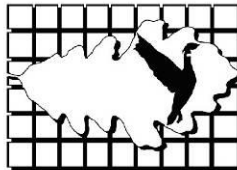


OTTAWA SANDS WETLAND ASSESSMENT AND RESTORATION CONCEPT PLAN

Submitted to:
OTTAWA COUNTY PARKS AND
RECREATION
12220 FILLMORE ST RM 267
WEST OLIVE, MI 49460
August 28, 2020
(AES Project # 20-0089)



Prepared by:



Applied Ecological Services, Inc.
120 West Main Street
West Dundee, IL 60118
(847-844-9385)

TABLE OF CONTENTS

<i>Section</i>	<i>Page</i>
1.0 ECOLOGICAL COMMUNITY ASSESSMENT METHODS.....	1
2.0 WETLAND ASSESSMENT SUMMARY	2
3.0 EXISTING ECOLOGICAL CONDITIONS, POTENTIAL RESTORATION & MANAGEMENT OPPORTUNITIES.....	5
4.0 SITE PHOTOGRAPHS	19
 <i>List of Figures</i>	
Figure 1. Ottawa Sands Plant Community Units and Wetland Assessment Areas	4
 <i>List of Tables</i>	
Table 1. Ranking of prospective projects in the Ottawa Sands wetland assessment.....	2
Table 2. Ecological Communities, Total Acres, Photo #, Grade, Dominant Plant Species	3

1.0 ECOLOGICAL COMMUNITY ASSESSMENT METHODS

Applied Ecological Services, Inc. (AES) reviewed present day aerial photography, soils data, wetland maps, floodplain maps, topography, and other resources prior to conducting the onsite wetland assessment at Ottawa Sands. The map review provided valuable information when identifying potential natural features and ecological communities. The topography and ground water hydrology data allowed us to better predict where suitable wetland habitat currently occurs or could be created.

AES used Michigan Natural Features Inventory's "Natural Communities of Michigan: Classification and Description" (Kost et al., 2007) to identify and map individual ecological communities on the site. This classification system is a standard for the region and ensures that ecologists and land managers identify communities properly. It is important to note that the community classification system identifies and describes communities based on high quality examples. However, AES's methods also state the importance of identifying degraded communities of the original ecological community.

AES Ecologists conducted an onsite Wetland Assessment within the Ottawa Sands project area on June 11 & 12, 2020. This included identification and assessment of the existing wetland plant communities and restoration opportunities. Input from Ottawa County Parks and Recreation staff was also factored into recommended restoration strategies. The Wetland Assessment included:

1. Walking Ottawa Sands within the provided boundary while mapping, describing, and photo documenting existing and potential wetlands on a recent aerial photography map and/or in ArcGIS Collector (Figure 1);
2. Identifying wetland restoration and management opportunities to guide future land stewardship.

2.0 WETLAND ASSESSMENT SUMMARY

Based on the Wetland Assessment conducted by AES on June 11 & 12, 2020, Ottawa Sands contains 18 wetland and upland restoration or enhancement opportunity areas in various locations and ecological condition (see Figure 1). Table 1 represents a ranking of Ottawa Sands wetland restoration projects, based on our Wetland Assessment. Table 2 lists each of the 18 wetland and upland assessment areas, noting ecological communities and provides Michigan plant community classification, wetland restoration recommendation, total acreage in community, mapped Area #, and dominant plant species.

Table 1. Prioritized ranking of prospective wetland restoration projects in the Ottawa Sands.

Rank	Area(s)	Condition	Description of Restoration Concept	Timeline
1	9, 10, 14	Disturbed Dunal Wetlands	Dunal Wet Prairie – Emergent Marsh created by connecting and reshaping existing wetlands. Enhance restoration with native seeds and plugs. Manage as a unit with surrounding upland dune fields.	2021: Construction, Installation 2022-2024: Mgmt, Monitoring, etc.
2	6, 7	Low Diversity Riverine Emergent Marsh/Southern Wet Meadow	Restored and enhanced Riverine Emergent Marsh and Southern Wet Meadow using existing topography and shallow excavations to create gradual slopes where seasonal flooding can create wetland transition zones. Enhance restoration with native seeds and plugs and manage as a unit.	2021: Permits 2022: Construction, Installation 2023-2025: Mgmt, Monitoring, etc.
3	3	Low Diversity Riverine Emergent Marsh/Southern Wet Meadow – Shrub-Carr	Restored and enhanced Riverine Emergent Marsh and Southern Wet Meadow using existing topography and shallow excavations to create gradual slopes where seasonal flooding can create wetland transition zones. Enhance restoration with native seeds and plugs and manage as a unit. Thin midstory trees along shoreline to allow herbaceous layer to flourish.	2021: Permits 2022: Construction, Installation 2023-2025: Mgmt, Monitoring, etc.
4	2	Filled Lagoon A	Dunal Wet Prairie – Emergent Marsh created by connecting and reshaping existing wetlands. Enhance restoration with native seeds and plugs. Manage as a unit with surrounding upland dune fields.	2021: Construction, Installation 2022-2024: Mgmt, Monitoring, etc.
5	8	Filled Lagoon B	Dunal Wet Prairie – Emergent Marsh created by connecting and reshaping existing wetlands. Enhance restoration with native seeds and plugs. Manage as a unit with surrounding upland dune fields.	2021: Construction, Installation 2022-2024: Mgmt, Monitoring, etc.

Table 2. Ecological communities, total acres, area #s, and dominant plant species.

County Named Ecological Community (from MNFI Classification)	AES Wetland Assessment	AES Recommended Wetland Restoration	Acres /feet	Area #	Existing Dominant Plant Species
Disturbed Dune Field (Uplands)	Low Diversity Reclaimed Sand Mine	Enhanced Vegetated Disturbed Dune Field	98.49 ac	1	Marram grass (<i>Ammophila breviligulata</i>), little bluestem (<i>Schizachyrium scoparium</i>), sand reed (<i>Calamovilfa longifolia</i>), horse mint (<i>Monarda punctata</i>)
Artificial Wetlands	Filled Lagoon A	Reconstruct Dunal Wet Prairie – Emergent Marsh	4.68 ac	2	Cottonwood (<i>Populus deltoides</i>), switch grass (<i>Panicum virgatum</i>), Kentucky bluegrass (<i>Poa pratensis</i>)
Southern Hardwood Swamp (The Sag, North)	Moderate Diversity Southern Wet Meadow and Shrub-Carr	Enhanced Southern Wet Meadow, Southern Shrub-Carr	0.86 ac	3	Cottonwood (<i>Populus deltoides</i>), red maple (<i>Acer rubrum</i>), black willow (<i>Salix nigra</i>), witch hazel (<i>Hamamelis virginiana</i>), spicebush (<i>Lindera benzoin</i>), lake sedge (<i>Carex lacustris</i>), blue joint grass (<i>Calamagrotis canadensis</i>), rice cut grass (<i>Leersia oryzoides</i>)
Great Lakes Marsh (The Sag, North)	Low Diversity Riverine Emergent Marsh	Enhanced Riverine Emergent Marsh	1.62 ac	3	Broadleaf cattail (<i>Typha latifolia</i>), broadleaf arrowhead (<i>Sagittaria latifolia</i>), waterlily (<i>Nymphaea odorata</i>)
Inundated Shrub Swamp	Low Diversity Southern Hardwood Swamp	Enhanced Southern Hardwood Swamp	1.15 ac	4	Red maple (<i>Acer rubrum</i>), black gum (<i>Nyssa sylvatica</i>), buttonbush (<i>Cephalanthus occidentalis</i>), fringed sedge (<i>Carex crinita</i>), blue flag iris (<i>Iris virginica</i>)
Dry Mesic Northern Forest	Low Diversity Disturbed Wet Swale	Enhanced Southern Wet Meadow – Shrub-Carr	0.10 ac	5	Cottonwood (<i>Populus deltoides</i>), blue flag iris (<i>Iris virginica</i>), meadow fescue (<i>Schedonorus pratensis</i>), Kentucky bluegrass (<i>Poa pratensis</i>)
Great Lakes Marsh (The Sag, South)	Low Diversity Riverine Emergent Marsh And Southern Wet Meadow	Enhanced Riverine Emergent Marsh, Restored and Expanded Southern Wet Meadow	0.93 ac	6	Cottonwood (<i>Populus deltoides</i>), lake sedge (<i>Carex lacustris</i>), broadleaf cattail (<i>Typha latifolia</i>), broadleaf arrowhead (<i>Sagittaria latifolia</i>)
Great Lakes Marsh (The Sag, South)	Low Diversity Riverine Emergent Marsh, Degraded Southern Wet Meadow	Enhanced Riverine Emergent Marsh, Restored Southern Wet Meadow	0.93 ac	7	Cottonwood (<i>Populus deltoides</i>), Tartarian honeysuckle (<i>Lonicera tatarica</i>), crested sedge (<i>Carex cristatella</i>), Kentucky bluegrass (<i>Poa pratensis</i>)
Disturbed Dune Field	Filled Lagoon B	Reconstruct Dunal Wet Prairie – Emergent Marsh	1.71 ac	8	Switch grass (<i>Panicum virgatum</i>), little bluestem (<i>Schizachyrium scoparium</i>), red fescue (<i>Festuca rubra</i>), quackgrass (<i>Elytrigia repens</i>), meadow fescue (<i>Schedonorus pratensis</i>)
Disturbed Dune Field	Disturbed Dunal Wetland	Enhanced Dunal Wet Prairie – Emergent Marsh	1.54 ac	9	Sandbar willow (<i>Salix interior</i>), reed canary grass (<i>Phalaris arundinacea</i>), rushes (<i>Juncus</i> spp.)

Emergent Marsh	Low Diversity Dunal Emergent Marsh	Restored Dunal Emergent Marsh	6.32 ac	10	Cottonwood (<i>Populus deltoides</i>), hardstem bulrush (<i>Juncus acutus</i>), willows (<i>Salix</i> spp.), giant reed (<i>Phragmites australis</i>)
Disturbed Dune Field	Disturbed Dunal Depression	Reconstruct Dunal Wet Prairie – Emergent Marsh	0.66 ac	11	Little bluestem (<i>Schizachyrium scoparium</i>)
Mesic Northern Forest	Low Diversity Floodplain Forest	Enhanced Floodplain Forest	0.18 ac	12	Red oak (<i>Quercus rubra</i>), white pine (<i>Pinus strobus</i>), northern white cedar (<i>Thuja occidentalis</i>), Bebb's oval sedge (<i>Carex bebbii</i>), satin grass (<i>Muhlenbergia</i> sp.)
Disturbed Dune Field	Disturbed Dunal Wet Depression	Reconstruct Dunal Wet Prairie – Emergent Marsh	0.30 ac	13	Sandbar willow (<i>Salix interior</i>), Kentucky bluegrass (<i>Poa pratensis</i>), rushes (<i>Juncus</i> spp.)
Disturbed Dune Field	Disturbed Dunal Wet Depression	Reconstruct Dunal Wet Prairie – Emergent Marsh	0.30 ac	14	Little bluestem (<i>Schizachyrium scoparium</i>)
Dry Mesic Northern Forest	Moderate Diversity Southern Hardwood Swamp	Enhanced Southern Hardwood Swamp	0.48 ac	15	Sugar maple (<i>Acer saccharum</i>), blue flag iris (<i>Iris virginica</i>), blue joint grass (<i>Calamagrostis canadensis</i>), eastern star sedge (<i>Carex radiata</i>)
Disturbed Dune Field	Low Diversity Degraded Hardwood Swamp	Enhanced Southern Hardwood Swamp	0.11 ac	16	Cottonwood (<i>Populus deltoides</i>), quaking aspen (<i>Populus tremuloides</i>), black willow (<i>Salix nigra</i>) blue joint grass (<i>Calamagrostis canadensis</i>)
Great Lakes Marsh	Moderate Diversity Emergent Marsh	Enhanced Emergent Marsh	2.20 ac	17	Black willow (<i>Salix nigra</i>), buttonbush (<i>Cephalanthus occidentalis</i>), blue flag iris (<i>Iris virginica</i>), tussock sedge (<i>Carex stricta</i>), lake sedge (<i>Carex lacustris</i>), wooly sedge (<i>Carex pellita</i>)
Mesic Northern Forest	Low Diversity Degraded and Flooded Southern Mesic Forest	Enhanced Southern Hardwood Swamp	1.21 ac	18	Red oak (<i>Quercus rubra</i>), basswood (<i>Tilia americana</i>), ironwood (<i>Ostrya virginiana</i>), Japanese barberry (<i>Berberis thunbergii</i>)

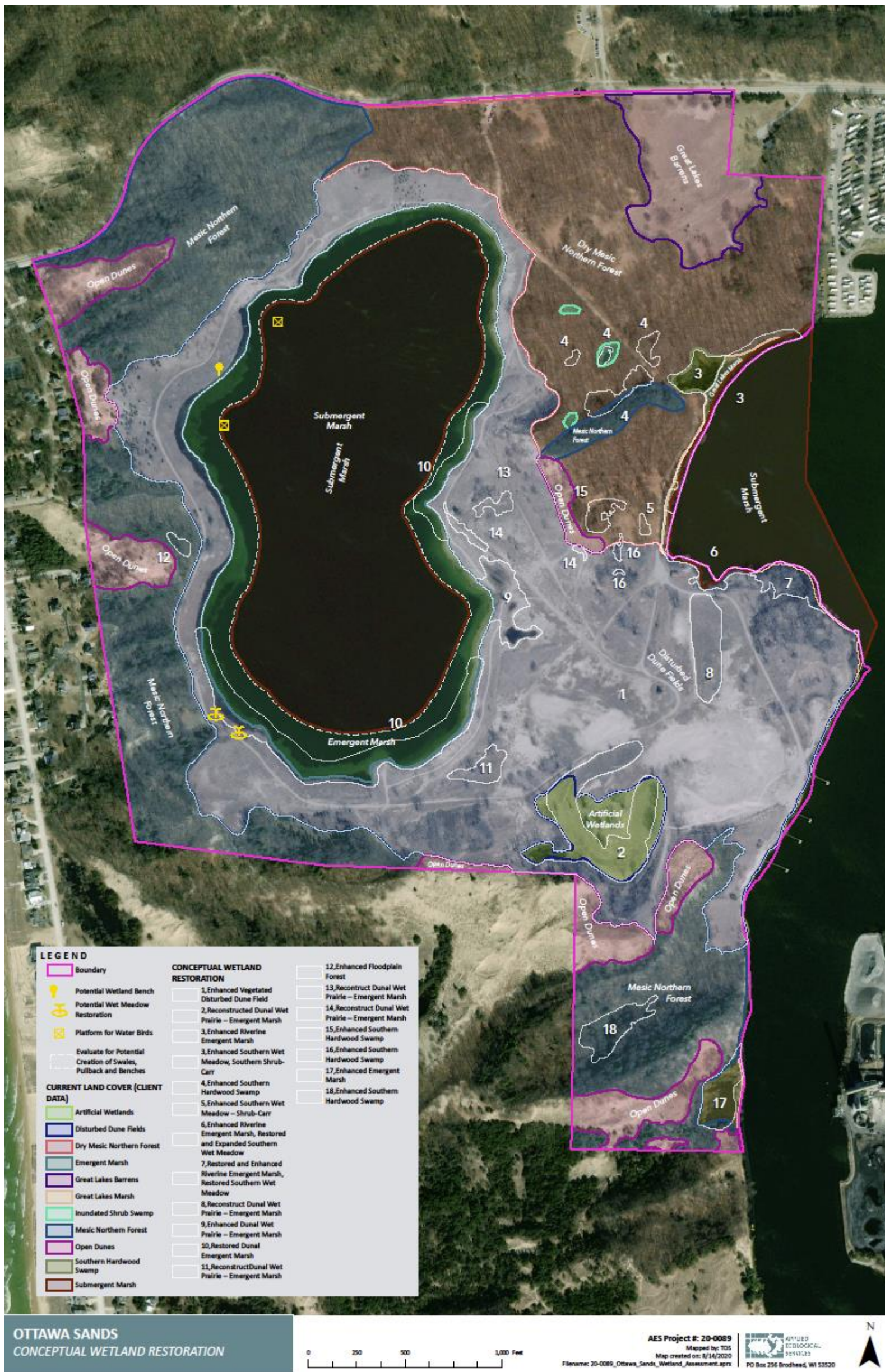


Figure 1. Ottawa Sands Plant Community Units and Wetland Assessment Areas.

3.0 EXISTING ECOLOGICAL CONDITIONS, POTENTIAL RESTORATION & MANAGEMENT OPPORTUNITIES

Local native plant communities are in alignment with Michigan's Natural Communities (Kost et al., 2007) and provide a general template for developing ecological restoration and management goals for the Ottawa Sands site. In most cases, pristine conditions that once existed can no longer be completely restored. Thus, we are left to manage remaining ecological remnants and to restore and manage degraded ecosystems back to a sustainable state.

Without human intervention and conscientious land stewardship, the general health and sustainability of the ecological communities within Ottawa Sands will likely continue to decline. Black locust (*Robinia pseudo-acacia*), tree-of-heaven (*Ailanthus altissimus*), and Siberian elm (*Ulmus pumila*) will invade the dry upland habitats of the reclaimed sand mine and begin to reduce the natural diversity of these open dune habitats. Shrubs such as Tatarian honeysuckle (*Lonicera tatarica*) will encroach in understory habitats and spread quickly to dominate large areas. The non-native giant reed (*Phragmites australis*) and narrow-leaved cattails (*Typha angustifolia*) can increase very rapidly in wetlands to change composition and function of these crucial habitats for Great Lakes birds and insects. Ecological restoration projects can establish and maintain natural areas for plants and animals to flourish by the planning and implementation of invasive species removal (such as non-native trees and shrubs), native plant reintroductions (such as pollinator host plants), and other land management activities that enhance and maintain stable, resilient plant communities for increased ecosystem health and biodiversity.

Two rare species are known to occur at Ottawa sands: Pitcher's thistle (*Cirsium pitcheri*) and Fowler's toad (*Bufo fowleri*). These species are targets for rare species conservation efforts and can benefit from ecological restoration projects. Pitcher's thistle is a biennial species that thrives on the bare soil patches left during shifting sands in the dunes region. Fowler's toad is an amphibian which needs ephemeral pond habitat and other shallow lake margin wetlands to complete its life cycle. Wetland enhancement projects at Ottawa Sands should benefit Fowler's toad and can incorporate habitat improvements for this species.

Ecological restoration involves: evaluating current site conditions, recommending a plan for project timeframe and land management actions to benefit ecosystem health, and on-the-ground implementation of the management plan to reconfigure each site to better provide habitat for native species. To facilitate native plant community resilience, the first step is often to remove invasive trees and shrubs (and other invasive species) to create the suitable conditions to reintroduce native plants. Long-lived native species, such as red oak (*Quercus rubra*) and sugar maple (*Acer saccharum*), can become healthy canopy dominants in the dunes woodlands, but can also become overabundant – even with the increased browsing pressure of White Tailed Deer (*Odocoileus virginianus*). Usually a diverse, multi-layered and complex ecological restoration provides habitat for a wide range of native plant species that can adapt and increase/decrease with the annual/long-term weather and climate fluctuations that shape regional ecosystems, as well as other biotic and abiotic variables that shape long-term resilience.

A further complicating factor in the Ottawa Sands restoration planning is a drastically changing water-table. Lake Michigan water levels are currently at a 20-year high and have increased about 2 feet from 2012-13 low-level peaks. Generally, the Lake Michigan water levels fluctuate on 10-year intervals, but it is predicted with climate change the increased atmospheric humidity and rainfall events will create a new average high water table.

The focus of the Wetland Assessment and primary objective of this conceptual plan is to provide a list of potential wetland restoration and management opportunities to supplement management already in

progress by the Ottawa County Parks and Recreation staff and volunteers. Below are restoration and management recommendations for each of the identified and mapped wetlands and potential wetlands within the park. The current ecological community is listed, with the proposed restored ecological community italicized in parentheses. Figure 1 includes a map that depicts the location of each wetlands and potential wetland areas while Section 3.0 includes photographs of each mapped area.

1) Low Diversity Reclaimed Sand Mine (*Enhanced Vegetated Disturbed Dune Field*)

Previously, much of Ottawa Sands was an active sand mine which disturbed large areas and created variations in the upland topography and vegetation cover between the lake and the Grand River. Most of the disturbed sand dune habitat (Area 1) bordering the excavated lake have been reclaimed after the mining activity was discontinued. These areas now consist of semi-stable native plant communities with low-diversity assemblages of upland plants, such as Marram grass (*Ammophila brevifolia*), little bluestem (*Schizachyrium scoparium*), sand reed (*Calamovilfa longifolia*), and horse mint (*Monarda punctata*). A notable species, the Great Lakes endemic Pitcher's thistle (*Cirsium pitcheri*, federal/state threatened), has established in the sandy uplands adjacent to the lake. Other nearby sandy areas contain additional species such as common milkweed (*Asclepias syriaca*) and switchgrass (*Panicum virgatum*). The dominant native tree is cottonwood (*Populus deltoides*). Invasive species in this plant community include the herbs spotted knapweed (*Centaurea maculata*), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*), quack grass (*Elymus repens*) and white sweet clover (*Melilotus alba*). Invasive trees and shrubs include bush honeysuckle (*Lonicera* spp.), autumn olive (*Elaeagnus umbellata*), and tree of heaven (*Ailanthus altissima*).

This low-diversity upland community, characterized here as Disturbed Dune Field, holds potential for an enhanced ecological restoration with addition of select herbaceous, tree, and shrub species typically found in higher quality examples of the coastal sand ecosystems. Native herbs appropriate for dune restoration include: harebell (*Campanula rotundifolia*), Plains puccoon (*Lithospermum carolinense*), and silverweed (*Potentilla anserina*). Shrubs of sandy upland open dune systems for restoration include: shrubby cinquefoil (*Dasiphora fruticosa*), common juniper (*Juniperus communis*), and sand cherry (*Prunus pumila*), among others. The freshwater marsh and wet prairie plant communities should be established in the Disturbed Dune Field in order to create a gradient of wet to dry plant communities that can move upslope and downslope with lake level change and rainfall patterns.

Restoration and management recommendations for Area 1 (Enhanced Vegetated Disturbed Dune Field) are included below:

- Conduct tree and shrub thinning to reduce shading to upland dune habitat. This should be done during winter months to reduce negative impacts. Non-native trees and shrubs such as Siberian elm (*Ulmus pumila*) and Tatarian honeysuckle (*Lonicera tatarica*) should be targets for removal.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Establish fuel matrix and native plant diversity and begin to conduct occasional controlled burns depending on availability of sufficient amounts of herbaceous fuel.
- Create focal points for floral diversity by including shrub islands or other garden-like areas that can educate the public and provide wildlife habitat for birds, insects, and other animals.

2) Filled Lagoon A (*Reconstructed Dunal Wet Prairie – Emergent Marsh*)

Area 2 represents Filled Lagoon A, which occupies 4.86 acres adjacent to the east boundary of Ottawa Sands, south of the lake (Figure 1). Previously, these lagoons functioned as dunal wetlands during the active mining operations but were filled in during mine reclamation. These areas are currently low-diversity wetlands with upland buffers that could be reshaped in conjunction with the wetland restoration.

Filled Lagoon A (Area 2) is a high priority for restoration and management because of connection to higher quality areas, presence of established wetland vegetation, and relatively less difficult wetland restoration at this location. Specifically, the Wet Prairie and Emergent Marsh community can be constructed from pre-existing wetlands. Dominant native species at this site include: horsetail (*Equisetum arvense*), switch grass (*Panicum virgatum*), and arrowleaf (*Sagittaria latifolia*). Non-native dominants include: Canada thistle (*Cirsium arvense*), Kentucky bluegrass (*Poa pratensis*), and tall fescue (*Schedonorus arundinaceus*). Towards the deeper water giant reed (*Phragmites australis*) has been an invasive species of management attention. Adjacent uplands contain native groves of cotton wood (*Populus deltoides*), but also many invasive trees and shrubs. Restoration of this basin should include shallow excavations and scraping of the margins of existing wet meadows to establish a gradual slope from low to high ground, accommodating creating conditions for shallow Emergent Marsh to Wet Prairie to sandy upland habitats which will migrate up and down slope with lake level change and precipitation patterns. Appropriate native shrubs for reintroduction include red osier dogwood (*Cornus alba*) and meadowsweet (*Spiraea* spp.). Herbaceous species for wetland restoration include sweet flag (*Acorus americanus*), blue joint grass (*Calamagrostis canadensis*), sedges (*Carex* spp.), grass-leaved goldenrod (*Euthamia graminifolia*), blue flag iris (*Iris virginica*), arrowhead (*Sagittaria* spp.), wool-grass (*Scirpus cyperinus*), rough goldenrod (*Solidago rugosa*), and bur reed (*Sparganium* spp.), among others.

Restoration and management recommendations for Area 2 (Reconstructed Dunal Wet Prairie-Emergent Marsh) are included below:

- Excavate and regrade topography to create the Dunal Wet Prairie – Emergent Marsh with broad gently-sloped transition areas to adjacent uplands.
- Invasive shrub removal and tree thinning in uplands to reduce shading to the understory. This should be done in conjunction with work in the adjacent wetland restoration. Non-native trees and shrubs such as black locust (*Robinia pseudo-acaica*) and tree of heaven (*Ailanthus altissima*) should be targets for removal. Cottonwood should also be thinned to create open habitats.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Restore herbaceous Wet Prairie communities with seeds and Emergent Marsh with plugs.
- Conduct controlled burns to enhance wet prairie establishment and occasionally afterwards depending on the amount of herbaceous fuel available.
- Plant additional young trees to eventually replace the older ones. Native shrubs can also provide cover for bird habitats.

3) Southern Wet Meadow - Shrub-Carr (*Enhanced Southern Wet Meadow - Shrub-Carr*) Riverine Emergent Marsh (*Enhanced Riverine Emergent Marsh*)

The Sag on the Grand River is a natural focal point of the Ottawa Sands wetland restoration, due to the historic quality of the Emergent Marsh community and unique features that could allow public interpretation and/or recreation opportunities (canoe launch, etc.). On the Sag's northern extent, a small pocket of Southern Sedge Meadow – Southern Shrub-Carr (0.86 acres) exists in the transition zone to the Riverine Emergent Marsh zone (1.62 acres) (Figure 1). Southeast facing slopes and an abrupt upland transition to Dry-Mesic and Mesic Northern Forest creates deeply shaded shoreline habitats and has led to suppression of shoreline wetland buffers. Currently, the Sedge Meadow/Shrub-Carr portion of the Sag (North) is dominated by porcupine sedge (*Carex hystrixina*), hop sedge (*Carex lupulina*), tussock sedge (*Carex stricta*), witch hazel (*Hamamelis virginiana*), and spicebush (*Lindera benzoin*). The Emergent Marsh is currently dominated by blue joint grass (*Calamagrostis canadensis*), lake sedge (*Carex lacustris*), arrowhead (*Sagittaria latifolia*), and in deeper water, water lily (*Nymphaea odorata*), etc.

This Sedge Meadow/Shrub-Carr and Emergent Marsh complex can be enhanced by managing the upland buffers to allow light to reach shoreline vegetation. By thinning the midstory shrubs and saplings, the herbaceous layer will be allowed to respond with increased growth of grasses and sedges, as well as wetland wildflowers that will benefit pollinators and other wildlife. The adjacent Dry-Mesic Northern Forest communities could function as an open woodland. Black cherry (*Prunus serotina*) and sassafras (*Sassafras albidum*) can be dense in the subcanopy and reach the canopy, suppressing understory plants. These are the target species for removal (after any non-native species are removed), as well as maple (*Acer* spp.). Invasive species that occur in the Southern Sedge Meadow - Shrub-Carr and Riverine Emergent Marsh complex are reed canary grass (*Phalaris arundinacea*) and narrow-leaved cattail (*Typha angustifolia*).

Restoration and management recommendations for Area 3 (Enhanced Southern Wet Meadow/Shrub-Carr and Riverine Emergent Marsh) are included below:

- Invasive shrub removal and understory tree thinning to reduce shading of seed bank and herbaceous plants. This should be done during winter months to reduce soil disturbance.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Seed upland buffer with dry-mesic woodland mixture in late fall or spring following one growing season of woody re-sprout treatments and remove weeds.
- Enhance the Sedge Meadow/Shrub-Carr with additional plugs. Monitor and remove weeds in the Sedge Meadow and Emergent Marsh zones.

4) Southern Hardwood Swamp (*Enhanced Southern Hardwood Swamp*)

Area 4 represents a series of wetland depressions within the Dry-Mesic Northern Forest and the opportunity for an Enhanced Southern Hardwood Swamp. Currently, these wetlands are shaded by the abundance of red oak (*Quercus rubra*) but still contain swamp forest indicator trees such as red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*). Herbaceous indicators remain but are currently suppressed due to the deep shade. Fringed sedge (*Carex crinita*) and blue flag iris (*Iris virginica*) were observed persisting in these wetland pockets. The invasive species that dominate this habitat include tree of heaven (*Ailanthus altissima*) and garlic mustard (*Alliaria petiolata*).

To enhance the Southern Hardwood Swamp components of the Dry-Mesic Northern Forest unit, midstory canopy thinning should be used to promote increased light levels for herbaceous layer restoration and to develop an emergent marsh component to these wetland depressions. Red oak is the most abundant tree, thus this species will be the primary tree for removal, but other species such as sugar maple could also be thinned with a selective cutting of certain low-diameter size classes. Buttonbush (*Cephalanthus occidentalis*) is a characteristic shrub of this habitat but is currently missing or in very diminished presence. Buttonbush as well as other wetland shrubs could be planted along with suitable herbaceous wetland species. These wetland depressions are suitable habitat for Fowler's toad and can be part of an integrated effort to create additional enhanced habitat for this rare amphibian.

Restoration and management recommendations for Area 4 (Enhanced Southern Hardwood Swamp) are included below:

- Start invasive shrub removal and understory tree thinning to reduce shading to seed bank and herbaceous plants. This should be done during winter months to reduce negative impacts. Tree-of-heaven (*Ailanthus altissima*) is a primary focus for invasive species removal in this area.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.

- Seed upland buffers with dry-mesic woodland mixture in late fall or spring following one growing season of woody re-sprout treatments and spot herbicide of weeds.
- Plant additional wetland tree, shrub, and herbaceous species to increase floral diversity. Focus on wetland margins to create transition zones between the uplands and wetlands.

5) Disturbed Wet Swale (*Enhanced Southern Wet Meadow and Shrub-Carr*)

A small wet swale (0.10 acres) was identified just west of the entrance road in an area where the Dry-Mesic Northern Forest is transitioning to the previously mined Disturbed Dune habitat. Currently the wetland has an open canopy of red oak (*Quercus rubra*) sassafras (*Sassafras albidum*), and cottonwood (*Populus deltoides*) and an herbaceous layer dominated by non-native grasses such as Kentucky bluegrass (*Poa pratensis*) and meadow fescue (*Schedonorus pratensis*). The wetland swale does support a few wetland obligate species, such as blue flag (*Iris virginica*) and rush (*Juncus* spp.). Barberry (*Berberis thunbergii*) is a prevalent invasive shrub at this site and will need to be removed during restoration.

This wetland could be restored to a Southern Wet Meadow and Shrub-Carr community with greater floral diversity. Shrubs that could be added to this site include: dogwood (*Cornus* spp.), hazelnut (*Corylus americana*), winterberry holly (*Ilex verticillata*), gooseberry (*Ribes* spp.), meadowsweet (*Spiraea* spp.), etc. Restoration could also include herbaceous species of the Southern Wet Meadow such as swamp milkweed (*Asclepias incarnata*), tussock sedge (*Carex stricta*), Virginia mountain mint (*Pycnanthemum virginianum*), swamp goldenrod (*Solidago patula*), purple meadow rue (*Thalictrum dasycarpum*), and golden alexanders (*Zizia aurea*).

Restoration and management recommendations for Area 5 (*Enhanced Southern Wet Meadow and Shrub-Carr*) are included below:

- Plant additional tree and shrub species to increase floral diversity. Focus on wetland margins to create transition zones between the uplands and wetlands.
- Remove invasive cool season grasses and other weeds and plant seeds and plugs of native wetland species to restore and enhance herbaceous layer.
- Cut/herbicide invasive trees/shrubs and woody re-sprouts and spot herbicide herbaceous weeds during first growing season.

6) Low Diversity Riverine Emergent Marsh (*Enhanced Riverine Emergent Marsh*) Low Diversity Southern Wet Meadow (*Enhanced Southern Wet Meadow*)

This wetland restoration (Area 6) focuses on the Sag's shoreline and adjacent buffers (0.93 acres) from the office building, south to the main channel of the Grand River. Currently, the Emergent Marsh remains with a low-diversity mix of wetland species such as lake sedge (*Carex lacustris*), broadleaf arrowhead (*Sagittaria latifolia*), and broadleaf cattail (*Typha latifolia*). The upland buffer of this community contains red oak (*Quercus rubra*) and sugar maple (*Acer saccharum*) as well as cottonwood (*Populus deltoides*). Invasive brush, primarily Tatarian honeysuckle (*Lonicera tatarica*), was a dominant component of the upland shoreline, but recent restoration efforts have removed most of the largest shrubs.

The degraded Emergent Marsh is high priority for restoration and management because it still maintains many conservative plant species that require more sunlight to prosper and become sustainable. This southern portion of the Sag-Emergent Marsh complex can be enhanced by managing the upland buffers by restoring the Dry-Mesic Northern Forest components. Sugar maple (*Acer saccharum*), black cherry (*Prunus serotina*), cottonwood (*Populus deltoides*), red oak (*Quercus rubra*), can be over abundant in the midstory canopy and suppress the understory. Thinning small diameter saplings will allow the canopy trees to further dominate the area and allow herbaceous and shrub zone restoration. Other invasive species that occur in the Riverine Emergent Marsh complex are reed canary grass (*Phalaris arundinacea*) and narrow-leaved cattail (*Typha angustifolia*).

Restoration and management recommendations for Area 6 (Enhanced Riverine Emergent Marsh – Southern Wet Meadow) are included below:

- Shallow excavation of the shoreline behind the office could create a small sedge meadow.
- Conduct tree and shrub thinning to reduce shading to the shoreline understory. This should be done during winter months to reduce negative impacts. Prioritize removal of invasive species.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Enhance floral diversity with native shrubs and herbaceous species.

7) Low Diversity Riverine Emergent Marsh (*Enhanced Riverine Emergent Marsh*) Degraded Southern Wet Meadow (*Enhanced Southern Wet Meadow*)

Area 7 focuses on the Sag's adjacent wetland buffers (0.93 acres) towards the southern terminus of the Sag inlet and near where the Sag meets the Grand River. Currently, the area contains an old field and degraded sedge meadow with wetland species such as blue joint grass (*Calamagrostis canadensis*), lake sedge (*Carex lacustris*), tussock sedge (*Carex stricta*), and germander (*Teucrium canadense*). The old field component, which was essentially a mowed lawn is now dominated by Kentucky bluegrass (*Poa pratensis*) and other species that withstand degradation, such as common milkweed (*Asclepias syriaca*). Invasive brush, primarily Tatarian honeysuckle (*Lonicera tatarica*), was a dominant component of the upland shoreline, but recent restoration efforts have removed most of the largest shrubs. The emergent marsh portion is found just off shore and has a significant shrub component of willow (*Salix spp.*) and dogwood (*Cornus spp.*). The tree canopy is dominated by cottonwood (*Populus deltoides*). This area is high priority for restoration and management because of the low gradient shoreline slope that allows for water fluctuations to shape the wetland plant communities. Other invasive species that occur in the Riverine Emergent Marsh complex are reed canary grass (*Phalaris arundinacea*) and narrow-leaved cattail (*Typha angustifolia*).

Potential is high for restoration of this unique area to develop an enhanced Riverine Emergent Marsh and expanded Southern Wet Meadow. Minimal regrading of spoil piles along the shoreline and thinning of cottonwood could reshape the wetland transition zone. Wetland plantings could enhance this area into a beautiful expanse of sedges and species such as blue flag iris (*Iris virginica*) to stabilize the community and increase ecological function. A wide range of wetland species should be used to form a broad palette for restoration potential that can respond and adapt to water level fluctuations through time.

Restoration and management recommendations for Area 7 (Enhanced Riverine Emergent Marsh – Southern Wet Meadow) are included below:

- Conduct tree and shrub thinning to reduce shading to the shoreline understory. This should be done during winter months to reduce negative impacts.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Enhance floral diversity with native shrubs and herbaceous species.

8) Filled Lagoon B (*Reconstructed Dunal Wet Prairie – Emergent Marsh*)

Filled Lagoon B (Area 8) occupies 1.71 acres adjacent to the southern terminus of the Sag. The site is a shallow wetland grading to a deeper pool to the west. At Ottawa Sands, these areas were artificially created as wetlands during the active mining operations but were filled in during mine reclamation.

These areas are currently low-diversity wetlands with upland buffers that could be reshaped to create a Dunal Wet Prairie-Emergent Marsh restoration.

The Filled Lagoon B is a high priority for restoration and management because of connection higher quality areas, presence of established wetland vegetation, and relatively less difficult restoration at this location. Specifically, the Wet Prairie and Emergent Marsh community can be constructed from existing wetlands. Dominant native species at this site include: horsetail (*Equisetum arvense*), switch grass (*Panicum virgatum*), and arrowleaf (*Sagittaria latifolia*). Non-native dominants include: Canada thistle (*Cirsium arvense*), Kentucky bluegrass (*Poa pratensis*), and tall fescue (*Schedonorus arundinaceus*). Towards the deeper water giant reed (*Phragmites australis*) has been an invasive species of management attention. Adjacent uplands contain native groves of cottonwood (*Populus deltoides*). Restoration of this basin should include shallow excavations and scraping of the existing wet meadows to regrade the upland transition zones to create gradual transitions allowing for fluctuating water levels to create a mix of shallow Emergent Marsh to Wet Prairie that transition to sandy upland habitats. Appropriate native plants for reintroductions include: swamp milkweed (*Asclepias incarnata*), bluejoint grass (*Calamagrostis canadensis*), sedges (*Carex stricta*, *Carex pellita*, and *C. aquatilis*), red osier dogwood (*Cornus alba*), cordgrass (*Spartina pectinata*), Baltic rush (*Juncus balticus*), twig-rush (*Cladium mariscoides*), and tag alder (*Alnus rugosa*).

Restoration and management recommendations for Area 8 (Reconstructed Dunal Wet Prairie – Emergent Marsh) are included below:

- Excavate and regrade to create the Dunal Wet Prairie – Emergent Marsh with broad tapered transition areas to adjacent uplands.
- Restore herbaceous Emergent Marsh and Wet Prairie communities with plugs and/or seed.
- Begin conducting controlled burns every two to three years on average depending on the amount of herbaceous fuel available. Burns will be more successful if conducted in late fall.
- Native shrubs should be used to enhance floral diversity, such as cover for bird habitats.

9) Disturbed Dunal Wetland (*Enhanced Dunal Wet Prairie – Emergent Marsh*)

Wetland area of Area 9 occupies 1.54 acres just east and connected to the lake. The site is an emergent wetland created by high water levels and between low ridges in the Disturbed Dune Field. Currently, a low-diversity wetland with upland buffers containing Pitcher's thistle (*Cirsium pitcheri*) that could be reshaped to create a Dunal Wet Prairie-Emergent Marsh restoration zones.

Area 9 is a high priority for restoration and management because of connection to the lake, presence of established wetland vegetation, and relatively less difficult restoration at this location. Specifically, the Wet Prairie and Emergent Marsh community can be constructed from pre-existing wetlands. Dominant native species at this site include American squarestem (*Juncus acutus*) and willow (*Salix* spp.). Another non-native dominant observed was reed canary grass (*Phalaris arundinacea*). Towards the lake, giant reed (*Phragmites australis*) was observed with a few inundated stems. Adjacent uplands contain native warm season grasses such as Marram grass (*Ammophila breviligulata*) and little bluestem (*Schizachyrium scoparium*). Restoration of this basin should include shallow excavations in adjacent uplands, primarily to the east and south, to create gradual transitions allowing for fluctuating water levels and development of a shallow Emergent Marsh to Wet Prairie. Appropriate native plants for reintroductions include: swamp milkweed (*Asclepias incarnata*), bluejoint grass (*Calamagrostis canadensis*), sedges (*Carex stricta*, *Carex pellita*, and *C. aquatilis*), red osier dogwood (*Cornus alba*), cordgrass (*Spartina pectinata*), Baltic rush (*Juncus balticus*), twig-rush (*Cladium mariscoides*), and shrubby cinquefoil (*Dasiphora fruticosa*).

Restoration and management recommendations for Area 9 (Enhanced Dunal Wet Prairie-Emergent Marsh) included below:

- Excavate and regrade to create the Dunal Wet Prairie – Emergent Marsh with broad tapered transition areas to adjacent uplands, possibly connecting to Area 13 and 14.
- Restore herbaceous species of Emergent Marsh with plugs and Wet Prairie with seed.
- Begin conducting controlled burns every two to three years on average depending on the amount of herbaceous fuel available. Burns will be more successful if conducted in late fall.
- Native shrubs should be used to enhance floral diversity, such as cover for bird habitats.

10) Low Diversity Dunal Emergent Marsh (*Restored Dunal Emergent Marsh*)

Area 10 is a wetland area of 6.32 acres along the east and south littoral shelf connected to the excavated lake. The wetland consists of shallow depressions and lake margins in the floodplain of the excavated lake, inundated when rain levels or prevailing winds allow water to encroach upon the shoreline. Currently, a low-diversity wetland with a few wetland indicators is present and could be reshaped to create gradual slopes and a shallow Dunal Emergent Marsh restoration zone. The north half of the lake is composed of steeper shorelines but should be considered and further assessed for wetland habitat enhancements for shorebirds and secretive marsh birds. In addition, floating islands could be installed to provide nesting habitat..

Area 10 could be incorporated into the Area 9 concept for restoration and management because of connection to the lake and contiguous upland buffer connecting these two areas. Dominant native species at this site include: American squarestem (*Juncus acutus*) and willow (*Salix* spp.). A non-native dominant was also observed: reed canary grass (*Phalaris arundinacea*). Towards the lake, giant reed (*Phragmites australis*) was observed with a few inundated stems. Adjacent uplands contain native warm season grasses such as Marram grass (*Ammophila breviligulata*) and little bluestem (*Schizachyrium scoparium*). Restoration of this emergent shoreline should include shallow excavations in adjacent uplands, primarily to the east and south, to create gentle slopes and promote the development of a shallow Emergent Marsh to Wet Prairie gradient that would move up and down slope with lake level changes and precipitation patterns. Appropriate native plants for reintroductions include: swamp milkweed (*Asclepias incarnata*), bluejoint grass (*Calamagrostis canadensis*), sedges (*Carex stricta*, *Carex pellita*, and *C. aquatilis*), red osier dogwood (*Cornus alba*), cordgrass (*Spartina pectinata*), Baltic rush (*Juncus balticus*), twig-rush (*Cladium mariscoides*), and shrubby cinquefoil (*Dasiphora fruticosa*).

Restoration and management recommendations for Area 10 (Restored Dunal Emergent Marsh) are included below:

- Excavate and regrade to create the Dunal Wet Prairie – Emergent Marsh with broad tapered transition areas to adjacent uplands.
- Restore herbaceous Emergent Marsh and Wet Prairie communities with plugs and/or seed.
- Native shrubs should be used to enhance floral diversity, such as cover for bird habitats.

11) Disturbed Dunal Depression (*Reconstructed Dunal Wet Prairie – Emergent Marsh*)

As a part of the Disturbed Dune Field, Area 11 consists of a sandy dunal swale with an area of 0.66 acres. Previously, this area was part of the active mining operation and was reclaimed and stabilized. The swale is closely associated with adjacent uplands on steep to moderate slopes and together form a unit for restoration in the larger basin. This depression has very few wetland species and was dominated by Kentucky bluegrass (*Poa pratensis*), but swamp milkweed (*Asclepias incarnata*) was observed on the margin of the pond and a few frogs were also observed inhabiting the wetland. Tatarian honeysuckle (*Lonicera tatarica*) was the dominant invasive shrub. Little bluestem (*Schizachyrium scoparium*) and horse mint (*Monarda punctata*) were dominant natives on the upland slopes.

Restoration and management recommendations for Area 11 (Reconstructed Dunal Wet Prairie – Emergent Marsh) are included below:

- Excavate and regrade to create the Dunal Wet Prairie – Emergent Marsh with broad tapered transition areas to adjacent uplands.
- Restore herbaceous Emergent Marsh and Wet Prairie communities with plugs and/or seed.
- Native shrubs should be used to enhance floral diversity, such as cover for bird habitats.

12) Low Diversity Floodplain Forest (*Enhanced Floodplain Forest*)

Area 12 is small wetland depression found west of the lake with an area of 0.18 acres and within the Mesic Northern Forest. The opportunity for an Enhanced Floodplain Forest restoration is apparent by the high-diversity of small trees and shrubs in the understory. Currently, these wetlands are shaded by the abundance of red oak (*Quercus rubra*) but still contain forest indicator trees such as white pine (*Pinus strobus*) and northern white cedar (*Thuja occidentalis*). Shrubs such as serviceberry (*Amelanchier* sp.), pagoda dogwood (*Cornus alternifolia*), and choke cherry (*Prunus virginiana*) lend diversity to this shady wetland habitat. Herbaceous indicators remain, being suppressed due to the deep shade. *Carex* and *Muhlenbergia* species were observed in the herbaceous layer, indicating that restoration of the herb layer containing a graminoid component is possible. Few invasive species were dominant plants in this habitat, but Kentucky bluegrass (*Poa pratensis*) was observed.

To enhance the Floodplain Forest components of this wetland as part of the Mesic Northern Forest unit, midstory canopy thinning should be used to promote increased light levels for herbaceous layer restoration and to develop an emergent marsh component to this wetland depressions. Red oak will be the primary species for removal, but other species such as sugar maple could also be thinned with a selective cutting of certain low-diameter size classes.

Restoration and management recommendations for Area 12 (Enhanced Floodplain Forest) are included below:

- Start invasive shrub removal and tree thinning to reduce shading to seed bank and understory plants. This should be done during winter months to reduce negative impacts.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Seed community with dry-mesic woodland mixture in late fall or spring following one growing season of woody re-sprout treatments and spot herbicide of weeds.
- Plant additional native wetland tree, shrub, and herbaceous species to increase floral and structural diversity. Focus on wetland margins to create transition zones between the uplands and wetlands.

13) Disturbed Dunal Wet Depression (*Dunal Wet Prairie – Emergent Marsh*)

As a part of the Disturbed Dune Field east of the lake, Area 13 consists of a sandy wet swale with an area of 0.30 acres. Previously, this area was part of the active mining operation and was reclaimed and stabilized. The swale has gentle to moderate slopes that form a unit for restoration. This wetland basin has very few wetland indicators, but rushes (*Juncus* spp.) and willows (*Salix* spp.) were observed inhabiting the wetland. Kentucky bluegrass (*Poa pratensis*) was observed invading the wetland. Tatarian honeysuckle (*Lonicera tatarica*) was the dominant invasive shrub. Little bluestem (*Scizachyrium scoparium*) and horse mint (*Monarda punctata*) were dominant natives of the upland.

Restoration and management recommendations for Area 13 (Dunal Wet Prairie – Emergent Marsh) are included below:

- Excavate and regrade to create the Dunal Wet Prairie – Emergent Marsh with broad tapered transition areas to adjacent uplands.
- Restore herbaceous Emergent Marsh and Wet Prairie communities with plugs and/or seed.
- Native shrubs should be used to enhance floral diversity, such as cover for bird habitats.

14) Disturbed Dunal Wet Depression (*Reconstructed Dunal Wet Prairie – Emergent Marsh*)

As a part of the Disturbed Dune Field, Area 14 consists of a sandy wet swale, which currently serves as a trail just east of the lake, with an area of 0.30 acres. The swale is closely associated with the lake shoreline. This wetland basin has very few wetland indicators, but sandbar willow (*Salix interior*) and horsetail (*Equisetum hyemale*) were observed inhabiting the wetland. Spotted knapweed (*Centaurea maculata*) was observed invading the upland area. Little bluestem (*Schizachyrium scoparium*) and switchgrass (*Panicum virgatum*) were dominant natives of the upland.

Wetland Area 14 could be deepened and enlarged by shallow excavation to create gradual slopes allowing Wet Prairie and Emergent Marsh vegetation to establish and fluctuate with the water levels. This restored wetland could be combined with either Area 13 and/or Area 9 to create a larger dunal wetland complex.

Restoration and management recommendations for Area 14 (Reconstructed Dunal Wet Prairie – emergent Marsh) are included below:

- Excavate and regrade to create the Dunal Wet Prairie – Emergent Marsh with broad tapered transition areas to adjacent uplands.
- Restore herbaceous Emergent Marsh and Wet Prairie communities with plugs and/or seed.
- Native shrubs should be used to enhance floral diversity, such as cover for bird habitats.

15) Southern Hardwood Swamp (*Enhanced Southern Hardwood Swamp*)

Area 15 is a wetland depression on the border of the Disturbed Dune Field and within the Dry-Mesic Northern Forest represents the opportunity for an Enhanced Southern Hardwood Swamp. Currently, these wetlands are shaded by saplings and canopy trees such as sugar maple (*Acer saccharum*) and black cherry (*Prunus serotina*) but still contain swamp forest indicator trees such as red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*). Witch hazel (*Hamamelis virginiana*) and ironwood (*Ostrya virginiana*) are characteristic of this habitat. Herbaceous indicators are blue joint grass (*Calamagrostis canadensis*), sedges (*Carex leptoneura*, *Carex radiata*), and blue flag iris (*Iris virginica*). Blue flag iris was particularly abundant in this wetland pocket due to open canopy allowing light to permit vegetation to thrive. The invasive species that dominate this habitat include tree of heaven (*Ailanthus altissima*), barberry (*Berberis thunbergii*), and garlic mustard (*Alliaria petiolata*).

To enhance the Southern Hardwood Swamp components of the Dry-Mesic Northern Forest unit, canopy thinning should be used to promote increased light levels for herbaceous layer restoration and to develop an emergent marsh component to this wetland depressions. Shrubs will be the primary species for removal, including barberry (*Berberis thunbergii*) and non-native rose (*Rosa* sp.) but other species such as a sugar maple could also be thinned with a selective cutting of certain low-diameter size classes.

Restoration and management recommendations for Area 15 (Enhanced Southern Hardwood Swamp) are included below:

- Start invasive shrub removal and understory tree thinning to reduce shading of seed bank and understory plants. This should be done during winter months to reduce negative impacts.

- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Seed community with dry-mesic woodland mixture in late fall or spring following one growing season of woody re-sprout treatments and spot herbiciding weeds.
- Plant additional native wetland tree, shrub, and herbaceous species to increase floral and habitat diversity. Focus on wetland margins to create transition zones between the uplands and wetlands.

16) Degraded Southern Hardwood Swamp (*Enhanced Southern Hardwood Swamp*)

Area 16 is a wetland depression in the disturbed transition area of the Disturbed Dune Field and represents the opportunity for an Enhanced Southern Hardwood Swamp. Currently, these wetlands are relatively open and shaded by saplings and canopy trees such boxelder maple (*Acer negundo*), quaking aspen (*Populus tremuloides*), and cottonwood (*Populus deltoides*) but still contain swamp forest indicator trees such as black ash (*Fraxinus nigra*). Herbaceous indicators are water plantain (*Alisma subcordata*), blue joint grass (*Calamagrostis canadensis*), and germander (*Teucrium canadense*). The invasive species that dominate this habitat include barberry (*Berberis thunbergii*) and Tatarian honeysuckle (*Lonicera tatarica*).

To enhance the Southern Hardwood Swamp components of Area 16, woody understory removal and selective canopy thinning should be used to promote space for further wetland plantings. Shrubs for removal will be barberry and Tatarian honeysuckle. Tree species such as cottonwood and boxelder maple could also be thinned with a selective cutting of canopy and/or certain low-diameter size classes. Green ash (*Fraxinus pensylvanica*) should be removed due to susceptibility to emerald ash borer infestations and death. Buttonbush (*Cephalanthus occidentalis*) and winterberry holly (*Ilex verticillata*) are characteristic shrubs suitable for reintroduction in this habitat.

Restoration and management recommendations for Area 16 (Enhanced Southern Hardwood Swamp) are included below:

- Start invasive shrub removal and subcanopy woody plant removal and selective tree thinning to reduce shading of seed bank and understory plants. This should be done during winter months to reduce negative impacts.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Seed upland buffers with dry-mesic woodland mixture in late fall or spring following one growing season of woody re-sprout treatments and spot herbicide of weeds.
- Plant additional native wetland tree, shrub, and herbaceous species to increase floral and habitat diversity. Focus on wetland margins to create transition zones between the uplands and wetlands.

17) Moderate Diversity Emergent Marsh (*Enhanced Emergent Marsh*)

Area 17 is a wetland (2.20 acres) of an inlet on the Grand River shoreline and adjacent to the high dunes. Currently, the emergent marsh remains stable with a moderate diversity of wetland species such as wooly sedge (*Carex pellita*), lake sedge (*Carex lacustris*), tussock sedge (*Carex stricta*), blue flag (*Iris virginica*). Buttonbush (*Cephalanthus occidentalis*) is a prevalent wetland shrub in this community and black willow (*Salix nigra*) forms a tree component. The upland buffer of this community contains jack pine (*Pinus banksiana*), black cherry (*Prunus serotina*), red oak (*Quercus rubra*) and basswood (*Tilia americana*) as well as cottonwood (*Populus deltoides*). Invasive brush, primarily Tatarian honeysuckle (*Lonicera tatarica*), was a dominant component of the upland shoreline.

This emergent marsh is medium priority for restoration and management because it still maintains many conservative plant species that require more sunlight to prosper and become sustainable. This

southern portion of Ottawa Sands can be improved by managing the Emergent Marsh and enhancing upland buffers by resorting the Dry-Mesic Northern Forest components. Black cherry (*Prunus serotina*), red oak (*Quercus rubra*), basswood (*Tilia americana*) can be create dense shade when growing in the canopy, subcanopy and shrub layers, which suppresses the understory. Thinning small diameter understory trees will allow the canopy trees to continue dominating the area without opening the community to invasive plants; this will also allow herbaceous plant and shrub restoration. Other invasive species to be removed are purple loosestrife (*Lythrum salicaria*) reed canary grass (*Phalaris arundinacea*) and green ash (*Fraxinus pensylvanica*).

Restoration and management recommendations for Area 17 (Enhanced Emergent Marsh) are included below:

- Conduct subcanopy tree and shrub thinning to reduce shading to the shoreline understory. This should be done during winter months to reduce negative impacts.
- Cut/herbicide woody re-sprouts and spot herbicide herbaceous weeds during first growing season following brush & tree removal.
- Enhance structural and floral diversity by installing native shrubs and herbaceous species.

18) Degraded Flooded Southern Mesic Forest (*Enhanced Southern Hardwood Swamp*)

Area 18 is a 1.21 acre wetland depression within the Mesic Northern Forest and Open Dunes which represents an opportunity for re-toration of Enhanced Southern Hardwood Swamp. Currently, this wetland is very low in plant diversity and in a transition period as this newly flooded upland plant community shifts to wetland conditions. Previously, abundance was high of red oak (*Quercus rubra*), black cherry (*Prunus serotina*), basswood (*Tilia americana*). Most of the canopy is now dead, but still contains a few trees of red oak and ironwood (*Ostrya virginiana*). The dominant invasive species in the shrub layer is barberry (*Berberis thunbergii*).

To enhance the Southern Harwood Swamp, plantings to develop an emergent marsh and forested wetland plant community should allow for wetland restoration in this unique situation. Buttonbush (*Cephalanthus occidentalis*) and winterberry holly (*Ilex verticillata*) are characteristic shrubs that are suitable in this habitat. Suitable herbaceous species include fringed sedge (*Carex crinita*) and blue flag iris (*Iris virginica*) that thrive in these forested wetland pockets.

Restoration and management recommendations for Area 18 (Enhanced Southern Hardwood Swamp) are included below:

- Following woody plant removal, continue with one growing season of woody re-sprout treatments and spot herbicide of herbaceous weeds.
- Plant wetland community with a diverse mixture of wetland trees, shrubs, and herbs in late fall or spring.

References

Kost, M.A.; Albert, D.A.; Cohen, J.G; Slaughter, B.S.; Schillo, R.K.; Weber, C.R.; Chapman, K.A. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report Number 2001-21, Lansing, MI 314 pp.

4.0 SITE PHOTOGRAPHS

Area 1 (see Figure 1 for locations)

* Note Upland composed of Disturbed Dune Fields.
East and west flanks of lake and larger area south of lake.



Area 2 (see Figure 1 for locations)

* Notes: Filled Lagoon in Disturbed Dune Field adjacent to Open Dunes.
Reconstruct Dunal Wet Prairie – Emergent Marsh



Area 3 (see Figure 1 for locations)

* Notes: Shoreline of the Sag (North), Emergent Marsh and Sedge Meadow inlets.
Enhanced Southern Wet Meadow, Southern Shrub-Carr



Photo 2 – Sedge Meadow



Area 4 (see Figure 1 for photo locations)

* Notes: Wet Depressions within Dry-Mesic Northern Forest adjacent to entrance road.
Enhanced Southern Hardwood Swamp



Photo 2



Area 5 (see Figure 1 for photo locations)

* Notes: Wet Swale/Drainage Ditch adjacent to the Sag and entrance road.
Enhanced Southern Wet Meadow – Shrub-Carr



Area 6 (see Figure 1 for locations)

* Notes: Shoreline and Emergent Marsh of Southern portion of the Sag of Grand River.
Enhanced Riverine Emergent Marsh, Restored and Expanded Southern Wet Meadow



Area 7 (see Figure 1 for locations)

* Notes: Wet Meadow/Old Field adjacent to the Sag of Grand River.
Restored and Enhanced Riverine Emergent Marsh, Restored Southern Wet Meadow



Area 8 (see Figure 1 for locations)

* Notes: Filled Lagoon near the Sag of Grand River.
Reconstruct Dunal Wet Prairie – Emergent Marsh



Area 9 (see Figure 1 for locations)

* Notes: Inter-dunal Swale adjacent to lake.
Enhanced Dunal Wet Prairie – Emergent Marsh



Area 10 (see Figure 1 for locations)

* Notes: Lake shoreline Littoral Shelf.
Restored Dunal Emergent Marsh



Area 11 (see Figure 1 for locations)

* Notes: Wet Depression within Disturbed Dune Field.
Reconstruct Dunal Wet Prairie – Emergent Marsh



Area 12 (see Figure 1 for locations)

* Notes: Wet Depression between Open Dunes, Mesic Northern Forest, and Lake.
Enhanced Floodplain Forest



Area 13 (see Figure 1 for locations)

* Notes: Wet Depression in Disturbed Dune Field.
Reconstruct Dunal Wet Prairie – Emergent Marsh



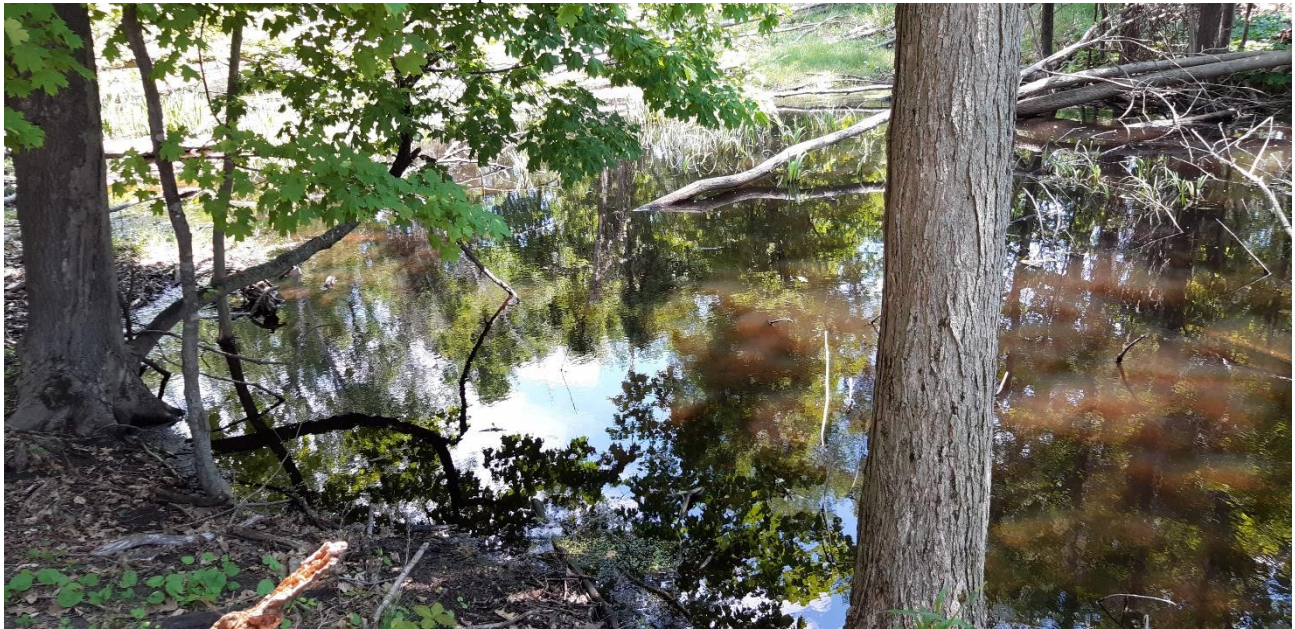
Area 14 (see Figure 1 for locations)

* Notes: Linear Swale adjacent to excavated lake shoreline.
Reconstruct Dunal Wet Prairie – Emergent Marsh



Area 15 (see Figure 1 for locations)

* Notes: Wet Depression in Dry-Mesic Northern Forest.
Enhanced Southern Hardwood Swamp



Area 16 (see Figure 1 for locations)

* Notes: Wet Depression in transition between Disturbed Dune Field and Dry-Mesic Northern Forest
Enhanced Southern Hardwood Swamp



Area 17 (see Figure 1 for locations)

* Notes: Emergent Marsh inlet adjacent to the Grand River.
Enhanced Emergent Marsh



Area 18 (see Figure 1 for locations)

* Notes: Wet depression between Open Dunes and Northern Mesic Forest.
Enhanced Southern Hardwood Swamp



