded cuttings are common routes of dispersal from urban areas.

CONTROL:

Mechanical:
Large colonies are extremely difficult to dig due to their high rhizome densities. Digging of large colonies is not recommended as it is very labor intensive and unlikely that all below ground material can be removed. Small patches may be dug; however, care should be used in removing plant material and placing it in plastic bags for proper disposal. Repetitive cutting or mowing within a single growing season has been effective. Eradication of the rhizome system is necessary for complete control.

Chemical:
Systemic herbicides have been generally effective at controlling Japanese knotweed. Repetitive cutting of stems combined with spot application of Roundup, Accord, Glypro, AquaNeat, Rodeo, Habitat/Polaris, or Garlon 3A on the re-sprouting leaves, as well as foliar spraying in large populations will control knotweed populations. Due to the extensive rhizome system, multiple herbicide applications may be required. Best control has been obtained in Ohio with Roundup and Habitat. Some herbicides are approved for wetland or riparian use (e.g., Accord, Glypro, AquaNeat), while others should only be used in upland sites. To be most effective, many herbicides require a penetrating or sticking agent such as Nu-Film-P.

Knotweed flowers

Biological:
There are numerous insects and pathogens that attack the species in its natural habitats. No research has been conducted on these possible biological controls.

Credits and additional information:

Plant Conservation Alliance-Alien Plant Working Group
Ohio Department of Natural Resources, www.ohiodnr.gov
The Nature Conservancy, Ohio Chapter
Cornell University, www.invasiveplants.net
OIPC website, www.oipc.info

INVASIVE PLANTS OF OHIO

Fact Sheet 11 Narrow-leaved and Hybrid Cattail

Typha angustifolia, T. x *glauca*

NARROW-LEAVED CATTAIL (on left)

DESCRIPTION:

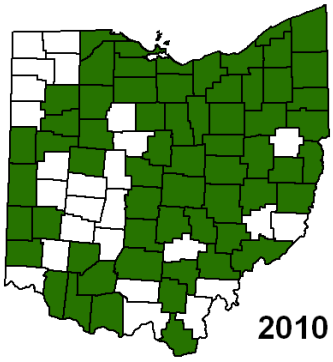
Narrow-leaved cattail is an introduced species which hybridizes with the native common cattail (*T. latifolia*), shown at right in the photo. The hybrid produced is also an invasive, *T.* x *glauca*. All three aquatic/wetland perennials may grow to a height of 10 feet and produce a velvety brown spike of flowers. The hybrid and narrow-leaved cattail flower spikes have a gap of 1 to 4 inches between the male and female flowers, while there is no gap between the flowers of the native cattail. The leaves originate at the base of the stem and spread outward as they rise into the air. The invasive species and its hybrid have leaves that are ¼ to ¾ inches wide; the native cattail leaves are ½ to 1 inch. Below ground, starchy rhizomes anchor the plant to the soil. If the plants are growing in a colony, their rhizomes may become intertwined and form a dense mat.

Narrow-leaved cattail is believed to have been introduced to the Atlantic seaboard from the dry ballast of European ships. It has spread westward and occurs throughout much of the United States. The hybrid cattail may occur wherever both the native and the narrow-leaved species are present. All three taxa are found throughout Ohio. The native cattail's frequency and distribution is shrinking due to the spread of narrow-leaved and hybrid cattails.

HABITAT:

Cattails can be found in damp soil or shallow water where sufficient nutrients are available. They are commonly found along expressways, in artificial ditches and shallow ponds, at the edges of calm waters, in consistently damp patches of rural and suburban yards, in marshes as well as brackish and polluted waters to a depth nearing 3 feet. These taxa also invade fens, wet meadows, wet prairies, and beach swales.

NARROW-LEAVED CATTAIL

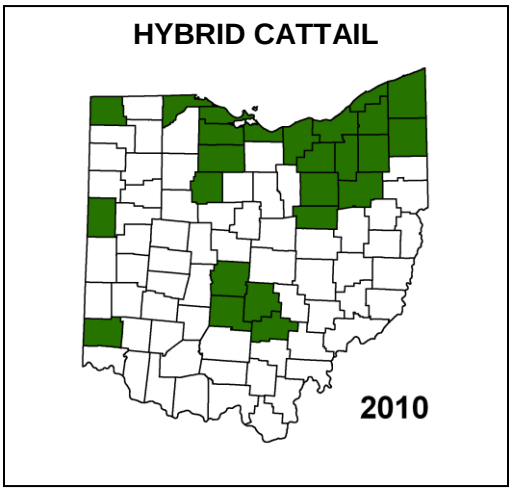


INVASIVE CHARACTERISTICS:

Narrow-leaved and hybrid cattail establish dense stands and may be allelopathic, producing chemicals which discourage growth of other plants. Cattails reproduce both vegetatively by rhizomes and sexually through massive amounts of seeds. The flower head of the parent plant can produce 250,000 seeds, which are wind-dispersed. Seeds may remain viable in the seed bank for up to 100 years. Cattail seeds prefer freshwater, and will not germinate unless saturated in at least 1/2 an inch of water.

CONTROL:

Mechanical: Manipulation of water levels can kill cattails by inhibiting airflow from the cattail shoots to the roots. Removing dead leaves and submerging the shoots in early spring will eliminate gas diffusion and will eventually "suffocate" the plant. It is critical to remember that even if dead leaves from the previous year are completely removed, aerobic conditions will be restored to the rhizome as soon as the new growing shoot penetrates the water surface. Even if water levels are sustained at only a few inches above the tops of the growing shoots, oxygen is prevented from reaching the rhizomes. Burning and disking are not effective for these species due to the extensive rhizomes.



Chemical: Foliar application of systemic herbicides such as Accord, Rodeo, Glypro, AquaNeat, and Habitat/Polaris can be very effective. A non-ionic surfactant should be added to the herbicide in wet areas. Herbicides can be applied aerially, using low and high volume spraying, and hand-wicking for smaller populations or those mixed with native wetland vegetation (to minimize treatment of non-target species). Treatment in late summer or early fall is most effective. Re-treatments are usually necessary due to the extensive rhizome system.

Biological: Population levels of ten muskrats per acre, when combined with high spring-time water levels, can nearly eliminate the emergence of cattails within a span of two years. Water levels in the range of four to five feet also favor the wintertime survival of muskrats in flooded areas. Grazing on seedlings and young cattails without extensive rhizomes can reduce the stem density of the colony. For mature plants, grazing combined with water-level management reduces survival rates.

Credits and additional information:

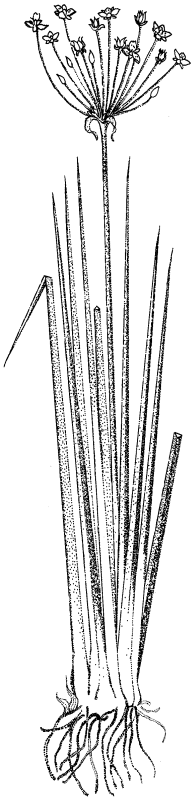
Plant Conservation Alliance-Alien Plant Working Group
Ohio Department of Natural Resources, www.ohiodnr.gov
The Nature Conservancy, Ohio Chapter
Wisconsin DNR, www.dnr.wi.gov
OIPC website, www.oipc.info

Note: Maps of species' ranges are based on records as of 2010.

Aquatic Invasive Species

Flowering rush

Butomus umbellatus



What is flowering rush?

Flowering rush (*Butomus umbellatus* L.) is a perennial aquatic plant, native to Europe and Asia. It grows along lake and river shores as an emergent plant. Emergent plants are rooted in the lake bottom with stems and leaves that grow above the surface of the water. A familiar emergent plant is cattail. Flowering rush may also grow as a non-flowering, submersed plant, growing below the surface of the water, with limp, ribbon-like leaves.

How to identify it

Identification of flowering rush can be difficult, especially when the plants do not have flowers. It closely resembles many native emergent plants, such as bulrush. The emergent form of flowering rush has three-angled fleshy leaves and may produce a cluster of pink flowers (Figure above and photo below).

Photo: Peter Dziuk

How does it spread?

Flowering rush has been sold as an ornamental garden plant and is most likely introduced into new waterbodies by humans. The plant spreads primarily by vegetative means, usually not by seed. Vegetative reproduction can result from growth of thick rhizomes, which are underground stems. Rhizomes also may produce small tubers or buds, which can disperse and grow into new plants. Also, small buds or "bulblets" that form in the clusters of flowers also can disperse and grow into new plants. Water currents, ice movement, muskrats, and geese can easily move these reproductive structures to new locations within a water body.

Why is it a problem?

Dense stands of flowering rush may interfere with swimming and other use of lakes. Resource managers are concerned that flowering rush may become an aggressive competitor and displace native emergent vegetation, such as hardstem bulrush.

Where is flowering rush in Minnesota?

Flowering rush was first recorded in Anoka County in 1968 and has since been located in these counties: Aitkin, Becker, Dakota, Hennepin, Itasca, Le Sueur, Rice, Todd, and Washington. Despite its 30-year presence in the state, the distribution of flowering rush is widely scattered and uncommon.

Regulatory Classification

Flowering rush is classified as a *prohibited invasive species* in Minnesota. It is illegal to possess, buy, sell, transport, and plant.

Management of flowering rush in MN

The DNR has two goals that apply to flowering rush management: 1) to prevent the spread of flowering rush within Minnesota; and 2) to reduce the impacts caused by invasive species to Minnesota's ecology, society, and economy.

Prepared by the Invasive Species Program, Division of Ecological Resources
Minnesota Department of Natural Resources Rev. July 2009

To attain these goals, the following four strategies are used:

- Prohibit the sale of flowering rush in Minnesota.
- Monitor current distribution and assess changes.
- Support research to develop and implement better management methods.
- Provide information to those interested in how to best manage flowering rush.

Control of Flowering Rush

The Minnesota Department of Natural Resources (DNR) supports well-planned control of flowering rush. Nevertheless, lakeshore residents and users must ensure that control of this plant does not cause unintended harm, such as the removal of native bulrush. Native plants protect lake water quality and provide valuable fish and wildlife habitat. If you are a landowner who is interested in controlling flowering rush along your shoreline, you should be aware of the following:

Removal of emergent aquatic plants, including flowering rush, in public waters requires a permit from the DNR. *Anyone who wants to control flowering rush must apply to the DNR for a permit. With proper justification, a DNR aquatic plant management permit may be issued to remove the invasive plant in order to provide reasonable use and access for landowners.*

Invasive species often move into disturbed areas, for example, those from which native plants have been removed. Improper control methods can worsen the flowering rush problem. Information on control methods is given below.

Hand digging and removal will decrease the abundance of flowering rush. This method can be used to remove isolated plants but hand digging will also uproot rhizomes or buds, which can disperse and grow into new plants. Proper care must be taken to contain and remove all plant fragments from the water. This side effect of hand digging means that this method may not be acceptable in all lakes.

Cutting flowering rush using both hand tools and mechanical devices below the water surface will not kill the plant but will decrease the abundance of visible foliage during the year of cutting. Multiple cuts may be required during the summer as flowering rush grows back from the root. Again, proper care must be taken to remove all cut plant fragments from the water and to keep mechanical devices from inadvertently uprooting rhizomes or buds from the lake bottom.

Herbicide treatments have been used to control flowering rush**.** At present, it is not clear whether any of the available herbicides can be used to provide long-lasting control without harming native plants growing with or near flowering rush**.** Efforts to improve control with herbicides are continuing. People considering control of flowering rush with herbicide should know that ***any use of herbicide in public waters in Minnesota requires a DNR permit*****.**

Information and technical assistance

If you would like additional information on management of flowering rush or other, aquatic invasive species, contact the nearest DNR Invasive Species Program staff member:

Northwest MN, Park Rapids 218-699-7293

Northeast MN, Grand Rapids 218-999-7805

Central and West Central MN, Brainerd 218-833-8645; Fergus Falls 218-739-7576 ext. 259

Central and Southeast MN, St. Paul 651-259-5828

Southern MN, New Ulm 507-359-6079

Statewide, DNR Central Office - St. Paul 651-259-5100

Prepared by the Invasive Species Program, Division of Ecological Resources
Minnesota Department of Natural Resources Rev. July 2009