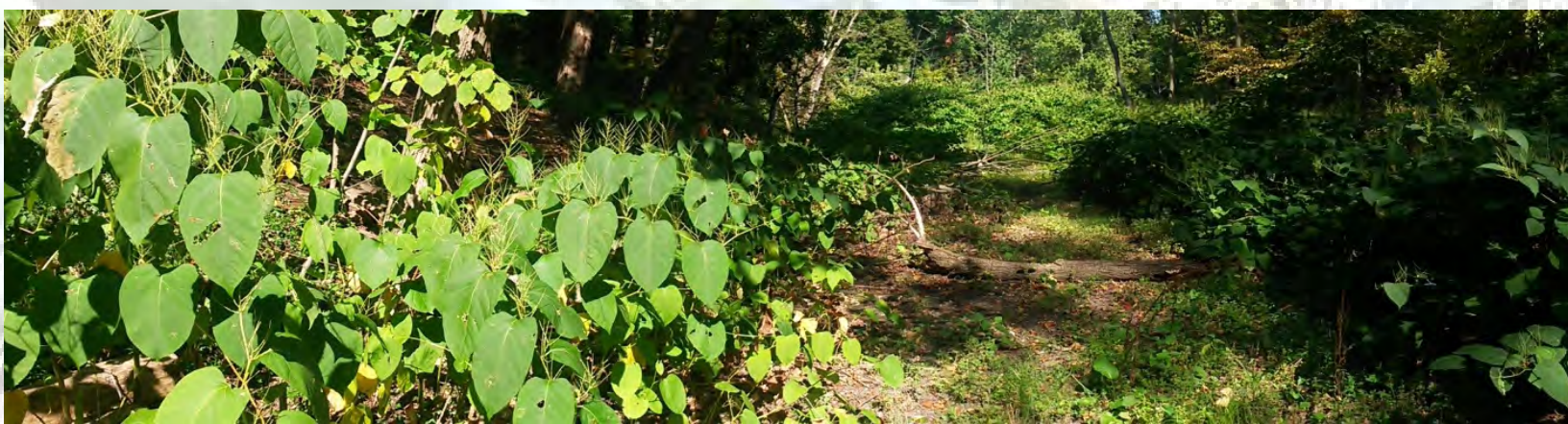


**INVASIVE PLANT MANAGEMENT PLAN
FOR
THE CITY OF ST. JOSEPH, MICHIGAN
2015 - 2020**



MAY 10, 2015

**INVASIVE PLANT MANAGEMENT PLAN
FOR
THE CITY OF ST. JOSEPH, MICHIGAN**

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I. INTRODUCTION

Invasive species, which include plant, animal, and disease organisms, pose significant threats to the functioning of native ecosystems as well to the human built environment and economy. Invasives are defined in law as species that are non-native (i.e., alien) to the ecosystem under consideration and whose presence is likely to cause negative effects on the environment, economy, or human health (Federal Register 1999). Our globally-connected world means, among other things, that the potential for new invasive species is increasing every year. It is certainly a problem that governments, non-profits, and citizens cannot afford to ignore. It is the problem of invasive plant species that is the focus of this plan.

The movement of plant species from place to place is nothing new. Indigenous peoples brought with them their medicinals, ceremonials, and food plants, effectively expanding original ranges. European settlers did the same. Still today, non-native (or alien) plant species are promoted for use as new food and fiber plants or as landscaping ornamentals. In fact, it is not uncommon to find a plant that is classified as an invasive simultaneously offered for sale by a nursery. In the past, many of our future invasives were touted as the next best thing for wildlife habitat or erosion control (e.g., multiflora rose, Russian olive, buckthorn, reed canary grass, and many others). In addition, there is inadvertent transport of plant propagules (seeds and roots and rhizomes) by a wide variety of means ranging from tires and treads of heavy equipment to the soles of hiker's boots. The prevalence of invasive plant species such as purple loosestrife along roadside ditches is testimony to the efficacy of heavy equipment as potential invasive species vectors.

Invasive plant species are no respecters of property lines; they are found on public and private lands alike, in both abandoned industrial sites and high quality natural areas. Their aggressive growth threatens ecosystem diversity and integrity, property values, and even city infrastructure stability and maintenance. They present yet another challenge to government planners and other agencies and departments already taxed with the intricacies of land and infrastructure management in a city.

With a proactive stance, the City of St. Joseph has undertaken the formation of an Invasive Plant Management Plan (IPMP). This plan, by the very nature of its subject, must be an adaptive management plan, revised periodically to account for changes on the landscape as well as emerging invasive species threats. The plan itself will have adaptive features embedded within it (e.g., rapid response to new invasions, preventative strategies, and monitoring). The decision to create a plan has been precipitated by the City's current problems with Japanese and giant knotweed¹ (*Polygonum cuspidatum* and *P. sachalinense*) and the threats that these aggressively growing species represent to property values and infrastructure. The City is aware that other invasive plant problems exist; it has already invested in an invasive species inventory that will inform this plan and assist in prioritizing the next actions.

In short, the overarching goals of the IPMP are two-fold: (1) create an adaptive management framework that addresses the prevention, control, and long-term management of invasive plant species problems

¹ Hybridization is reported to occur between Japanese and giant knotweed to produce Bohemian knotweed (*P. x bohemicum*), feared to be more invasive than either of its parents. Characters observed in plants examined in the City of St. Joseph suggest this hybrid may be present. Japanese knotweed also goes by the synonym *Fallopia japonica*, giant knotweed by *Fallopia sachalinensis*.

in the City of St. Joseph, Michigan and (2) provide recommendations for initial implementation based on the recent inventory, initial prioritization, and current concerns. Inherent in these goals is the understanding that successful long-term management is ultimately about restoring healthy ecosystems capable of resisting reinvasion by stabilizing soils and re-establishing diverse native plant communities composed of well-adapted plants of southwest Michigan's natural communities.

II. CURRENT CONDITIONS

A. Where We Begin: Regional Ecological Setting

The City of St. Joseph, Michigan lies along the southeastern shore of Lake Michigan in Berrien County, in the state's southwest corner. The City, dissected by deep forested ravines, occupies a unique peninsular setting bounded entirely by the vastness of the lake and picturesque lakeshore bluffs. Along its eastern border, the City meets the St. Joseph River as it winds its way to confluence with the Paw Paw River to form a complex mouth with the lake (Figure 1). This unique geography created a historically important connective trade route between the Great Lakes and Mississippi watersheds even from pre-settlement days; European settlement began about 1669. With its deepwater port, dunes and shoreline parks, the City styles itself as "the Riviera of the Midwest." With such a moniker, this is clearly a city that values its natural setting with its unique ecosystems.

St. Joseph lies within the regional landscape ecosystem called the Southern Lake Michigan Lake Plain (Albert 1995). This sub-subsection ecological classification is typified by lacustrine deposits that support beech-sugar maple forest, oak-hickory forest, oak savanna, white oak-white pine forest, open sand dunes, and coastal plain marsh. In pre-settlement times wetland (marshes and lowland hardwoods) dominated riparian lands within the floodplain. Most of the rare plants in this ecosystem are coastal plain disjuncts from the Atlantic and Gulf coasts or species characteristic of sand dunes. This region's rich biodiversity is particularly threatened by the encroachments of invasive species.

B. Defining the Problem: Invasive Plant Species and Disturbed Settings

Why should the City of St. Joseph care about invasive species? In many ways, their presence seems inevitable, almost beyond anyone's control. There are, for example, naturalized alien plant species that have been on the North American landscape since the time of European settlement; they have been present so long that they are now considered native by the average citizen. As an example, who hasn't enjoyed and picked the common oxeye daisy (*Chrysanthemum leucanthemum*)? How many people outside of botanists and ecologists know that the species originated in Eurasia?

Berrien County ranks third of Michigan's 83 counties in the number of non-native species recorded (382). This all encompassing list of alien species includes species used in agriculture, common roadside weeds in addition to recognized problem species. It is those problem species— those with propensity to "take over" and out compete native species and cause damage to both natural and managed ecosystems, and pose problems for public health and property—that are of greatest concern in a world with ever-shrinking natural areas and an increasing human population and development footprint. It seems that we cannot afford to just let nature take its course if we value our native ecosystems and

Figure 1. City Of St. Joseph Project Area

Legend

- St Joseph Project Boundary
- Railroads
- Streams
- 10 Foot Contours
- Road Centerlines
- Surface Water

Elevation In Feet

- High : 954.025
- Low : 576.253

Location Map



0 500 1,000 2,000 3,000 4,000 Feet



Document Name: 04_Fig01_ProjectLocation
Map By: DWA
Last Modified: 4/10/2015

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native biodiversity, and the valuable benefits they provide. And, while the economic damage and costs to control invasive species is becoming better understood (Pimentel 2011), the challenge will be to prevent further damage through a sound control and management plan.

Below, we outline some of the main drivers behind the concern about invasive species. We also describe the initial effort St. Joseph has already invested in to address this problem in the form of an invasive plant inventory.

1. Negative Effects

Not all non-native species are disruptive of ecosystems. It is the ones with superior ability to out compete other plants that become invasive problems. These share suites of traits that make them competitive with other species (TNC 2010). These traits include:

- Abundant seed production
- Earlier seasonal germination and leaf-out
- Fewer pests and diseases in new ecosystems
- Allelopathy: production of toxic chemicals that limits growth of competitors
- Ability to thrive under a variety of conditions
- Ability to reproduce sexually (seeds) and asexually (rhizomes, tubers, etc.)

When invasive plants out compete natives, the diversity of an ecosystem is reduced. Food sources (e.g., pollen, nectar, seeds, fruits, and insects) for various animal species may disappear, causing populations to plummet. Thus, through deleterious impacts on plant diversity, invasive plants affect far more than just numbers and abundances of native plant species (although in many cases that is reason enough for alarm). Their dominance and overabundance also creates a cascade of impairments to ecosystem services affecting such things as crop and timber production, fish and wildlife habitat, recreation (hunting, fishing, hiking, bird-watching, etc.), water quality and quantity, landscape aesthetics, and property values. Thus simplified by loss of diversity, ecosystems are less resilient to perturbations of climate and weather. In St. Joseph, for example, ravines dominated by knotweed are much more susceptible to erosion than those with intact native vegetation (ironically, because, among other things, knotweed was introduced into the U.S. for the purpose of erosion control). Such vulnerabilities are of particular concern in these times of climate change with its projections of increased storm intensity.

2. Invasive Plant Inventory

It is crucial to “know the enemy,” so to speak. Early detection is key to achieving a cost-effective and successful control program and producing the desired outcomes for management. The City already has taken a fundamental step forward by securing a professional inventory of the main invasive plant species within and near its borders. In November and December 2013, biologist Randy Counterman of Natural Landscapes GPS-located invasive species populations, collecting additional estimates of each population’s areal cover and density using a standardized data form. The results of his survey effort identified 173 population centers of four key invasive plant species (see mapped data in Figures 2A and 2B, and tabulated data in Appendix 1). Such information is critical to developing an understanding of source populations and their potential for infestation of

new areas. A summary of the inventory data, risk assessment, and management objectives and recommendations are presented in Table 1 below.

In addition to Japanese/giant knotweed, other key invasive plant species existing within the City borders and captured in the survey include Oriental bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), and common reed (*Phragmites australis*). This last invasive species is often referred to simply by its genus name as *Phragmites* although there is also a non-invasive native species in this same genus. Lyme grass (*Leymus arenarius*), an invasive colonizing beach and dune areas along the southern coasts of Lake Michigan, including Berrien County, is an emerging threat to the City's shoreline areas and a species that should be integrated into an early detection and rapid response program (ED/RR). (See a list of other potential invasive species for the region in Appendix 2).

The group of species causing great and immediate concern is Japanese and giant knotweed and their hybrid forms. These are Asian species originally introduced as ornamentals; possession and distribution of these species is now legally prohibited in Michigan (Michigan Natural Resources and Environmental Protection Act 1994). This aggressively growing semi-woody perennial forb species has invaded ravines within the City boundaries and poses a threat to infrastructure, residences and property values. This species is known to thrive in disturbed conditions (MDNR 2012) and it is suspected that recent work on City infrastructure exacerbated an existing problem within the City's ravines. The growth habit of this species means that its rhizomes (underground stems) and roots can penetrate cracks in pavement and foundations. It is a master at eliminating competition from other plant species through light limitation, alterations in nutrient cycling, and allelopathy (chemical production that limits growth of other species) (MDNR 2012). The end result is dense monoculture thickets that create vulnerabilities to erosion and destroy native ecosystems.



Photo 1. Ravines receive stormwater and sediments from steep slopes to create conditions favorable for invasive species.

3. Disturbed Settings

Disturbance, in ecological terms, refers to changes in average environmental conditions that cause pronounced changes in ecosystems. Disturbances, such as fire, windstorms, floods and heavy runoff, insect outbreaks, trampling by humans and animals can all lead to substantial shifts in ecosystem composition and functioning. Disturbed areas are more susceptible to invasive species establishment, a habitat quality that ecologists refer to as *invasibility*.

Figure 2A. Invasive Plant Inventory 2013 (North)

2013 Invasive Survey Point Labels

- 1 - Individual/few/several (24 locations)
- 2 - Less than 1,000 sq ft (41 locations)
- 3 - 1,000 sq ft to half acre (38 locations)
- 4 - Half acre to one acre (26 locations)
- 5 - Greater than one acre (5 locations)

Legend

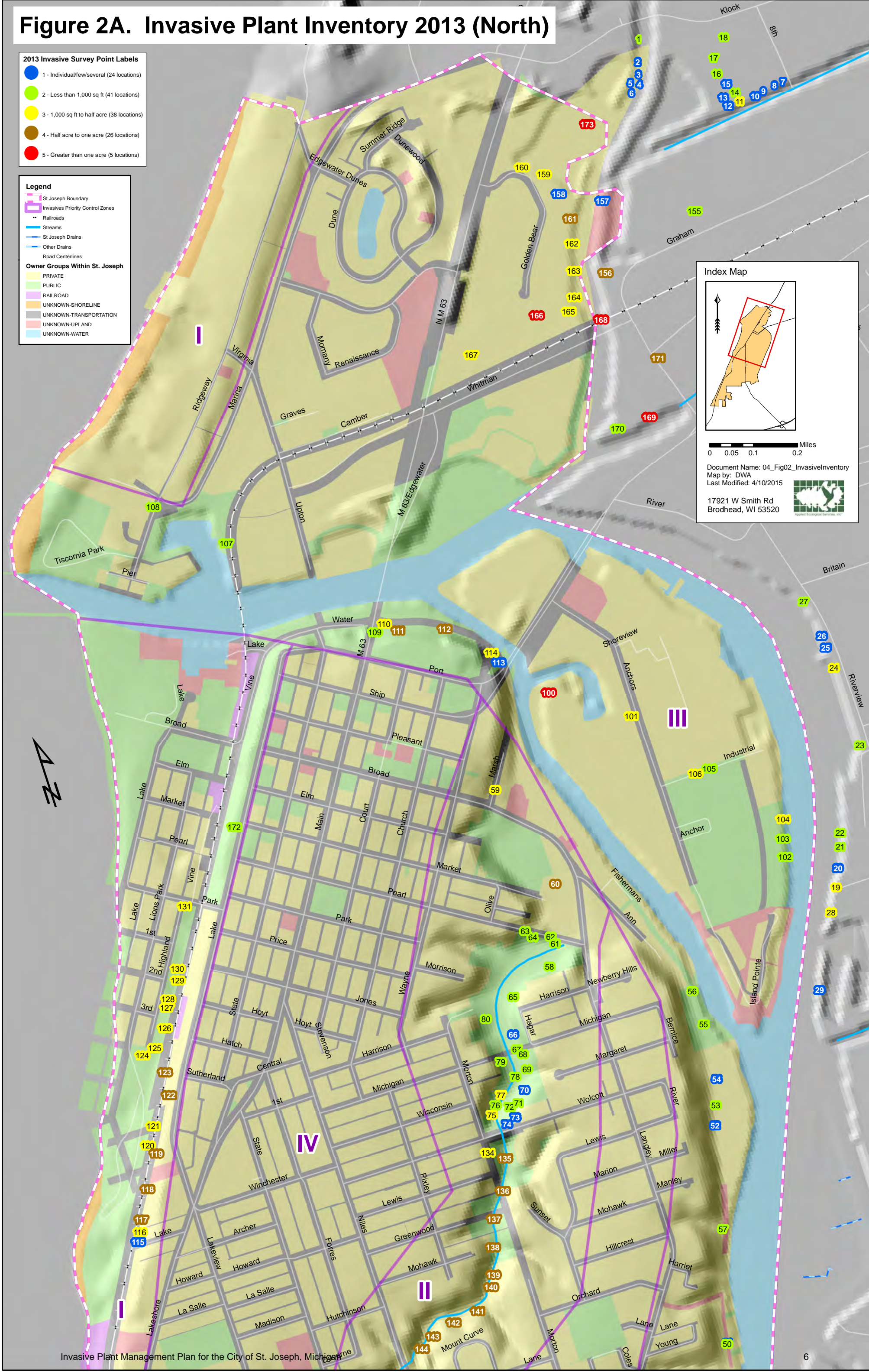
- St Joseph Boundary
 - Invasives Priority Control Zones
 - Railroads
 - Streams
 - St Joseph Drains
 - Other Drains
 - Road Centerlines
- Owner Groups Within St. Joseph**
- PRIVATE
 - PUBLIC
 - RAILROAD
 - UNKNOWN-SHORELINE
 - UNKNOWN-TRANSPORTATION
 - UNKNOWN-UPLAND
 - UNKNOWN-WATER

Index Map

0 0.05 0.1 0.2 Miles

Document Name: 04_Fig02_InvasiveInventory
 Map by: DWA
 Last Modified: 4/10/2015

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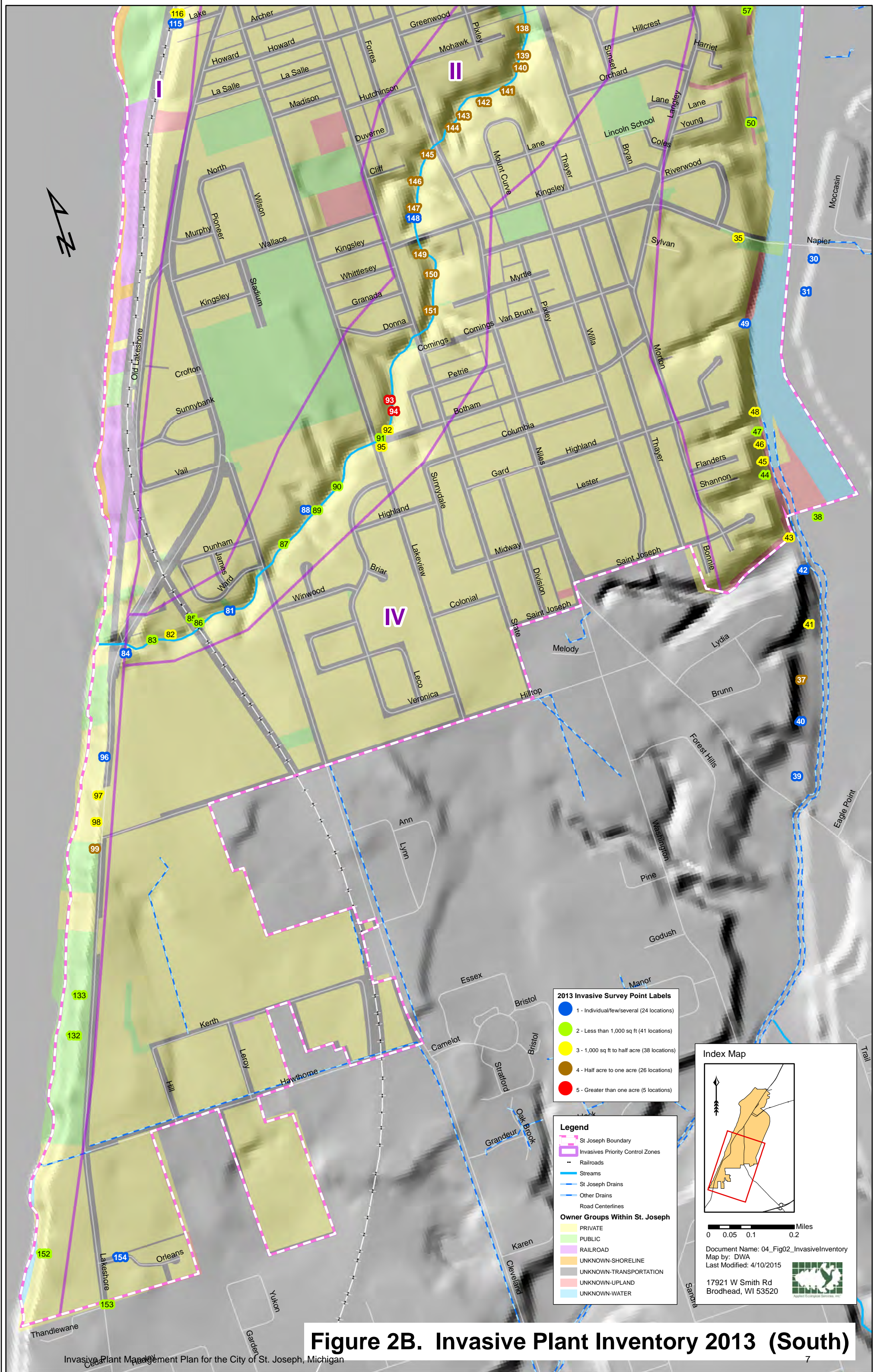


Figure 2B. Invasive Plant Inventory 2013 (South)

In the City of St. Joseph, the ravine system is one such area of chronic disturbance. The ravines have experienced significant slope erosion and sediment build-up in the ravine bottoms, creating ideal conditions for the establishment and growth of Japanese and giant knotweed. The knotweed itself exacerbates the erosion problem by creating dense shading resulting in bare soil. Urban stormwater runoff continues the cycle of erosion. There are likely other contributing factors such as non-native earthworm species that destroy the humus and litter layers, further exposing mineral soil to erosion and leaching of nutrients and potentially contributing to water quality degradation downstream.



Photo 2. Unvegetated slopes can be restored to minimize eroding sediments, one of the factors contributing to invasive species problems.

C. Desired Condition: Reduced Invasive Plant Populations and Restored Healthy Ecosystems

The City of St. Joseph understands the importance of integrating ecosystem restoration into a comprehensive invasive species management plan, because removing invasive plants must be done in conjunction with creating a healthy functional ecosystem. The City envisions that implementation of such a plan will achieve healthy, resilient natural communities in its coastal, forested ravines, river shoreline, travel corridors, and neighborhood settings, by reducing existing invasive species such as Japanese/giant knotweed, common reed, Oriental bittersweet, and Japanese honeysuckle to a minor component of the City's operations and management programming.

The City will further reduce the possibility of new invasive species from becoming established through implementation of an Early Detection/Rapid Response program that will involve City staff, community organizations, homeowner and commercial property owners, and other partners and stakeholders. This management and control effort will ensure the protection of the City's investments in infrastructure and park and recreational amenities, as well as natural communities that provide aesthetic and other natural resource benefits to residents and visitors. Controlling invasive species will also protect property investments by homeowners, at risk from the damage caused by invasive species.

Table 1. Summary of Target Invasive Plant Populations in the City of St. Joseph: inventory data, risk assessment, management objectives and recommendations.															
(Data used in this summary was produced by Randy Counterman of Natural Landscapes during field inventories conducted November and December 2013 (Nov. 14, 15; Dec. 3, 4, 6, 10, 18, and 19).															
Common Name	Scientific Name	Description	Control Priority Level	Inventory Date ¹	Number Populations by Management Zones ²				Total Number Populations	Population Cover Est ³ (acres)	Dominant Population Density ⁴	Threats/Risk Areas	Management Objectives	Management Options & Recommendations	Control Methods
					I	II	III	IV							
Japanese knotweed Giant knotweed	<i>Fallopia japonica</i> or <i>Polygonum cuspidatum</i> <i>Polygonum sachalinensis</i>	Semi-woody perennial forb in the Buckwheat family; introduced as an ornamental from E Asia in late 1800s for landscape screening and erosion control; spreads by rhizomes to form large, dense monocultural thickets along riverbanks, pond edges, wetlands and low areas, along hillsides, woodland edges, roadsides, and yards; tolerates semi shade and wide variety of soils and moisture conditions; prefers moist, well-drained sites with nutrient-rich soils.	High	2013	8	38	33	79	26	Dense	Eroded ravine bottoms receiving excess stormwater and heavily shaded side slopes create bare soils and nutrient rich sediment deposits that facilitate invasion and population expansion.	Remove and control all populations on City and private lands with homeowner and commercial landowner cooperation. Stabilize and restore treatment sites immediately. Mitigate excessive stormwater runoff to ravines and backyards above ravines. Coordinate as needed with Township, County, State, and other regional partner land managers to control populations in a similar fashion on bordering lands and transportation corridors.	Hire contractor(s)/restoration specialist(s) with herbicide applicator certification to control populations on City land and immediately restore and regularly monitor all treatment locations, applying follow-up treatments as needed to maintain control. Coordinate with private property owners and other partners to provide available contractor information. Trained volunteers may be an option to control costs in low risk areas.	Eradication can take several growing seasons; chemical control is advised on large stands (Czarapata 2005). Studies in WI achieved improved control with summer mowing to reduce biomass, in combination with fall herbicide application using aminopyralid (Milestone), imazapyr (Arsenal), or glyphosate (Renz 2014).	
Oriental bittersweet	<i>Celastrus orbiculatus</i>	Rapidly spreading woody vine from abundant seed and rhizomes, with colorful orange berries in fall; native to E China, Korea, and Japan; planted as an ornamental on fences and trellises. Berries spread by birds into forests where it forms dense stands which shade out native vegetation and can girdle and overtop trees (can climb 60' and reach 4" in diameter), making trees susceptible to wind damage. Hybridizes with the native bittersweet (<i>Celastrus scandens</i>), making it a genetic threat to the native species.	High	2013	22	4	19	45	16	Scattered Individuals	Open woods, woodland edges, undisturbed forests, roadsides, fencerows, and open grasslands.	Remove and control all populations on City and private lands with homeowner and commercial landowner cooperation. Stabilize and restore treatment sites immediately. Mitigate excessive stormwater runoff to ravines and backyards above ravines. Coordinate as needed with Township, County, State, and other regional partner land managers to control populations in a similar fashion on bordering lands and transportation corridors.	Hire contractor(s)/restoration specialist(s) with herbicide applicator certification to control populations on City land and immediately restore and regularly monitor all treatment locations, applying follow-up treatments as needed to maintain control. Coordinate with private property owners and other partners to provide available contractor information. Trained volunteers may be an option to control costs in low risk areas.	Chemical control is advised for large stands. Triclopyr formulated for use with penetrating oil or a strong solution of glyphosate (20% a.i. suggested) can be applied to cut stems in the fall after native plants have gone dormant or in early spring before the emergence of spring ephemerals (Czarapata 2005). Where possible, pull cut/treated vines from trees to discourage potential new growth from climbing back into the canopy.	
Common reed	<i>Phragmites australis</i>	Tall, warm-season perennial grass with feather-like seed heads at the top of its stems; plants can reach heights of 15 or more feet; stout rhizomes from aggressive strains form dense continuous mats that crowd out other natives and provide minimal wildlife habitat value. Non-native strains were introduced on the east coast in the last century and have been spreading across the continent, swamping out native genetics.	High	2013		3	27	30	12	Dense	Roadside ditches, open wetlands, riverbanks, lake shores, disturbed or undisturbed plant communities; prefers alkaline and brackish waters but will tolerate highly acidic conditions; can grow in water up to 6' deep and in somewhat dry sites. Rhizomes can reach up to 6' deep with roots emerging at the nodes.	Remove and control all populations on City and private lands with homeowner and commercial landowner cooperation. Stabilize and restore treatment sites immediately. Mitigate excessive stormwater runoff to ravines and backyards above ravines and bottomlands in the river corridor. Coordinate as needed with Township, County, State, and other regional partner land managers to control populations in a similar fashion on bordering lands and transportation corridors.	Hire contractor(s)/restoration specialist(s) with herbicide applicator certification to control populations on City land and immediately restore and regularly monitor all treatment locations, applying follow-up treatments as needed to maintain control. Coordinate with private property owners and other partners to provide available contractor information. Trained volunteers may be an option to control costs in low risk areas.	For large stands, glyphosate with 1.5 % a.i. can be applied to upper foliage in early fall with backpack sprayer and wand extension (taller stands may need to be reduced by cutting in early August). Follow-up with fire in the spring and treat surviving growth when knee- to waist-high. Monitor for seedbank response and re-establish native plant community as needed (Czarapata 2005).	

Common Name	Scientific Name	Description	Control Priority Level	Inventory Date ¹	Number Populations by Management Zones ²				Total Number Populations	Population Cover Est ³ (acres)	Dominant Population Density ⁴	Threats/Risk Areas	Management Objectives	Management Options & Recommendations	Control Methods
					I	II	III	IV							
Japanese honeysuckle	<i>Lonicera japonica</i>	A woody vine with pairs of white to yellow tubular fragrant flowers native to eastern Asia and Japan, often planted as an ornamental. Purple to black fruits dispersed widely by birds in fall; dense root system suckers extensively and runners sprout where they make contact with soil; forms a dense cover over trees, shrubs, and groundlayer vegetation. Can make trees top heavy and susceptible to breakage during wind storms.	Medium	2013	2	16	10		30	5.3	Patchy	Open woods, woodland edges, thickets, roadsides, fencerows, prairies, disturbed areas.	Remove and control all populations on City and private lands with homeowner and commercial landowner cooperation. Stabilize and restore treatment sites immediately. Mitigate excessive stormwater runoff to ravines and backyards above ravines. Coordinate as needed with Township, County, State, and other regional partner land managers to control populations in a similar fashion on bordering lands and transportation corridors.	Hire contractor(s)/restoration specialist(s) with herbicide applicator certification to control populations on City land and immediately restore and regularly monitor all treatment locations, applying follow-up treatments as needed to maintain control. Coordinate with private property owners and other partners to provide available contractor information. Trained volunteers may be an option to control costs in low risk areas.	Can be controlled to some degree with prescribed burning (typically spring burn); glyphosate can be applied to foliage in fall after native plants have gone dormant, but before hard freeze (Czarapata 2005).
								184	59.3						

¹ 2013 Inventory conducted by Randy Counterman of Natural Landscapes

² See Management Zone Map in Figure ___; Zone I=coast/near cost settings w/ multiple landownership types, including railroad, City, residential and commercial properties; Zone II=ravine settings w/ public and private properties, and City utilities easements, Zone III=St. Joseph River and tributary corridors w/ industrial properties.

³ Based on cover classification 0=none; 1=individual/few/several; 2=<1,000 ft² (half tennis court); 3=1,000 ft² to 0.5 acres; 4=0.5 acres to 1 acre (football field w/o end zones); 5=>1 acre.

⁴ Based on density classification S=sparse (scattered individual stems or very small stands); P=patchy (a mix of sparse and dense areas); D=dense (greater than 40% of the area); M=monoculture (nearly 100% of the area).

III. PARTNERSHIPS AND NETWORKS

Invasive plant management can't and doesn't happen in a vacuum. Plant species are respecters of neither boundaries nor ownerships. In recognition of this, networking and planning efforts have begun at many levels. Awareness of and participation in the larger community of those dealing with invasive plants is of mutual benefit. For example, participating in early detection and warning networks can assist the City with its adaptive management planning while contributing to the larger regional effort to control invasive species. Partnering with regional organizations may facilitate finding funds for management, control and restoration. Given the widespread nature of the problem, partnerships are vital to success. In Appendix 3 we provide a table of useful internet links that includes many of these organizations and resources, in addition to a listing of contacts for invasive species information in Michigan in Appendix 4.

A. The Big Picture: National Efforts

There are numerous national initiatives dealing with invasive species. Some originate in the federal government and its agencies while others are managed by universities or non-profit organizations. In this section we highlight a few of the most prominent sites and ones that appear to be kept up to date.

Recognizing the scope of invasive species threats, the USDA initiated a National Invasive Species Information Center with a website portal (NISIC 2014). This site has abundant information including links to policy and control strategies.

The University of Georgia has an interactive real-time mapping of invasive species with information available down to the county level (EDD Maps 2014). This clearinghouse could be used by the City as a means of contributing information to the regional, State, and national planning efforts.

The Nature Conservancy (TNC) is among the national leaders in invasive species efforts. They have an initiative called "Protecting Native Plants and Animals" and have produced model invasive plant management guides for landowners (TNC .2010).

B. What We Have in Common: Regional Efforts

The Stewardship Network (TSN) provides the backbone structure for collaborative conservation, including regional invasive species efforts, through its Cluster model. Clusters are locally led and driven collaborative conservation communities, which consist of organizations and individuals working together on common conservation and stewardship goals. TSN provides a turn-key suite of technology and human services to accelerate on-the-ground impact and community-based collaboration. TSN supports and strengthens local and regional initiatives through an online Searchable Events Calendar, Searchable Resources, Annual Education & Outreach Program, Garlic Mustard Challenge, Monthly Webcast, Annual Conference, Signature Leadership Training Program, and a wide variety of administrative services.

The Midwest Invasive Species Information Network (MISIN 2014) is a robust site with early detection reporting including graphical displays of distribution and frequency, news articles, requests for citizen

assistance, species information, smart phone apps, alerts, and more. It is managed and kept current by Michigan State University (Applied Spatial Ecology and Technical Services Laboratory).

The Midwest Invasive Plant Network (MIPN 2014) provides a valuable clearinghouse role for the Midwest. It sells modestly priced informative publications, provides links to other sites and smart phone apps, hosts a listserv, provides a resource page for Cooperative Weed Management Areas (CWMA) and facilitates participation in early detection and rapid response, among other services.

The Great Lakes Early Detection Network (GLEDN 2014) compiles records of invasives in the Midwest from citizens and other agencies and facilitates verification of records. It offers an early alert service to participants. This is potentially a powerful tool for understanding management control at a regional scale. The data, however, are only as good as the participation.

Cooperative Weed Management Areas (CWMAs) and Cooperative Invasive Species Management Areas (CISMAs) are partnerships of government agencies, tribes, non-profit organizations, individuals and various other entities concerned with managed invasive species in a geographical area. They typically try to involve the major landowners and natural resource managers in an area. MIPN, mentioned above, serves as a resource for CWMAs in Michigan. In Wisconsin, Invasive Plants Association of Wisconsin provides a wealth of information as well.

C. Zeroing In: State Initiatives

The State of Michigan (Department of Natural Resources, Wildlife Division) has produced an invaluable action framework (Higman and Campbell 2009). This St. Joseph IPMP has incorporated many of its suggestions and strategies. The State framework draws together information from academia, conservation non-profits, tribes and other stakeholders. It is a primary point of reference for those working on invasive species issues in Michigan. The Michigan DNR provides information on the current status of invasive plants throughout the state (see a listing of target species for southern Michigan in Appendix 2). The DNR's website also has dedicated several pages to the management of invasive species (Appendix 3).

D. Bringing It Home: City of St. Joseph Partnerships

A city's invasive plant management plan is inextricably bound to other land management plans. Excavation and earthmoving associated with infrastructure upgrading, construction, road construction and general road maintenance activities, for example, are often precipitating factors for spread of invasive species. Comprehensive plans and park plans may offer opportunities for including invasive species management in larger funding efforts. Their activities should also become integrated in an ED/RR protocol enabling observers to keep track of invasive problems that may occur with soil disturbing activities.

The City is well underway in forming strategic partnerships that can help with regional coordination, funding, labor, and expertise (Table 2). Larger partnerships can be more competitive when applying for grant funding. The State of Michigan is actively encouraging regional approaches to invasive plant control and management through its funding approach.

Table 2. Potential Partners for City of St. Joseph Invasive Plant Management Plan

PARTNER	CONTACT INFORMATION	WEBSITES	FUNCTION
Stewardship Network: Southwest Corner Cluster	Paul MacNellis, Coordinator paul.macnellis@wmi.ch.edu , swcc@stewardshipnetwork.org	http://www.stewardshipnetwork.net/clusters/southwest-corner-cluster	Assist with regional coordination and procuring funding. St. Joe lies within the Cluster’s jurisdiction. The Cluster is part of the larger Stewardship Network, enhancing funding opportunities.
Southwest Michigan Land Conservancy	Nate Fuller, Conservation and Stewardship Director fuller@swmlc.org 269.324.1600	http://www.swmlc.org/content/who-we-are	Their work along the St. Joe River and Lake Michigan shoreline potentially complementary. Map resources.
West Michigan Cluster CWMA	Becky Huttenga, Chairperson Ottawa Conservation District becky.huttenga@macd.org 616.846.8770 x5 Pat Ruta McGhan, Shared Services Botanist on the Huron-Manistee National Forest pruta@fs.fed.us 231.745.4631 x3102	http://www.ottawacd.org/invasive_plants.html http://www.fs.usda.gov/main/hmnf/landmanagement/planning	Coordination with Ottawa County, particularly Road Commission and Drainage Office with cross-jurisdictional operations. Opportunities for larger scale grant funding like CZM
Berrien Conservation District	Nancy Carpenter Nancy.carpenter@mi.nacdnet.net 269-471-9111 ext. 3	http://berrienconservationdistrict.webs.com/	Involved in relevant activities like soil erosion, education, etc.

In short, an effective invasive plant management plan needs to communicate with other land-based plans as well as governmental and non-profit entities with interest in and responsibilities for invasive plant management. The easiest way to accomplish this is through the existing cooperative CWMAs or CISMAs and soil conservation districts.

IV. MANAGEMENT AND CONTROL STRATEGIC APPROACH

The City of St. Joseph plan provides an integrated and adaptive approach organized around a cost-effective framework that will help the City and stakeholders achieve the plan’s stated goal of reducing invasive species populations and restoring healthy ecosystems. Achieving this goal will ultimately help the City and stakeholders to protect property values and natural resource assets that are intrinsic to the

area's economy. These goals will be accomplished through the widely adopted and tested integrated strategies of prevention and protection, education and outreach, early detection and rapid response, combined with a control and management program that prioritizes sites based on risk, applies science-based control methods, and ensures success through monitoring and periodic plan review. This will require leadership to provide direction and to empower staff to carry out the program.

A. The Cutting Edge: Preventing New Invasions

By necessity, the overarching goal of an invasive plant management plan is a realistic one of control, not eradication. This is especially true of a city with multiple ownerships, an abundance of developed land, unique landforms such as shoreline, dunes, and forested ravines, and concentrated ongoing human activity. Perhaps the most useful way to think about controlling invasive plants is to break the problem down into the following sub-goals.

1. Prevention and Protection

"Prevention is worth a pound of cure;" this is no idle adage when it comes to invasive plant species. The most cost effective strategy by far is to prevent invasive species from being introduced in the first place and to limit opportunities for their dispersal and establishment when they first occur. As part of prioritization (see below) high quality natural areas should receive particular protection from invasive species establishment.

Education is crucial. Prevention requires an observant and aware citizenry. Citizens need to be provided information that defines invasive species in terms of their potentially deleterious effects. Citizens should be made aware of potentially invasive species and avoid their purchase from local nurseries and online vendors. A basic literacy in the City's invasive plants will allow spot control at the level of the landowner. It will also enable them to participate in an early detection and rapid response protocol (see below, next section).

Michigan's Department of Agriculture and Rural Development publishes lists of regulated undesirable species that have been defined in law (Michigan Natural Resources and Environmental Protection Act 1994). Species listed as "prohibited" (such as Japanese and giant knotweed and their hybrids) cannot be sold or grown in the state. This list can become part of the education and outreach program.

Taking another approach, Northwest Michigan Invasive Species Network has published "Recommended Planting Guidelines for Municipalities" and also has procured commitments from local nurseries to refrain from purchasing or planting invasive ornamental plants as part of their "Go Beyond Beauty" program certification (Appendix 3).

Some other on-site preventative recommendations include:

- Limit extent of soil disturbance as well as the time bare soil is exposed.
- Use a green mulch cover crop such as annual ryegrass or oats to prevent erosion and limit weed establishment while the permanent seeding becomes established.
- Avoid using commercial "wildflower" mixtures of unknown origin in natural settings.

- Plant native species whenever possible using seed from sources as local as possible.
- Use weed-free mulch (hay or straw) in every project with soil disturbance.
- Protect stockpiled soil from establishment of weeds.
- Don't transport soil from a known invasive site.
- Educate the citizenry about which species to avoid purchasing or planting.
- Work with road maintenance crews and other earthmovers to ensure that machinery is cleaned between locales.
- Monitor sites with soil disturbance for the occurrence of invasives

2. Education and Outreach

Education. Education is crucial to the initiation of a sustainable invasive plant management program. Most citizens are simply unaware of the prevalence and threat of invasive plants and remain so unless a species personally affects their property or a familiar natural place. Not only do people need education about identifying invasive plants in their environment and understanding their potential deleterious effects, they also need cautions against purchasing alien ornamentals or aquatic plants with potential for spreading to the wild and becoming a problem.

The public at large is unaware of basic ecological principles and the identification and values of native species. Rallying public support for controlling invasive plants not only requires information transfer about negative effects of invasives, it also necessitates providing information about native ecosystems and the ecosystem services and cost-savings that they can represent. In a society where a mowed turf lawn is a standard of acceptable beauty, it will take some concerted effort to build a new aesthetic sense into the population.

In the City of St. Joseph, educational efforts should target the City's particular problem species and provide information about their detection and control to residents. Prevention should also be part of outreach to residents and businesses, alerting them to potentially problematic species that may show up, or species sold as ornamentals that should be avoided.

To provide a positive alternative, the City might consider developing customized native species planting guidelines for the City using existing information about native species suited for ornamental use in southwest Michigan. Information is available through Michigan State University with recommendations for ferns, wildflowers, trees, shrubs and vines, and grasses, sedges, and rushes. Invasive plant organizations are another potential source of information. Such a list (in print or online) might include lists of local nurseries that are committed to producing locally and ethically sourced native plants.

Outreach. An outreach strategy can keep the public aware, informed and involved. Efforts may take the form of print publications, web site pages and blogs, social media, booths at outdoor festivals, and activities that include direct involvement of teachers and students, youth groups and other citizen organizations (scouts, churches, sports teams, service groups, companies, etc.).

The City might consider developing an online interactive map display of invasive hotspots, coupled with invasive plant species information and photographs. Outreach information can be used in

reports to the public and funders. It also can be used to procure additional funding by demonstrating a vibrant ongoing project and by engaging volunteer labor that can be used for match.

3. Early Detection/Rapid Response

An early detection and rapid response (ED/RR) protocol works closely with the first line of defense, prevention. There are national guidelines available to assist with developing such a protocol (National Invasive Species Council 2003). The three components are: (1) early detection, (2) rapid assessment and (3) rapid response. In all cases, training and education is paramount for success as is cooperation with partners who already may be engaged in this activity. In addition, the City should consider participation in one of the regional early detection reporting systems online (i.e., MIPN 2014 or GLEDN 2014). Such participation provides advance warning of emerging threats in the region and allows the City to benefit from and contribute to the information base. Particular attention should be directed toward high risk areas on both the City's public and private lands, such as those areas with recent or chronic disturbance and ability to serve as vector corridors (e.g., steep wooded ravines receiving excess stormwater runoff, construction sites, utility and rail corridors, roadsides, parking lot perimeters, and backyards and gardens). Other high risk areas include public parks and high value natural areas (lake and river shorelines and wetlands) that may protect the greatest concentrations of the City's biodiversity assets.

An ED/RR plan needs detection teams to be the eyes and feet on the ground. It also needs key decision-makers designated who are empowered to take action at all steps including an active and speedy control response. The goal is to detect and eradicate the invasive plant species before the problem becomes too expensive to manage.

Detection. Active detection uses networks of partners with the training and capability for systematic monitoring of critical areas on both public and private properties (as described above). Although resources limit effort, careful targeting can effectively stretch resources. Educational institutions at all levels, service clubs, scouts, and others might be recruited and trained to adopt and monitor particular areas. Passive detection networks are composed of individuals or groups (such as "friends" groups for parks or public lands, Audubon chapters, sportsmen groups, etc.) who can opportunistically detect and report potential invasions.

Rapid Assessment. Following detection of an invasive species, a knowledgeable person will need to assess the situation addressing questions such as:

- What is the tendency of the species to spread, colonize, and/or compete with natives
- How large is the population that was detected?
- Are there indications that it has already spread?
- Are there activities occurring in the area (construction, roadwork, trail work etc.) that makes dispersal more likely?
- What specific threats to ecosystems may be present?

The City is advised to compile a list of professionals or institutions that are available as needed to corroborate plant identifications.

Rapid Response. Using information from the Rapid Assessment, designated decision maker(s) will lay out an immediate action plan. This may range from restrictions such as cleaning of heavy equipment to source eradication using professional herbicide applicators. The main function of an ED/RR protocol is the ability to stop new invasions before they spread. Once a rapid response occurs, the site becomes part of the long term control protocol.

B. The Long Haul: Control and Management

A long-term management and control plan must be, above all, adaptive. Invasive species, by their very nature, pose a moving target in time and space. Invasive plant management is a process that involves continual prioritization, control efforts, monitoring, and repeated control. This means that the ED/RR protocol is being enacted concurrently control within a management plan.

1. Prioritization

There is no one perfect starting point for invasive plant management implementation. Prioritization is both an initial strategy as well as an ongoing task in an adaptive management plan. Multiple factors must be weighed and re-weighed as more information becomes available. Once control has begun, results of efforts need to be documented through monitoring to inform subsequent actions. In this section we discuss the major factors that become part of a prioritization scheme.

Sites are initially ranked based on the threat infestations pose and the feasibility of control. This combines an ecological understanding with a cost-effectiveness analysis.

Level of Threat. Assessing the level of threat and severity of impacts requires integration of multiple factors. Many species have already been ranked by invasive species networks and can be a source of information. Their process included answering questions such as:

- What is the invasive plant species' population size and dispersion on the site?
- What are the plant species' life history traits (e.g., growth rate, growth form, allelopathy, seed production)?
- What is the soil type?
- What are the ecological stressors? Are they chronic (e.g., erosion, slumping, flooding)?
- What are the human stressors (e.g., construction, pavement, foot traffic)?
- What is the ecological quality of the site considering factors such as plant community diversity, presence of rare species, and habitat for animals?

Feasibility: Opportunity, Cost and Funding. While ranking according to level of threat is a good first step, feasibility for control inevitably comes down to issues of cost and funding. And funding may be tied to scale of effort, available partners, land ownership, location, or other factors. For example, an invasion that is ranked relatively low threat on a public park might find an opportunity for control through funds procured for overall park improvement. A large and pervasive invasive problem, by contrast, likely will need to wait for specific invasive species funds coming from a large federal or state program. Partnerships are particularly important for securing funding. The City may in some

cases find itself best positioned to join in a larger effort, contributing in-kind matches of data and labor.

An invasive plant management plan positions the City to take advantage of opportunities for funding as they arise; it streamlines the City's ability to respond to proposal requests by providing a suite of variously-sized projects, identified locations, and a variety of identified partners who can participate and provide match. Many invasive species funding sources designate the need or desirability of having partnerships.

Timeline. The time required to achieve eradication or control of an invasive species population depends on several factors, including the size and distribution of the population, growth characteristics of the plant species and difficulty of control, access constraints, and time and budget limitations, as described above. In the most feasible control situations, eradication can be achieved cheaply and easily within 2-3 years. This would be the case with a small isolated population of a new invader that is quickly detected and removed before becoming widespread. In the case of widespread populations, such as the knotweed, eradication or at least containment will be a long-term effort (likely greater than 5 years) with available resources.

2. Control Strategies

Control strategies are aimed at stopping new invasions and at controlling extant populations so that they remain at culturally and ecologically acceptable levels and do not continue to spread. It most often involves some sort of lethal control of the plants themselves involving manual removal (e.g., grubbing, cutting, mowing) and/or chemical treatment followed by restoration. Such strategies are aimed at killing plants (foliage, stems, rhizomes, tubers) to eliminate the source population itself as well as its ability to reproduce. Some techniques, such as mowing or brushing, may seek only to limit the ability of the plants to reproduce by setting seed. Eradication is usually only possible in the case of new invasions limited in scale and scope.

Control strategies should follow the principles of integrated pest management (IPM). IPM employs an ecological framework to guide the selection of a suite of applicable techniques (manual, biological and chemical control, habitat manipulation, modification of cultural practices, etc.). Typically, when needed, the least toxic effective chemical treatment is used. State and federal laws for applicators must be followed. Best control practices exist for several species. The Michigan Natural Features inventory has made several available online (Appendix 3). Partners may have access to other resources as well. Control also should take place in an adaptive framework, informed further by monitoring results.

Finally, control strategies also involve teamwork. Through its identification of partners and an ED/RR plan, the City will be able to assemble teams who can assist in control and management. Teams are likely to include City and County departments with land management and planning duties, professional ecologists, civic groups, non-profits associated with natural resources and individual volunteer citizens. Such teamwork is invaluable when procuring grant funding

Specific control strategies for the primary invasive plant species in St. Joseph are discussed in Section V.

3. Maintenance and Restoration

Most invasive control is repetitive in nature, often extending through more than one growing season. Even on a patch level, eradication is likely to take more than one year (TNC 2003). The type and extent of follow-up control beyond typical maintenance is determined by monitoring (see below). Each control action should have a customized maintenance protocol designated at the outset.

Maintenance may involve repeated mowing, spot herbicide treatments, and/or prescribed burns. The frequency of maintenance actions is typically every year for the first couple years followed by lengthened intervals informed by monitoring results.

In some cases, removal of invasives with necessary follow-up maintenance is sufficient to allow a native ecosystem to recover on its own. In many situations, however, some seeding or planting of native species is needed to jump-start recovery. This is accomplished by having native species occupy vacant space that would otherwise be susceptible to erosion and re-invasion by the more aggressive invasive species.

Restoration may also be used to prevent invasions. A “weedy” patch could be restored to a native species assemblage of grasses and forbs that can better resist invasive species as well as provide habitat for pollinators and watchable wildlife, and reduce the risk of runoff and erosion. The goal of such restoration is to re-establish a functional ecosystem that provides more ecosystem services while also resisting invasive plants.

4. Monitoring

Monitoring should occur at regular intervals (seasons and years). It should employ standardized observation and measurement techniques as appropriate. The goal is to create a record of conditions that can be compared year to year.

Such monitoring should incorporate landscape level inventory and ED/RR detection activities as well as follow up assessment of areas receiving control and/or restoration actions. All findings should be mapped using GPS coordinates and linked to a dataset that includes population size and vigor estimates and observations of conditions that affect the level of threat (e.g., foot traffic, soil disturbance, construction, etc.). Photographs with scale should be used to document infestations. All these data can be linked to a GIS system thus facilitating the ability to keep information current and accessible for reporting and outreach purposes.

Landscape Inventory. The City has created an initial baseline inventory of current invasive plant populations by species and population (Figures 2A and 2B, and Appendix 1). Ideally, this type of City-wide inventory should be repeated at regular 5-year intervals. In addition, as part of an ongoing ED/RR protocol, a trained observer should visit all documented invasive populations yearly during the growing season to produce an update on conditions.

Post-Control and Restoration Monitoring. Each control or restoration action should include a monitoring component that can measure efficacy of the control actions after the standard maintenance routine is completed. Findings can be used to recommend follow-up, if needed, or to prescribe systematic maintenance (such as cycles of spot herbicide, mowing or prescribed burns).

5. Plan Review and Update

Like any plan, to remain effective the City should periodically review the overall success of the invasive species control program and its capacity to achieve the stated vision, goals, and success in controlling the four key invasive species currently identified as causing damage. This review process can occur at a time designated by the City, but should also include an annual effort to plan and schedule work for the coming season, as described in the following section.

V. RECOMMENDED ACTIONS: INVASIVE SPECIES CONTROL ANNUAL WORK PLAN

This section outlines recommended actions toward implementing a four-year Invasive Plant Management Plan using an annual work plan framework with a monthly schedule, as presented in Table 4. For purposes of presentation in this document, the work plan schedule is limited to a two-year timeline (2015 – 2016), and the budget estimates are limited to a 4-year cycle; however, the timeline and budget analysis can be extended as needed. Like any large scale undertaking that is anticipated to be ongoing for an extended period of time, the annual work plan allows work to be undertaken seasonally and in phases, with opportunities to re-evaluate goals and objectives, measure successes, and assess approaches and methods at regular intervals. It is recommended that the work plan be reviewed and updated on an annual basis by a dedicated Invasives Species Control Team composed of City staff and the City’s contractor/consultant. The invasive Plant Management Plan should likewise be reviewed and evaluated on a periodic basis.

The work plan assumes some flexibility in determining the specific scope of work, particularly when contractors and consultants are hired to undertake some of the work activities. The monthly schedule allows flexibility to adjust execution of the work in response to changing weather conditions, shifting priorities, staffing and volunteer scheduling conflicts, and coordination delays. City staff will require flexibility in integrating the work of the invasive species plan into other City planning efforts and in response to City budget constraints. With budget constraints in mind, it is the intent of the work plan to help the City prioritize control efforts and other activities proposed by the plan to maximize the benefits resulting from control investments.

The following sections provide additional details for undertaking the invasive species work plan.

A. Community Outreach, Staff and Volunteer Training

Public education and volunteer recruitment planning will be an integral part of the plan to both help the City develop realistic management goals, and to ensure a greater chance of long-lasting success in reducing invasive species populations. The following activities in Table 3 are proposed as part of an ongoing public education and outreach program.

Table 3. Proposed Public Education and Outreach Activities.	Timeline	Lead & Partners
Outreach and volunteer recruitment, training, and support for invasive plant control activities over the next four years. This includes an annual event to acknowledge the work and contributions of volunteers, provide updates on control efforts, and layout plans for the coming year.	Annual	City, partners, and stakeholders

Media outreach including radio, local newspapers, tv, and website.	Monthly	City staff
Public outreach workshops , designed to support volunteer efforts and increase the project’s impact. Examples for workshops: <ol style="list-style-type: none"> 1. Local natural history focusing on the Southern Lake Michigan Lake Plain ecosystem and the threat posed by invasive species to natural communities and private and public properties. 2. Hands-on invasive species identification and removal workshop, to kick-off the volunteer season. 3. Workshop about landscaping with natives focused on stabilizing ravine slopes and other environments vulnerable to invasion. 4. Workshop on the work of partners in the region and control success stories. 	Quarterly	City, partners, and stakeholders
Stakeholder and partner workshop for land managers and road crews to encourage adoption of best management practices to reduce the spread of invasive species.	Annually	City, partners, and stakeholders
Develop local display on native and invasive plants to educate the public about landscaping with non-invasive plants. To be housed in a visible location in town during the spring planting season, and serve to educate citizens about alternative non-invasive species useful in landscaping year-round.	Annually	City, partners, and stakeholders
Collaborate with willing landowners to remove invasive species from their landscaping.	Annually	City, partners, and stakeholders
Develop a website that provides information about the invasive species control program, including helpful GIS and inventory maps	Ongoing	City, partners, and stakeholders

B. Invasive Plant Management Oversight

The City Department of Parks and Grounds will serve as the lead on coordinating and implementing the invasives control plan. The City may also want to consider a limited time employee position or contracting outside services for undertaking certain aspects of the work, particularly for undertaking larger scale efforts, when funding allows.

C. Invasive Plant Management

In addition to the Invasive Plant Inventory 2013 Maps (Figures 2A and 2B), a map depicting four principle management zones is presented in Figure 3. This partitioning of the City identifies four unique settings where invasive species are established and conspicuous. These zones are defined as follows:

Zone I: Coast/near coast settings with multiple landownership types, including railroad, municipal (park), residential, and commercial properties.

Zone II: Ravine setting with private and public (park, school) properties, including a utility easement.

Zone III: St. Joseph River and tributary corridors, including industrial lands.

Zone IV: Residential and commercial neighborhoods, including some public properties (parks and school).

Table 4. City of St. Joseph Invasive Species Control Annual Work Plan Schedule (2015 - 2016)

Tasks	(Year)	2015												2016												Assumptions	Roles/ Responsibilities	Cost Projection/Options			Labor Projection/Options				Estimated Budget Range				
		(Calendar Month)	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N			D	Unit cost	Acres	Est Cost	Labor/Acre	Total Labor-hours	Labor/Acre	Total Labor-hours	Total Costs	Total Costs		
1. Community Outreach, Staff and Volunteer Training																																							
a. Organize and conduct annual staff and volunteer training sessions (including treatment and control methods, and monitoring and ED/RR protocols).				x	x					x	x											x	x			4 sessions/yr	Consultant/ assigned staff/ trained private landowners/ township staff											\$500	\$2000
b. Conduct outreach communications, special meetings, site visits, and reporting as needed.		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	10% LTE or staff time	Consultant/ assigned staff/ trained private landowners/ township staff											\$3000	\$5000	
c. Prepare annual summary of accomplishments, and review and update the annual work plan.																									10% LTE or staff time	Consultant/ assigned staff											\$3000	\$5000	
2. Invasive Plant Management Oversight																																							
a. Conduct management and oversight of invasive species control program activities, and document all activities.		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	25% LTE or staff time	Consultant/ assigned staff/ trained private landowners/ township staff											\$5500	\$15000	
3. Invasive Plant Management																																							
See: Map Figures 2A, 2B, and 3 for population locations and management zones; Table 1 Summary of Target Invasive Plant Populations with Control Priority Level, Management Objectives and Options, and Control Methods; Section V 4-Year Work Plan.																																							
a. Conduct Japanese/Giant Knotweed control in Priority 1 and 2 sites using highly trained staff or professionals.																									(See also control methods in Section V). Assumes summer mowing to reduce biomass, in combination with fall herbicide application using aminopyralid (Milestone), imazapyr (Arsenal), or glyphosate.	Highly qualified professionals or City staff, township staff	5,000	26	130,000	4	104							\$130,000	
b. Conduct Japanese/Giant Knotweed control in Priority 3 sites using volunteer labor.																									Same as above.	Trained volunteers	1,200	26	31,200			20	520	\$31,200					
c. Conduct Oriental Bittersweet control in Priority 1 and 2 sites using highly trained staff or professionals.				x	x																				(See also control methods in Section V). Triclopyr formulated for use with penetrating oil or a strong solution of glyphosate (20% a.i. suggested) can be applied to cut stems in the fall after native plants have gone dormant or in early spring before the emergence of spring ephemerals.	Highly qualified professionals or City staff, township staff	5,000	16	80,000	4	64						\$80,000		
d. Conduct Oriental Bittersweet control in Priority 3 sites using volunteer labor.				x	x																				Same as above.	Trained volunteers	1,200	16	19,200			20	320	\$19,200					
e. Conduct Phragmites control in Priority 1 and 2 sites using highly trained staff or professionals. (Assumed to be Population Classification Categories 4 and 5--See Figure 3)																									(See also control methods in Section V). Assumes 3 treatments per population with early or mid summer mowing and late summer/fall foliar herbicide application to regrowth at 2 qts/acre active ingredient per treatment).	Highly qualified professionals or City staff, township staff	5,000	12	60,000	4	48						\$60,000		
f. Conduct Phragmites control in Priority 3 sites using volunteer labor. (Assumed to be Population Classification Categories 1,2 and 3--See Figure 3)																									Same as above.	Trained volunteers	1,200	12	14,400			20	240	\$14,400					

Tasks	(Year)	2015												2016												Assumptions	Roles/ Responsibilities	Cost Projection/Options			Labor Projection/Options				Estimated Budget Range		
		(Calendar Month)	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N			D	Unit cost	Acres	Est Cost	Labor/Acre	Total Labor-hours	Labor/Acre	Total Labor-hours	Total Costs	Total Costs
																										\$/acre		\$/species	Professional hrs/acre	Professional Hours	Volunteer hrs/acre	Volunteer Hours	Low 4 year budget	High 4 year budget			
g. Conduct Japanese Honeysuckle control in Priority 1 and 2 sites using highly trained staff or professionals.				x	x			x	x	x	x					x	x			x	x	x	x			(See also control methods in Section V). Can be controlled to some degree with prescribed burning (typically spring burn); glyphosate can be applied to foliage in fall after native plants have gone dormant, but before hard freeze	Highly qualified professionals or City staff, township staff	5,000	5.3	26,500	4	21					
h. Conduct Japanese Honeysuckle control in Priority 3 sites using volunteer labor.				x	x			x	x	x	x					x	x			x	x	x	x			Same as above.	Trained volunteers	1,200	5.3	6,360			20	106	\$6,360		
4. Restoration and Maintenance																																					
a. Apply cover crop seeding for erosion control and new colonization prevention (100 lbs annual rye grass/acre raked in soil)				x	x	x			x	x	x					x	x	x			x	x	x			See Restoration Methods Section (Assumes 1 seeding event per year)	Highly qualified professionals or City staff, township staff	1,000	59	59,000		0	15	885		\$59,000	
b. Apply enhancement native ground story seeding (8-10lbs native forbs/sedges/grasses per acre, broadcast and raked into soil; species lists based on Natural Community Abstracts in Appendix ___.				x	x						x	x	x			x	x						x	x	x	See Restoration Methods Section (Assumes 1 seeding event per year)	Highly qualified professionals or City staff, township staff	1,000	59	59,000		0	15	885	\$59,000		
c. Conduct follow-up herbicide treatments as needed to maintain control in all treatment areas.				x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x			See treatment methods above.	Highly qualified professionals or City staff, township staff	1,000	59	59,000		0	15	885	\$59,000		
5. Monitoring and ED/RR																																					
a. Conduct ED/RR volunteer monitoring and reporting activities.				x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x			See Monitoring Method Section (Assumes must be done seasonally depending on target species)	Highly qualified professionals or City staff, township staff and volunteers								\$5,000	\$15,000	
b. Conduct erosion control and treatment performance monitoring and reporting activities for all treatment locations.				x	x				x	x													x	x			Highly qualified professionals or City staff, township staff							\$5,000	\$15,000		
TOTALS																																		\$140,160	\$385,500		

Figure 3. Invasives Management Zones

Legend

- St Joseph Boundary

Priority Control Zones

- Zone I: Coastal (309 ac)
- Zone II: Ravine (320 ac)
- Zone III: St. Joseph River And Tributary (755 ac)
- Zone IV: Other (954 ac)

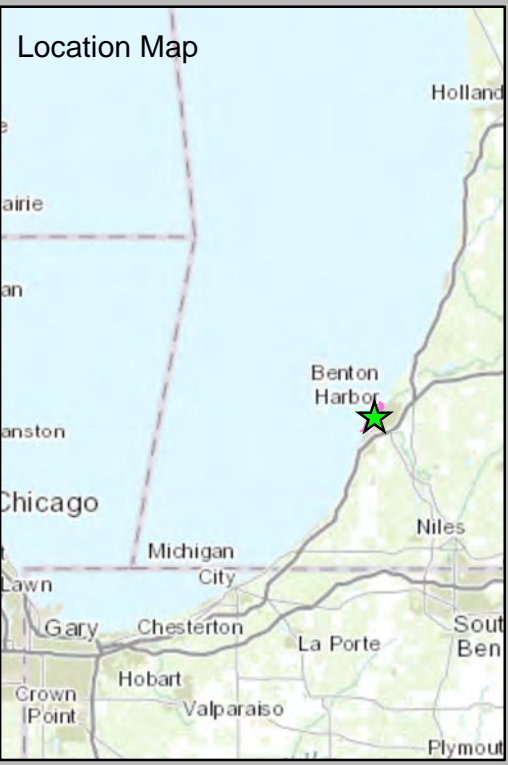
Invasive Population Locations Within St. Joseph by Size

- 1 - Individual/few/several (24 locations)
- 2 - Less than 1,000 sq ft (41 locations)
- 3 - 1,000 sq ft to half acre (38 locations)
- 4 - Half acre to one acre (26 locations)
- 5 - Greater than one acre (5 locations)

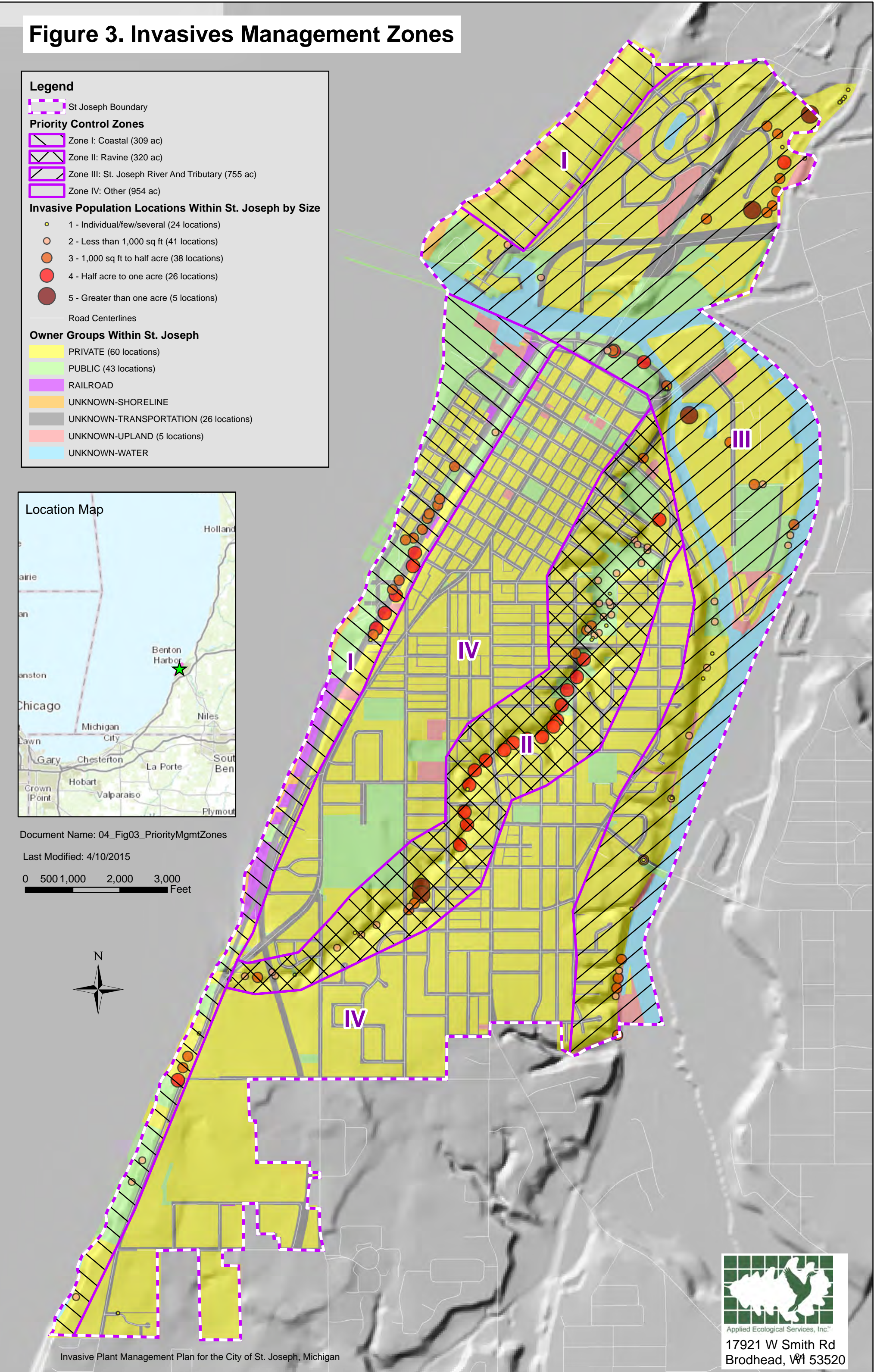
Road Centerlines

Owner Groups Within St. Joseph

- PRIVATE (60 locations)
- PUBLIC (43 locations)
- RAILROAD
- UNKNOWN-SHORELINE
- UNKNOWN-TRANSPORTATION (26 locations)
- UNKNOWN-UPLAND (5 locations)
- UNKNOWN-WATER



Document Name: 04_Fig03_PriorityMgmtZones
 Last Modified: 4/10/2015
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The Management Zones are intended to help the City prioritize and organize City staff, volunteers and stakeholders around management activities. The Management Zone map presents the invasive species population locations classified based on the area of coverage. For example, large red dots represent populations that cover a half-acre or more. These may be locations where the City focuses initial efforts to have the greatest impact on reducing population size. It is interesting to point out that in Zone II in the vicinity of the Kiwanis Park, where regular maintenance of the open recreational spaces of the park occurs, populations are significantly smaller than in other population locations within the ravine setting. This is an encouraging example of how targeted management can be successful.

Proposed methods for controlling the key invasive species identified in the plan are presented in Table 1. Additional methods may be considered based on guidance and recommendations provided by professional contractors and online partner resources (Appendices 3 and 4).

The following prioritization matrix (Table 5) is based on the risk level of the mapped invasive populations presented in Figures 2A, 2B, and 3. Applying this strategy is intended to maximize cost-effective and systematic control of invasive species over time and to minimize spread to new locations. These categories are intended to be re-evaluated periodically as part of the adaptive management approach of the plan, including annually during review and updating of the annual work plan and over the long term with review and updating of the broader management plan.

Priority Level	Risk Level	Description
1	High	Densely colonized high risk natural settings such as forested ravines and coastline settings, where existing native vegetation and species diversity occurs and can more easily be restored (avoiding costly restoration efforts).
2	High	Densely colonized vector locations risking spread along river corridors at risk for flooding and movement of invasive propagules (seeds and viable plants parts) downstream to new invasion sites.
3	Medium	Scattered populations in settings with lower sensitivity, where natural vegetation is not likely to be deleteriously impacted by colonization and erosion risk is low.

D. Restoration and Maintenance

Restoration of treatment sites should be undertaken by professional restoration specialists with knowledge of species selection and best methods for stabilizing and revegetating disturbed conditions. When scheduling such efforts, methods and maintenance activities should be specified and approved by the City as part of a contractual agreement. When volunteers are included in restoration and maintenance efforts, they must have proper oversight by trained individuals to ensure quality control. Follow-up maintenance of all treated control sites will be required on a regular basis following initial control efforts to be cost-effective and long-lasting. It will be imperative that treatment activities and locations be documented and mapped, to facilitate proper maintenance and monitoring of these sites.

E. Monitoring and ED/RR

Monitoring and ED/RR efforts should be scheduled on a regularly occurring basis, using standardized forms for accurate and complete data collection. Undertaking monitoring efforts of this nature will require trained staff, volunteers, or professionals, who can be accountable for the results and interpretation of the data. Standardized forms for both regular monitoring of treatment sites and for conducting ED/RR efforts are included in Appendix 5. Generally, monitoring is most effectively conducted during early, mid-season, and late-season periods of vegetative growth. Scheduling treatment site monitoring will also be influenced by the timing of treatment and scheduling of follow-up treatment efforts and outcomes. Some trained individuals can assess conditions of treatment success or sites of new invasions even during the off-season, when vegetation is dormant. For this reason, the work plan schedule includes all months of the year for undertaking monitoring and ED/RR activities, as budgets, staffing, and volunteer labor allows.

F. Demonstration Project

To initiate the City-wide invasives control effort, a demonstration project for the benefit of the general public has been designed for Kiwanis Park to provide an example on City-owned land of how invasive species management, restoration, and collaboration strategies can be undertaken. The proposed project location, which includes surrounding residential properties, is available for review at the City office. This project is part of a larger grant proposal that is intended to establish a new regional Cluster or CISMA (Cooperative Invasive Species Management Area) in southwest Michigan, to strengthen the networking support and resources available to the City for ongoing invasive species management as part of a regional effort.

G. Funding

Having solid partnerships with other stakeholders in invasive species concerns greatly increases chances of procuring funding, particularly funding for projects of significant size and scope. Many funders, including the State of Michigan, require partnerships to deal with topic that is inherently cross-jurisdictional. Partners may sometimes have useful certifications and training (e.g., pesticides, prescribed burning) that are needed in the project. An educational partner might be a key player in an early detection & rapid response program.

In addition, since almost all grant funding requires some level of match, having multiple partners can assist greatly with meeting that requirement. For example, partners may be able to mobilize volunteer labor, contribute to outreach and publicity, as well as providing in-kind services. The City may also be able to value the use of its GIS mapping services or other relevant City data. Funding sometimes may be available for related projects and needs (e.g., restoration, water quality protection, park improvements, pollinator habitat) that will allow the integration of invasive plant control as part of a larger related project. The City is more apt to be positioned to take advantage of such opportunities when they have a solid inventory. Funders vary in their requirements for using contractors. Sometimes whether or not the RFP must go out to bid depends on the contract amount. Some funders, such as the USEPA, allow a contractor to also be a partner on the grant if they currently hold a contract with the City.

In the Appendix, we list virtual cards for potential funders identified to date. These contain basic information about the grant opportunity (the funder, the website, the amount of funds available, eligible recipients, etc. As a first step in forming partnerships and securing funding, the City might

consider joining a regional CWMA or CISMA. Currently The Stewardship Network's Clusters (the Southwest Cluster) function as CISMAs. Conservation Districts frequently perform this role as well.

VI. SUMMARY

Invasive plant species are with us to stay but that does not mean that they must run wild and take over our landscapes. An adaptive invasive plant management plan can, enacted with a series of integrated actions, maintain a certain level of control, reduce incidences of invasions, protect high quality natural areas and in general, reduce their negative effects on the environment. For such a plan to be effective, it must be tied to control and management actions that are continually assessed by monitoring, producing a feed-back loop for adaptive management.

Invasive plants are a global, national and regional problem that respects no boundaries. Because of this, a successfully implemented plan must take advantage of shared information and resources across the many invasive species networks. Implementation frequently requires partnerships beyond the any particular land ownership.

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APPENDICES

Appendix 1. Invasive Species Population Data for the City of St. Joseph.

Table 2 contains invasive species data collected at 173 locations within the City of St. Joseph and adjacent lands by Randy Counterman during 2013. Data is classified by treatment status (Untreated or Treated) and by estimates of Area and Density. Table 1 summarizes the number of invasive species populations by public and private land ownership.

Table 1. Summary of Populations by Ownership Group.

Ownership Group	Jk	Jhv	Ob	Ph	UNK	Total	Percent
PRIVATE	20	12	17	11		60	35%
PUBLIC	21	9	12	1		43	25%
UNKNOWN-TRANSPORTATION	8	7	11			26	15%
UNKNOWN-UPLAND		1	1	3		5	3%
UNKNOWN-Outside City	20	1	3	11	4	39	23%
Total	69	30	44	26	4	173	100%

Table 2. Invasive Species Data Listing by GPS Point.

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
1	12/3/2013	Ob	Oriental bittersweet	Untreated	2	s	1	From northernmost stretch of Paw Paw River (inside SJ City limits) to start of wetland. Benton Harbor. < 10 plants.	UNKNOWN-Outside City	42.12282693400	-86.46450507600
2	12/3/2013	Ph	Common reed	Untreated	1	s	1	From northernmost stretch of Paw Paw River (inside SJ City limits) to start of wetland. Benton Harbor.	PRIVATE	42.12238919700	-86.46473252800
3	12/3/2013	Ob	Oriental bittersweet	Untreated	1	s	1	From northernmost stretch of Paw Paw River (inside SJ City limits) to start of wetland. Benton Harbor. < 5 plants.	PRIVATE	42.12205398100	-86.46492505100
4	12/3/2013	Ob	Oriental bittersweet	Untreated	1	s	1	From northernmost stretch of Paw Paw River (inside SJ City limits) to start of wetland. Benton Harbor. < 10 plants.	PRIVATE	42.12197208400	-86.46501791500

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
5	12/3/2013	Ob	Oriental bittersweet	Untreated	1	s	1	From northernmost stretch of Paw Paw River (inside SJ City limits) to start of wetland. Benton Harbor. < 10 plants.	PRIVATE	42.12187123300	-86.46516573400
6	12/3/2013	Ob	Oriental bittersweet	Untreated	1	s	1	From northernmost stretch of Paw Paw River (inside SJ City limits) to start of wetland. Benton Harbor.	PRIVATE	42.12182819800	-86.46521723300
7	12/3/2013	UNK	Unknown	Treated	1	d	3	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12082839000	-86.46038317700
8	12/3/2013	UNK	Unknown	Treated	1	d	3	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12081241600	-86.46068513400
9	12/3/2013	Jk	Japanese/giant knotweed	Untreated	1	S	1	Around MTEC. Benton Harbor. 1 plant.	UNKNOWN-Outside City	42.12076199100	-86.46109199500
10	12/3/2013	UNK	Unknown	Don't Know	1		1	Around MTEC. Benton Harbor. 1 plant.	UNKNOWN-Outside City	42.12072813500	-86.46129882300
11	12/3/2013	Jk	Japanese/giant knotweed	Treated	3	d	3	Around MTEC. Benton Harbor. Long narrow patch.	UNKNOWN-Outside City	42.12070524700	-86.46193599700
12	12/3/2013	Jk	Japanese/giant knotweed	Untreated	1	s	1	Around MTEC. Benton Harbor. 1 plant.	UNKNOWN-Outside City	42.12074422800	-86.46230149300
13	12/3/2013	Jk	Japanese/giant knotweed	Untreated	1	s	1	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12084448300	-86.46226537200
14	12/3/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12095511000	-86.46215879900
15	12/3/2013	Jk	Japanese/giant knotweed	Untreated	1	s	1	Around MTEC. Benton Harbor. 1 plant.	UNKNOWN-Outside City	42.12120664100	-86.46218514400
16	12/3/2013	UNK	Unknown	Treated	2	d	3	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12152290300	-86.46237766700
17	12/3/2013	Jk	Japanese/giant knotweed	Treated	2	d	3	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12191474400	-86.46230721500
18	12/3/2013	Jk	Japanese/giant knotweed	Treated	2	d	3	Around MTEC. Benton Harbor.	UNKNOWN-Outside City	42.12231981800	-86.46179390000
19	12/3/2013	Jk	Japanese/giant knotweed	Treated	3	p	2	Benton Harbor side of SJ River. DNR Public Access. In Park along edges.	UNKNOWN-Outside City	42.10172426700	-86.46692359400

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
20	12/3/2013	Jk	Japanese/giant knotweed	Treated	1	p	2	Benton Harbor side of SJ River. DNR Public Access. In planter in Park.	UNKNOWN-Outside City	42.10215520900	-86.46666061900
21	12/3/2013	Jk	Japanese/giant knotweed	Treated	2	d	3	Benton Harbor side of SJ River. DNR Public Access.	UNKNOWN-Outside City	42.10263240300	-86.46637010600
22	12/3/2013	Jk	Japanese/giant knotweed	Treated	2	d	3	Benton Harbor side of SJ River. Boat Launch. Along River. Has been cut.	UNKNOWN-Outside City	42.10296070600	-86.46623432600
23	12/3/2013	Jk	Japanese/giant knotweed	Treated	2	d	3	Benton Harbor side of SJ River. Boat Launch. Along River. Has been cut.	UNKNOWN-Outside City	42.10484063600	-86.46472108400
24	12/3/2013	Jk	Japanese/giant knotweed	Treated	3	d	3	Benton Harbor side of SJ River. City Marina. Has been cut.	UNKNOWN-Outside City	42.10683739200	-86.46474635600
25	12/3/2013	Jk	Japanese/giant knotweed	Treated	1	d	3	Benton Harbor side of SJ River.	UNKNOWN-Outside City	42.10753929600	-86.46477782700
26	12/3/2013	Jk	Japanese/giant knotweed	Treated	1	d	3	Benton Harbor side of SJ River.	UNKNOWN-Outside City	42.10767161800	-86.46480536500
27	12/3/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3	Benton Harbor side of SJ River.	UNKNOWN-Outside City	42.10860443100	-86.46501958400
28	12/3/2013	Jk	Japanese/giant knotweed	Treated	3	d	3	Benton Harbor side of SJ River. Pier 1000 property.	UNKNOWN-Outside City	42.10117948100	-86.46732521100
29	12/3/2013	Ph	Common reed	Untreated	1	p	2	Benton Harbor side of SJ River. Pier 1000 property.	UNKNOWN-Outside City	42.09946000600	-86.46847450700
30	12/3/2013	Jk	Japanese/giant knotweed	Treated	1	p	2	Benton Harbor side of SJ River.	UNKNOWN-Outside City	42.08821737800	-86.47437715500
31	12/3/2013	Jk	Japanese/giant knotweed	Treated	1	p	2	Benton Harbor side of SJ River.	UNKNOWN-Outside City	42.08749830700	-86.47495758500
32	12/4/2013	Ob	Oriental bittersweet	Untreated	1	s	1	Few plants.	PUBLIC	42.08930206300	-86.47657847400
33	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	p	2		PUBLIC	42.08930206300	-86.47657847400
34	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	p	2		PUBLIC	42.08930206300	-86.47657847400
35	12/4/2013	Jhv	Japanese honeysuckle	Untreated	3	p	2		PUBLIC	42.08930206300	-86.47657847400
36	12/4/2013	Jhv	Japanese honeysuckle	Untreated	3	d	3		PUBLIC	42.08930206300	-86.47657847400
37	12/4/2013	Ph	Common reed	Untreated	4	d	3		UNKNOWN-Outside City	42.07830178700	-86.47915327500

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
38	12/4/2013	Ph	Common reed	Untreated	2	p	2		UNKNOWN-Outside City	42.08205521100	-86.47693193000
39	12/4/2013	Ph	Common reed	Untreated	1	s	1	On pile of dumped soil.	UNKNOWN-Outside City	42.07604265200	-86.48030102300
40	12/4/2013	Ph	Common reed	Untreated	1	s	1		UNKNOWN-Outside City	42.07732319800	-86.47961401900
41	12/4/2013	Jhv	Japanese honeysuckle	Untreated	3	p	2		UNKNOWN-Outside City	42.07956171000	-86.47831964500
42	12/4/2013	Ob	Oriental bittersweet	Untreated	1	p	2		UNKNOWN-Outside City	42.08090472200	-86.47795414900
43	12/4/2013	Ph	Common reed	Untreated	3	p	2	This patch is 100' west of footbridge.	UNKNOWN-UPLAND	42.08178305600	-86.47807049800
44	12/4/2013	Jhv	Japanese honeysuckle	Untreated	2	p	2		PRIVATE	42.08345615900	-86.47819590600
45	12/4/2013	Ob/Jhv	Oriental bittersweet, Japanese honeysuckle	Untreated	3	d	3	Ob/Jhv	PRIVATE	42.08379995800	-86.47812712200
46	12/4/2013	Jhv	Japanese honeysuckle	Untreated	3	d	3		PRIVATE	42.08422613100	-86.47803950300
47	12/4/2013	Jhv	Japanese honeysuckle	Untreated	2	p	2		PRIVATE	42.08454644700	-86.47799134300
48	12/4/2013	Jhv	Japanese honeysuckle	Untreated	3	p	2		PRIVATE	42.08503401300	-86.47786128500
49	12/4/2013	Ph	Common reed	Untreated	1	p	2		UNKNOWN-UPLAND	42.08721125100	-86.47726082800
50	12/4/2013	Ob	Oriental bittersweet	Untreated	2	s	1		UNKNOWN-UPLAND	42.09193766100	-86.47497248600
51	12/4/2013	Jhv	Japanese honeysuckle	Untreated	1	s	1		UNKNOWN-UPLAND	42.09195709200	-86.47495007500
52	12/4/2013	Jhv	Japanese honeysuckle	Untreated	1	s	1		PRIVATE	42.09710454900	-86.47312641100
53	12/4/2013	Jhv/Ob	Japanese honeysuckle, Oriental bittersweet	Untreated	2	p	2	Jhv/Ob	PRIVATE	42.09757208800	-86.47289550300
54	12/4/2013	Ob	Oriental bittersweet	Untreated	1	s	1	"O" on form, assumed OB	PRIVATE	42.09817087700	-86.47260665900
55	12/4/2013	Ob/Jhv	Oriental bittersweet, Japanese honeysuckle	Untreated	2	d	3	Ob/Jhv	PUBLIC	42.09954023400	-86.47245657400
56	12/4/2013	Ob	Oriental bittersweet	Untreated	2	d	3		PUBLIC	42.10039901700	-86.47247433700
57	12/4/2013	Jhv	Japanese honeysuckle	Untreated	2	p	2		PRIVATE	42.09463512900	-86.47393488900
58	12/4/2013	Ob	Oriental bittersweet	Untreated	2	p	2	Kiwanis Park.	PUBLIC	42.10204803900	-86.47669768300
59	12/4/2013	Jk	Japanese/giant knotweed	Untreated	3	d	3	Marsh Street.	UNKNOWN-TRANSPORTATION	42.10655951500	-86.47659623600

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
60	12/4/2013	Ph	Common reed	Untreated	4	d	3	Transfer Station.	PRIVATE	42.10391986400	-86.47567379500
61	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	2	p	2	Uncertain (question mark)	UNKNOWN-TRANSPORTATION	42.10258948800	-86.47635161900
62	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	2	p	2	Uncertain (question mark)	UNKNOWN-TRANSPORTATION	42.10273218200	-86.47635781800
63	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	2	p	2	Uncertain (question mark)	UNKNOWN-TRANSPORTATION	42.10305416600	-86.47710096800
64	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	2	p	2	Uncertain (question mark)	UNKNOWN-TRANSPORTATION	42.10285079500	-86.47692394300
65	12/4/2013	Ob	Oriental bittersweet	Untreated	2	s	1		PUBLIC	42.10161542900	-86.47814607600
66	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	1	s	1	Uncertain (question mark)	PUBLIC	42.10074222100	-86.47852766500
67	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3		UNKNOWN-TRANSPORTATION	42.10037159900	-86.47856199700
68	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3		PUBLIC	42.10023176700	-86.47850012800
69	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	p	2		PUBLIC	42.09983182000	-86.47844576800
70	12/4/2013	Jk	Japanese/giant knotweed	Untreated	1	s	1		PUBLIC	42.09936368500	-86.47873508900
71	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3		PUBLIC	42.09906292000	-86.47916078600
72	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3		PUBLIC	42.09895920800	-86.47941172100
73	12/4/2013	Jk	Japanese/giant knotweed	Untreated	1	s	1	1 stem.	PUBLIC	42.09882974600	-86.47951138000
74	12/4/2013	Jhv	Japanese honeysuckle	Untreated	1	s	1		PUBLIC	42.09876728100	-86.47957217700
75	12/4/2013	Jk	Japanese/giant knotweed	Untreated	3	d	3	Along both sides of the stream.	PUBLIC	42.09916436700	-86.47986209400
76	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	2	p	2	Uncertain (question mark)	PUBLIC	42.09922790500	-86.47979271400
77	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	3	p	2	Uncertain (question mark)	PUBLIC	42.09935116800	-86.47958934300
78	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3		PUBLIC	42.09974241300	-86.47888636600
79	12/4/2013	Jk	Japanese/giant knotweed	Untreated	2	s	1		UNKNOWN-TRANSPORTATION	42.10031592800	-86.47914075900
80	12/4/2013	Jhv?	Japanese honeysuckle	Untreated	2	p	2	Uncertain (question mark)	PUBLIC	42.10130834600	-86.47921466800
81	12/6/2013	Ph	Common reed	Untreated	1	s	1		PUBLIC	42.08436310300	-86.49675571900
82	12/6/2013	Jhv	Japanese honeysuckle	Untreated	3	p	2		PRIVATE	42.08425879500	-86.49891233400
83	12/6/2013	Jhv	Japanese honeysuckle	Untreated	2	p	2		PRIVATE	42.08430063700	-86.49965667700
84	12/6/2013	Jhv	Japanese honeysuckle	Untreated	1	s	1		PRIVATE	42.08415746700	-86.50054526300
85	12/6/2013	Jhv	Japanese honeysuckle	Untreated	2	d	3		UNKNOWN-TRANSPORTATION	42.08447885500	-86.49807238600

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
86	12/6/2013	Jhv	Japanese honeysuckle	Untreated	2	p	2		PRIVATE	42.08432471800	-86.49788785000
87	12/6/2013	Jhv	Japanese honeysuckle	Untreated	2	p	2		PRIVATE	42.08553028100	-86.49432528000
88	12/6/2013	Ob	Oriental bittersweet	Untreated	1	s	1		PRIVATE	42.08617079300	-86.49327564200
89	12/6/2013	Ph	Common reed	Untreated	2	d	3		PRIVATE	42.08607971700	-86.49291861100
90	12/6/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3	1st Patch.	PRIVATE	42.08649337300	-86.49203002500
91	12/6/2013	Jk	Japanese/giant knotweed	Untreated	2	d	3		PRIVATE	42.08730638000	-86.49012315300
92	12/6/2013	Jk	Japanese/giant knotweed	Untreated	3	d	3		PRIVATE	42.08744394800	-86.48982584500
93	12/6/2013	Jk	Japanese/giant knotweed	Untreated	5	d	3	"4-5" PopEst - On loop to school. > 70% coverage of ravine.	PRIVATE	42.08814287200	-86.48943960700
94	12/6/2013	Jk	Japanese/giant knotweed	Untreated	5	p	2	"4-5" PopEst - 50% coverage and climbing slope.	PRIVATE	42.08781981500	-86.48943913000
95	12/6/2013	Jhv	Japanese honeysuckle	Untreated	3	p	2	Looks like yard waste area.	UNKNOWN-TRANSPORTATION	42.08715164700	-86.49016785600
96	12/6/2013	Ob	Oriental bittersweet	Untreated	1	s	1		PRIVATE	42.08185637000	-86.50229907000
97	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	3	d	3	On bluff.	PRIVATE	42.08085262800	-86.50295567500
98	12/6/2013	Ob	Oriental bittersweet	Untreated	3	p	2	On bluff.	PRIVATE	42.08036899600	-86.50323987000
99	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	4	d	3	On bluff.	PUBLIC	42.07983160000	-86.50352692600
100	12/10/2013	Ph	Common reed	Untreated	5	d	3	"4-5" PopEst - Can see from Penetrator (Bridge overpass over River).	PRIVATE	42.10841500800	-86.47393357800
101	12/6/2013	Jk	Japanese/giant knotweed	Untreated	3	p	2	Could be 2 patches.	PRIVATE	42.10724699500	-86.47157764400
102	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	2	d	3		PUBLIC	42.10281407800	-86.46820473700
103	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	2	d	3		PUBLIC	42.10325408000	-86.46808493100
104	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	3	p	2	Follows fence line on both sides.	PUBLIC	42.10370445300	-86.46787810300
105	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	2	d	3	Both sides of fence.	PUBLIC	42.10543990100	-86.46967828300
106	12/6/2013	Jk	Japanese/giant knotweed	Untreated, Treated	3	d	3	Mowed. Inside fence.	PUBLIC	42.10542559600	-86.47016990200

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
107	11/14/2013	Ob	Oriental bittersweet	Untreated	2	s	1	Private property. 60' x 30'. Sparse.	UNKNOWN-TRANSPORTATION	42.11431789400	-86.48251545400
108	11/14/2013	Ob	Oriental bittersweet	Untreated	2	s	1	Private property. 60' x 30'. Sparse.	PRIVATE	42.11571419200	-86.48444175700
109	11/14/2013	Jk	Japanese/giant knotweed	Untreated, Treated	2	d	3	10' diameter patch. 6' high.	UNKNOWN-TRANSPORTATION	42.11117923300	-86.47867035900
110	11/14/2013	Jk	Japanese/giant knotweed		3	d	3	40' x 20' patch. 2' ΓÇô 4' high.	UNKNOWN-TRANSPORTATION	42.11119592200	-86.47834599000
111	12/10/2013	Ob	Oriental bittersweet	Untreated, Treated	4	p	2	Ob, Japanese bush honeysuckle, other.	UNKNOWN-TRANSPORTATION	42.11116766900	-86.47830426700
112	11/14/2013	Jk	Japanese/giant knotweed	Treated	4	d	3	On slope. Has been recently mowed.	UNKNOWN-TRANSPORTATION	42.11068141500	-86.47655439400
113	11/14/2013	Ob	Oriental bittersweet	Untreated	1	p	2		UNKNOWN-TRANSPORTATION	42.10955834400	-86.47523713100
114	11/14/2013	Jhv	Japanese honeysuckle	Untreated	3	s	1	Along River. A few dozen.	UNKNOWN-TRANSPORTATION	42.10966718200	-86.47523605800
115	11/14/2013	Jk	Japanese/giant knotweed	Untreated	1	d	3	At top of Pedestrian Bridge.	PRIVATE	42.09874725300	-86.49238860600
116	12/10/2013	Ob/Jk	Oriental bittersweet, Japanese/giant knotweed	Untreated, Treated	3	p	2	Ob/Jk - High on bluff.	PRIVATE	42.09897232100	-86.49222672000
117	12/10/2013	Ob/Jk	Oriental bittersweet, Japanese/giant knotweed	Untreated, Treated	4	p	2	Ob/Jk - Along slope next to RR Tracks. 35% Ob coverage. 5% Jk coverage.	UNKNOWN-TRANSPORTATION	42.09924459500	-86.49205589300
118	12/10/2013	Ob/Jk	Oriental bittersweet, Japanese/giant knotweed	Untreated, Treated	4	s	1	Ob/Jk - RR Track slope. 15% Ob coverage. Few small Jk patches.	UNKNOWN-TRANSPORTATION	42.09990644500	-86.49155616800
119	12/10/2013	Ob	Oriental bittersweet	Untreated, Treated	4	s	1	10% Ob coverage on RR Track slope.	UNKNOWN-TRANSPORTATION	42.10066688100	-86.49091732500
120	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	100' x 40' patch between walk path and RR Track. Looks new.	UNKNOWN-TRANSPORTATION	42.10092449200	-86.49110007300
121	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	Between walk path and RR Track. Few scattered Ob. < 5%.	UNKNOWN-TRANSPORTATION	42.10132896900	-86.49073112000
122	12/10/2013	Ob	Oriental bittersweet	Untreated, Treated	4	s	1	20% coverage on slope.	PUBLIC	42.10192942600	-86.48993039100
123	11/14/2013	Ob	Oriental bittersweet	Untreated, Treated	4	s	1	20% coverage on slope.	UNKNOWN-TRANSPORTATION	42.10248923300	-86.48982071900

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
124	12/10/2013	Jhv	Japanese honeysuckle	Untreated	3	d	3	100' x 40' dense patch between trail and road.	PUBLIC	42.10305595400	-86.49035430000
125	11/14/2013	Jhv	Japanese honeysuckle	Untreated, Treated	3	p	2	Both sides of trail. Power-line corridor. Has been mowed.	PUBLIC	42.10313379800	-86.48988997900
126	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	Between trail and RR Track. Few/sparse.	PUBLIC	42.10350275000	-86.48938059800
127	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	Both sides of trail. Few/sparse.	PUBLIC	42.10397946800	-86.48910105200
128	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	Both sides of trail. Few/sparse. Silver dollar plant, too.	PUBLIC	42.10416746100	-86.48898065100
129	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	Both sides of trail. Few/sparse.	PUBLIC	42.10453355300	-86.48848915100
130	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	On RR Track side (other side is maintained/mowed). Few/sparse.	PUBLIC	42.10480570800	-86.48837506800
131	11/14/2013	Ob	Oriental bittersweet	Untreated	3	s	1	On RR Track side (other side is maintained/mowed). Few/sparse.	UNKNOWN-TRANSPORTATION	42.10619974100	-86.48751390000
132	11/15/2013	Jk	Japanese/giant knotweed	Untreated, Treated	2	d	3	Lookout Park. 60' x 20' patch. 8' high. Some have been cut. Top of bluff.	PUBLIC	42.07546567900	-86.50619232700
133	11/15/2013	Jk	Japanese/giant knotweed	Untreated, Treated	2	d	3	Lookout Park. 50' x 10' patch. Small patches that have been cut.	PUBLIC	42.07638692900	-86.50558507400
134	12/18/2013	Jk	Japanese/giant knotweed	Untreated	3	d	3	Top of ravine.	UNKNOWN-TRANSPORTATION	42.09818863900	-86.48052322900
135	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	d	3	From entrance to cut path. Both sides of trail.	PUBLIC	42.09792387500	-86.48004078900
136	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	d	3	Cut path 100 yards. Both sides of trail.	UNKNOWN-TRANSPORTATION	42.09718012800	-86.48044359700
137	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	100 yards. Measurement taken at mid-point. Both sides of trail.	PUBLIC	42.09659695600	-86.48100280800
138	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	Skinny patches on both sides of trail.	PUBLIC	42.09594833900	-86.48132431500
139	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	Skinny patches on both sides of trail.	PRIVATE	42.09530603900	-86.48158836400
140	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	50% coverage.	PRIVATE	42.09503448000	-86.48179006600
141	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	50% coverage.	PRIVATE	42.09457778900	-86.48244845900
142	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	50% coverage.	PRIVATE	42.09449815800	-86.48332846200
143	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	50% coverage.	PRIVATE	42.09432804600	-86.48411405100
144	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	p	2	50% coverage.	PRIVATE	42.09402954600	-86.48463368400

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
145	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	dp	3		PRIVATE	42.09357452400	-86.48571825000
146	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	dp	3		PRIVATE	42.09314489400	-86.48634851000
147	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	ps	2		PRIVATE	42.09251570700	-86.48667514300
148	12/18/2013	Ob	Oriental bittersweet	Untreated	1	s	1		PRIVATE	42.09233176700	-86.48677194100
149	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	dp	3		PRIVATE	42.09136986700	-86.48694729800
150	12/18/2013	Jk	Japanese/giant knotweed	Untreated	4	ps	2	Nothing in 2nd half of plot.	PRIVATE	42.09080886800	-86.48680174400
151	12/18/2013	Jk	Japanese/giant knotweed	Untreated, Treated	4	s	1	A lot has been cut at end of culvert.	PRIVATE	42.08994603200	-86.48719942600
152	12/18/2013	Ob	Oriental bittersweet	Untreated	2	p	2	@ condos	PRIVATE	42.07051241400	-86.50942444800
153	12/18/2013	Ob	Oriental bittersweet	Untreated, Treated	2	d	3	In yard and along power-line.	UNKNOWN-Outside City	42.06881189300	-86.50792217300
154	12/18/2013	Ob	Oriental bittersweet	Untreated, Treated	1	s	1	In chain-link fence.	UNKNOWN-TRANSPORTATION	42.06983578200	-86.50700140000
155	12/18/2013	Ph	Common reed	Untreated	2	d	3	Renaissance Athletic Center	UNKNOWN-Outside City	42.11850571600	-86.46446847900
156	12/18/2013	Ph	Common reed	Untreated	4	d	3	Between Paw Paw River Kayaking and foot bridge.	UNKNOWN-Outside City	42.11773848500	-86.46791875400
157	12/18/2013	Ph	Common reed	Untreated	1	s	1	At end of foot bridge.	UNKNOWN-UPLAND	42.11943268800	-86.46725010900
158	12/18/2013	Ob	Oriental bittersweet	Untreated	1	s	1		PRIVATE	42.11991918100	-86.46854960900
159	12/18/2013	Ob	Oriental bittersweet	Untreated	3	p	2	Several small patches between walk and wetland.	PRIVATE	42.12049329300	-86.46881485000
160	12/18/2013	Ob	Oriental bittersweet	Untreated	3	p	2	Several small patches between walk and wetland.	PRIVATE	42.12082040300	-86.46943426100
161	12/18/2013	Ph	Common reed	Untreated	4	d	3		PRIVATE	42.11926198000	-86.46843552600
162	12/18/2013	Ph	Common reed	Untreated	3	d	3		PRIVATE	42.11857390400	-86.46868479300
163	12/18/2013	Ph	Common reed	Untreated	3	d	3		PRIVATE	42.11802208400	-86.46886014900
164	12/18/2013	Ph	Common reed	Untreated	3	p	2		PRIVATE	42.11740505700	-86.46912086000
165	12/18/2013	Ob	Oriental bittersweet	Untreated	3	p	2		PRIVATE	42.11711800100	-86.46943938700
166	12/18/2013	Ph	Common reed	Untreated	5	s	1	PLO Wetland Conservation Area.	PRIVATE	42.11722111700	-86.47028970700
167	12/18/2013	Ph	Common reed	Untreated	3	p	2	Between DEQWCA and Hwy.	PRIVATE	42.11684179300	-86.47292816600
168	12/18/2013	Ph	Common reed	Untreated	5	p	2	Between RR Tracks and road.	UNKNOWN-Outside City	42.11668658300	-86.46849799200

GPS Point ID	Date	Species Code	Species Name	Treatment Status	Area	Density	Area/Density	Comments	Owner Group	LAT_DD	LONG_DD
169	12/18/2013	Ph	Common reed	Untreated	5	p	2	Between RR Tracks and Kayak parking lot.	UNKNOWN-Outside City	42.11412024500	-86.46825051300
170	12/18/2013	Ph	Common reed	Untreated	2	d	3		UNKNOWN-Outside City	42.11402976500	-86.46908986600
171	12/18/2013	Ph	Common reed	Untreated	4	d	3		UNKNOWN-Outside City	42.11535608800	-86.46710228900
172	12/18/2013	Ob	Oriental bittersweet	Untreated	2	p	2	On slope in Park.	PUBLIC	42.10766935300	-86.48515391300
173	12/19/2013	Ph	Common reed	Untreated	5	dp	3	Huge patch of Ph throughout large wetland.	PRIVATE	42.12132585000	-86.46694850900

Appendix 2. Regional Invasive Plant Watch List for Southern Lower Peninsula and Action Categories (Higman and Campbell 2009).

A List Species: medium to high threat; mostly isolated occurrences, treat wherever found.		
Common Name	Scientific Name	Growth Habit
Amur cork-tree	<i>Phellodendron amurense</i>	tree
Black jetbead	<i>Rhodotypos scandens</i>	shrub
European frog-bit	<i>Hydrocharis morsus-ranae</i>	aquatic forb
Giant hogweed	<i>Heracleum mantegazzianum</i>	forb
Giant knotweed	<i>Polygonum sachalinensis, Fallopiya sachalinensis</i>	forb
Hydrilla	<i>Hydrilla verticillata</i>	aquatic forb
Japanese stilt grass	<i>Microstegium vimineum</i>	grass
Kudzu	<i>Pueraria lobata</i>	forb
Norway maple	<i>Acer platinoides</i>	tree
Pale swallow wort	<i>Vincetoxicum rossicum</i>	forb
Black swallow wort	<i>Vincetoxicum nigrum</i>	forb
Reed manna grass	<i>Glyceria maxima</i>	grass
Water-hyacinth	<i>Eichhornia crassipes</i>	aquatic forb

B List Species: medium to high threat; mostly local - found in some areas but not others; designate areas for eradication, suppression or containment; may choose to control based on specific management goals and situations.		
Common Name	Scientific Name	Growth Habit
Baby's breath	<i>Gypsophila paniculatus</i>	forb
Flowering rush	<i>Butomus umbellatus</i>	aquatic forb
Japanese knotweed	<i>Polygonum cuspidatum, Fallopiya japonica</i>	forb
Leafy spurge	<i>Euphorbia esula</i>	forb
Rusian olive	<i>Elaeagnus angustifolia</i>	shrub
Scotch pine	<i>Pinus sylvestris</i>	tree

C List Species: medium to high threat; widespread; no action required; may choose to control based on specific management goals and situations.		
Common Name	Scientific Name	Growth Habit
Amur honeysuckle	<i>Lonicera maackii</i>	shrub
Autumn olive	<i>Elaeagnus umbellata</i>	shrub
Bell's honeysuckle	<i>Lonicera x bella</i>	shrub
Black locust	<i>Robinia pseudo-acacia</i>	tree
Canada thistle	<i>Cirsium arvense</i>	forb
Common buckthorn	<i>Rhamnus cathartica</i>	shrub
Curly pondweed	<i>Potamogeton crispus</i>	aquatic forb
Eurasian water milfoil	<i>Myriophyllum spicatum</i>	aquatic forb
European fly honeysuckle	<i>Lonicera xylosteum</i>	shrub
Garlic mustard	<i>Alliaria petiolata</i>	forb

C List Species continued.		
Glossy buckthorn	<i>Rhamnus frangula</i>	shrub
Japanese barberry	<i>Berberis thunbergii</i>	shrub
Japanese honeysuckle	<i>Lonicera japonica</i>	woody vine
Morrow's honeysuckle	<i>Lonicera morrowii</i>	shrub
Multiflora rose	<i>Rosa multiflora</i>	shrub
Oriental bittersweet	<i>Celastrus orbiculatus</i>	woody vine
Purple loosestrife	<i>Lythrum salicaria</i>	forb
Reed canary grass	<i>Phalaris arundinacea</i>	grass
Common reed	<i>Phragmites australis</i>	grass
Scotch pine	<i>Pinus sylvestris</i>	tree
Spotted knapweed	<i>Centaurea maculosa</i>	forb
Tartarian honeysuckle	<i>Lonicera tatarica</i>	shrub
Tree-of-heaven	<i>Ailanthus altissima</i>	tree
Variable-leaf watermilfoil	<i>Myriophyllum heterophyllum</i>	aquatic forb

D List Species: more information required; may choose to control based on specific management goals and situations.		
Common Name	Scientific Name	Growth Habit
Black alder	<i>Alnus glutinosa</i>	shrub
European highbush cranberry	<i>Viburnum opulus</i>	shrub
Lesser naiad	<i>Najas minor</i>	aquatic forb

Appendix 3: Internet Links to Invasive Species Organizations and Resources

ORGANIZATION or SITE	AVAILABLE RESOURCES	GEOGRAPHICAL AREA	WEBSITE LINK
Michigan Department of Natural Resources	Information on Michigan invasive species including funding	Michigan, Great Lakes	http://www.michigan.gov/dnr/0,4570,7-153-10370_59996---,00.html
Michigan Department of Natural Resources	Best Control Practices (BCPs) for invasive plants	Michigan, Great Lakes	http://www.michigan.gov/dnr/0,4570,7-153-10370_59996_61470-277506--,00.html
Michigan Natural Features Inventory	Best Control Practices (BCPs) for invasive plants	Michigan, Great Lakes	http://mnfi.anr.msu.edu/invasive-species/best-control-practice-guides.cfm
Ann Arbor, Michigan Natural Area Preservation	Native planting guidelines for urban and residential areas	Michigan	http://www.a2gov.org/departments/Parks-Recreation/NAP/Native-Plants/Pages/NativePlants.aspx
Michigan State University	Native planting guidelines. Species lists by region, plant life history information sheets, ecosystem services, etc	Michigan by region	http://nativeplants.msu.edu/
The Nature Conservancy	Landowner guide to invasive plant management	National	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/vermont/volunteer/nature-conservancy-invasives-landowner-guide-april-2010.pdf
National Invasive Species information Center	Clearinghouse: basic information, legislation, conferences, funding, education, etc.	National	http://www.invasivespeciesinfo.gov/index.shtml
Midwest Invasive Species Information Network	Clearinghouse for the Midwest on invasive species. Reporting feature for early detection.	Midwest	http://www.misin.msu.edu/
Midwest Invasive Plant Network	Clearinghouse for invasive plants in the Midwest. Reporting feature for early detection. Information on developing Cooperative Weed Management Areas	Midwest	http://www.mipn.org/

ORGANIZATION or SITE	AVAILABLE RESOURCES	GEOGRAPHICAL AREA	WEBSITE LINK
Early Detection and Distribution Mapping System (EDDMapS), University of Georgia	National distributions of invasive species by state, counties, and points	National	http://www.eddmaps.org/
IBIS: International Biological Information System	Links to invasive species mapping sites	World	http://ibis.colostate.edu/cwis438/websites/IBIS/Home.php?WebSiteID=10
National Institute of Invasive Species Science (NISS)	Cooperative organization of government and non-government entities with responsibilities for managing invasive species. Interactive map data. Modeling.	National	http://www.niiss.org/cwis438/websites/niiss/home.php?WebSiteID=1
Global Invasive Species Information Network	Geospatial data on species	World	http://www.gisin.org/DH.php?WC=/WS/GISIN/GISINDirectory/home_new.html&WebSiteID=4
Michigan Invasive Species Coalition (Michigan State University)	Practical information for the public. Cooperative Weed Management Areas (CWMAs)	Michigan	http://www.michiganinvasives.org/
US EPA, Invasive Species: Great Lakes	Links to other sites. A small amount of information.	Great Lakes	http://www.epa.gov/greatlakes/invasive/
SeaGrant Michigan, Native and Invasive Species	Mostly invasive aquatic plants and animals. Also has information on coastal native plants	Michigan	http://www.miseagrant.umich.edu/explore/native-and-invasive-species/
Invasive Plants Association of Wisconsin	Complementary resource about invasive plants including planning and control information and explanations of CISMAs	Wisconsin	http://ipaw.org/
Go Beyond Beauty	information on using native plants in landscaping.	Midwest	http://habitatmatters.org/go-beyond-beauty/landscapers/

ORGANIZATION or SITE	AVAILABLE RESOURCES	GEOGRAPHICAL AREA	WEBSITE LINK
Michigan Department of Natural Resources	Information on Michigan invasive species including funding	Michigan, Great Lakes	http://www.michigan.gov/dnr/0,4570,7-153-10370_59996---,00.html
Michigan Department of Natural Resources	Best Control Practices (BCPs) for invasive plants	Michigan, Great Lakes	http://www.michigan.gov/dnr/0,4570,7-153-10370_59996_61470-277506--,00.html
Michigan Natural Features Inventory	Best Control Practices (BCPs) for invasive plants	Michigan, Great Lakes	http://mnfi.anr.msu.edu/invasive-species/best-control-practice-guides.cfm
Ann Arbor, Michigan Natural Area Preservation	Native planting guidelines for urban and residential areas	Michigan	http://www.a2gov.org/departments/Parks-Recreation/NAP/Native-Plants/Pages/NativePlants.aspx

Appendix 4. Contacts for Invasive Species Information in Michigan

Aquatic Invasive Species	Contact	Email and Phone
<p>Aquatic Invasive Species Program Questions on overall aquatic invasive species program and Michigan's Aquatic Invasive Species State Management Plan. www.michigan.gov/aquaticinvasives</p>	<p>Sarah LeSage AIS Program Coordinator DEQ - Water Resources Division</p>	<p>lesages@michigan.gov 517-284-5472</p>
<p>Aquatic Invasive Plants General questions about aquatic plant identification and early detection, rapid response, and monitoring www.michigan.gov/invasivespecies</p> <p><i>Chemical Control</i> - Questions on the chemical control of aquatic species, permitting, and submerged plant identification. www.michigan.gov/deqinlandlakes</p> <p><i>Mechanical Removal</i> - Questions about mowing and other forms of mechanical control, permitting, and Great Lakes Shoreline management. www.michigan.gov/deqwetlands (Follow "Information" to "GL shoreline management")</p> <p><i>Phragmites</i> – Questions about identification and the control of invasive phragmites. www.michigan.gov/aquaticinvasives</p>	<p>Sue Tangora Wildlife Biologist DNR - Wildlife Division</p> <p>Aquatic Nuisance Control Program staff DEQ - Water Resources Division</p> <p>Anne Garwood Coastal Wetland Ecologist DEQ - Water Resources Division</p> <p>Kevin Walters Aquatic Biologist DEQ - Water Resources Division</p>	<p>tangoras@michigan.gov 517-284-6223</p> <p>DEQ-WRD-ANC@michigan.gov 517-284-5593</p> <p>garwooda@michigan.gov 517-284-5535</p> <p>waltersk3@michigan.gov 517-284-5473</p>
<p>Aquatic Invasive Animals Questions about Asian carp identification, status in Michigan, Michigan's Asian Carp Management Plan, other fish (e.g. snakehead) and aquatic animals (e.g. crayfish). www.michigan.gov/asiancarp</p>	<p>Seth Herbst Fisheries Biologist DNR - Fisheries Division</p>	<p>herbstS1@michigan.gov 517-284-5841</p>
<p>Great Lakes Regional Coordination Questions on Great Lakes coordination, restoration, and management. www.michigan.gov/deqgreatlakes</p>	<p>Matt Preisser Lake Coordinator DEQ - Office of the Great Lakes</p>	<p>preisserm@michigan.gov 517-284-5039</p>
<p>Ballast Water General questions on Michigan's ballast water program and Michigan's Section 401 certification. www.michigan.gov/aquaticinvasives</p> <p><i>Permits</i> - Questions on Michigan's state ballast water permit and application. www.michigan.gov/deqnpdes</p> <p><i>Reporting</i> - Questions regarding the requirement for oceangoing vessels and non-oceangoing vessels to report compliance with ballast water management practices. www.mi.gov/ballastwaterprogram</p>	<p>Sarah LeSage AIS Program Coordinator DEQ - Water Resources Division</p> <p>Sean Syts DEQ - Water Resources Division</p> <p>Roger Eberhardt DEQ - Office of the Great Lakes</p>	<p>lesages@michigan.gov 517-284-5472</p> <p>syts@michigan.gov 517-284-5469</p> <p>eberhardtr@michigan.gov 517-284-5055</p>

<i>Terrestrial Invasive Species</i>	<i>Contact</i>	<i>Email and Phone</i>
Terrestrial Invasive Plants, Mammals, and Birds Questions about identification, management and control terrestrial invasive species. www.michigan.gov/invasivespecies	Sue Tangora Wildlife Biologist DNR - Wildlife Division	tangoras@michigan.gov 517-284-6223
Insects <i>Agricultural & Landscape Pests</i> – Questions about invasive species that impact agriculture and landscapes MDARD Plant Pest Management <i>Forest Pests</i> - Questions about invasive insects, tree diseases, and invasive species impacts to forestry www.michigan.gov/invasivespecies (follow “Invasive Species Links” to “Forest Pests”)	Mike Bryan DARD - Pesticide and Plant Pest Management Division Ron Murray DNR - Forest Resource Division	bryanm@michigan.gov 517-284-5648 murrayr@michigan.gov 517-335-3353

<i>General (Aquatic & Terrestrial) Invasive Species</i>	<i>Contact</i>	<i>Email and Phone</i>
Invasive Species Laws/Regulations Questions about Michigan’s NREPA Part 413 Prohibited and Restricted species law, other regulations, species identification, and permits. www.michigan.gov/invasivespecies (follow “Invasive Species Laws” link)	<i>Plants and insects:</i> Mike Bryan DARD - Pesticide and Plant Pest Management Division <i>All other species:</i> Seth Herbst DNR - Fisheries Division Steve Huff DNR – Law Enforcement Division	bryanm@michigan.gov 517-284-5648 herbstS1@michigan.gov 517-284-5841
State Parks & State Administered Boat Launches Questions about invasive species and associated issues in state parks and at state administered boat launches	Alicia Ihnken Stewardship Analyst DNR – Parks & Recreation Division	ihnkenA@michigan.gov 517-335-0883
Enforcement To report invasive species law/regulation violations, please call the DNR RAP Line.	Report All Poaching (RAP) Line DNR - Law Enforcement Division District 25	1-800-292-7800
AIS Education and Outreach Questions about education programs and outreach materials related to AIS	Kevin Walters Aquatic Biologist DEQ - Water Resources Division	waltersk3@michigan.gov 517-284-5473

Additional Help

For general inquiries, or if none of the above contacts fit with your question, call the DEQ’s Environmental Assistance Center at 1-800-662-9278.

Appendix 5. Monitoring Forms

The following field forms and protocol documents are examples produced by the Central and Eastern Upper Peninsula Cooperative Weed Management Area (CWMA) group that could be adopted and adapted for use in the City of St. Joseph's invasive species control program.

1. Field Log Protocol
2. Invasive Species Field Log
3. Invasive Species Survey Protocol
4. Invasive Species Survey Form
5. CWMA Invasive Species Code Sheet
6. Assessment of Invasive Problem
7. Invasive Species Flash Cards

Field Log Protocol



FIELD LOG

A field log will be used to record each volunteer's field activity. This will be helpful in maintaining sequence for site ID numbers. A separate Field Log sheet should be maintained for each county the volunteer performs survey work. There are 8 columns on the Field Log sheet. Record the information in the following manner:

Waypoint Code

The waypoint code is a unique ID code to be used in mapping the location of each invasive plant found. The 9 digit code will be developed in the following manner: "MCWWPH001" where MC is the two letter code for the county, WW is the observer's initials, PH is the invasive species code, and 001 is the three digit sequence number. Waypoint Code details:

- **County** — Examples: "CC" = Chippewa County; "MC" = Mackinac County
- **Observer Initials**—First initial of first name and first initial of last name. Example: Willie Work would be "WW".
- **Species**—Enter the two digit code for the invasive plant species found at the location. Each volunteer will be given code sheets with all of the invasive plant common names, scientific names, and the two digit abbreviation codes. Example: phragmites = PH
- **Site ID Number**—This is a three digit sequence number. The first entry should be "001", the second "002", the third "003", etc. A sequence number of the ID for each person should never repeat in the county being surveyed.

Area—Select one of the following:

- 0 = None
- 1 = Individual/few/several
- 2 = < 1,000 square feet (half tennis court)
- 3 = 1,000 square feet to 0.5 acre (half a football field)
- 4 = 0.5 acre to 1 acre (football field without end zones)
- 5 = > 1 acre

Density—Select one of the following options:

- 1 = Sparse (scattered individual stems or very small stands)
- 2 = Patchy (a mix of sparse and dense areas)
- 3 = Dense (greater than 40% of the area)
- 4 = Monoculture (nearly 100% of area)

Treatment Status—Enter "U" for untreated; or "N" for nonconsecutive years treated; or enter the number of years of consecutive treatment; or "D" for don't know.

GPS Coordinates—Set a waypoint for each plant species found at each location. All coordinates must be recorded in decimal degrees. For example: N44.75723 W85.65276.

Comments—Use this space to record anything of interest about the find; i.e. note the use of flagging, general quality of natural community, last year treated (if known) or other pertinent information about the location, species infestation or mapping.

Updated: May 12, 2012

Invasive Species Field Log

Date: _____



Observer: _____ County: _____

Waypoint Code	Species	Area	Density	Treatment Status	Latitude i.e. N44.75723	Longitude i.e. W85.65276	Comments

<p>Waypoint Code: XXYYZZ001 XX = County Code YY = Observer's Initials ZZ = Species 001 = Site ID Number (consecutive, ascending, and non-repeating, i.e. 001, 002, 003, etc.)</p>	<p>Area 0 = None 1 = Individual/few/several 2 = < 1,000 sq. ft. (half tennis court) 3 = 1,000 sq. ft. to 0.5 acre 4 = 0.5 acre to 1 acre (football field w/o end zones) 5 = > 1 acre</p>	<p>Density 1 = Sparse (scattered individual stems or very small stands) 2 = Patchy (a mix of sparse and dense areas) 3 = Dense (greater than 40% of the area) 4 = Monoculture (nearly 100% of area)</p>	<p>Treatment Status U = Untreated # = Consecutive years treated N = Nonconsecutive years treated D = Don't know</p>
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Invasive Species Survey Protocol



Objective

The objective of the Invasive Species Survey is to develop a unified database of invasive species occurrences in the Upper Peninsula, in partnership with the Midwest Invasive Species Information Network (MISIN). These guidelines will assist all partners within the Cooperative Weed Management Areas (CWMA's) in documenting the occurrence and spread of invasive plants across the Upper Peninsula. The data we collect will allow us to develop and implement effective control strategies.

Documentation

All information about invasive species occurrences must be documented using the categories on the official data form. All locations must be recorded using a GPS device.

SURVEY FORM

An individual paper data form may be used for each site. For each GPS position collected, record the following information on the Survey Form.

- Date
- Observer's Name
- Contact Information: a) e-mail address and b) phone number
- County
- Other location information: a) Township; b) Townline; c) Range; and d) Section (if available).
- GPS Coordinates: Example — "N44.75723 and W85.65276" (should all be in decimal degrees)
- Map Box—Draw a map of the invasive plant location. Include information such as road name, nearest crossroad, which side of road the invasive is located, etc.
- Plant Species Name
- Area: Select one of the following options:
 - 0 = None
 - 1 = Individual/few/several
 - 2 = <1,000 square feet (half tennis court)
 - 3 = 1,000 square feet to 0.5 acre
 - 4 = 0.5 acre to 1.0 acre (football field w/o end zones)
 - 5 = > 1 acre
- Density: Select one of the following options
 - 1 = **Sparse** (scattered individual stems or very small stands)
 - 2 = **Patchy** (a mix of sparse and dense areas)
 - 3 = **Dense** (greater than 40% of the area)
 - 4 = **Monoculture** (nearly 100% of area)
- Treatment Status: Check "Untreated", "Consecutive Years Treated", "Nonconsecutive Treatment" or "Don't know". If consecutive years treated is known, please enter the number of years.
- Comments: Note use of flagging, general quality of natural community, last year treated (if known) or other pertinent information about the location, species infestation or mapping.

Invasive ID Code (For Office Use Only)

The box on the upper right corner of the Survey Form is reserved for a unique ID code to be used in mapping the location of each invasive plant found. The code will be developed in the following manner: "MCWWGM001" where MC is the two letter code for the county, WW is the observer's initials, GM is the invasive species code, and 001 is the three digit sequence number. Note: Within each county, the three digit sequence number of the ID for each person must never repeat.

Updated May 21, 2012

Invasive Species Survey Form



Date: _____

Invasive
ID Code: _____
(Office Use Only)

Observer's Name: _____

E-mail address: _____ Phone Number _____

Location Information of Invasive Species County: _____

Township: _____ Townline: _____ Range: _____ Section: _____

GPS Coordinates: _____ Latitude _____ Longitude _____

Map

N
↑

Plant Species: _____

Area — Circle one of the following options:

- 0 = None
- 1 = Individual/few/several
- 2 = <1,000 sq. ft. (half tennis court)
- 3 = 1,000 sq. ft. to 0.5 acre (half football field)
- 4 = 0.5 acre to 1.0 acre (football field w/o end zones)
- 5 = > 1.0 acre

Density — Circle one of the following options:

- 1 = Sparse (Scattered individual stems or very small stands)
- 2 = Patchy (A mix of sparse and dense areas)
- 3 = Dense (Greater than 40% of the area)
- 4 = Monoculture (Nearly 100% of the area)

Treatment Status (Check one):

- _____ Untreated
- _____ Consecutive years treated (# of years: _____)
- _____ Nonconsecutive Treatment
- _____ Don't know

Comments:

CWMA Invasive Species Code Sheet—Page 1 of 2



Top 10 Invasive Species

Common Name	Code	Scientific Name
canada thistle	CT	<i>Cirsium arvense</i>
common buckthorn	CB	<i>Rhamnus cathartica</i>
eurasion milfoil	EM	<i>Myriophyllum spicatum</i>
garlic mustard	GM	<i>Alliaria petiolata</i>
japanese knotweed	JK	<i>Fallopia japonica</i>
leafy spurge	LS	<i>Euphorbia isula</i>
phragmites (non-native)	PH	<i>Phragmites australis</i>
purple loosestrife	PL	<i>Lythrum salicaria</i>
scots/scotch pine	SP	<i>Pinus sylvestris</i>
spotted knapweed	SK	<i>Centaurea maculosa</i>

Invasive Species Network—Species of Concern

Common Name	Code	Scientific Name
austrian pine	AP	<i>Pinus nigra</i>
autumn olive	AO	<i>Elaeagnus umbellata</i>
baby's breath	BB	<i>Gypsophila paniculata</i>
bigleaf periwinkle	BP	<i>Vinca major</i>
bittersweet nightshade	BN	<i>Solanum dulcamara</i>
birdfoot trefoil	LC	<i>Lotus corniculata</i>
black jetbead	BJ	<i>Rhodotypos scandens</i>
black locust	BL	<i>Robinia pseudoacacia</i>
bouncing bet	SO	<i>Saponaria officinalis</i>
bristly locust	RH	<i>Robinia hispida</i>
bull thistle	BT	<i>Cirsium vulgare</i>
callery pear	CP	<i>Pyrus calleryana</i>
common chickweed	CC	<i>Stellaria media</i>
common St. John's wort	SJ	<i>Hypericum perforatum</i>
common tansy	TV	<i>Tanacetum vulgare</i>
common teasel	DF	<i>Dipsacus fullonum/sylvestris</i>
cow-vetch	VV	<i>Vicia villosa</i>

Invasive Species Network—Species of Concern—Continued

crown vetch	CV	<i>Coronilla varia</i>
cypress spurge	CS	<i>Euphorbia cyparissias</i>
dame's rocket	DR	<i>Hesperis matronalis</i>
europaean highbush cranberry	HC	<i>Viburnum opulus</i>
europaean swamp thistle	ST	<i>Cirsium palustre</i>
field hedge parsley	TA	<i>Torilis arvensis</i>
giant knotweed	GK	<i>Polygonum sachalinensis</i>
glossy buckthorn	GB	<i>Rhamnus frangula</i>
honeysuckle(s)	HS	<i>Lonicera sp.</i>
japanese hedge parsley	TJ	<i>Torilis japonica</i>
jimsonweed	JW	<i>Datura stramonium</i>
lily-of-the -valley	LV	<i>Convallaria majalis</i>
lombardy poplar	LP	<i>Populus nigra var. italic</i>
lyme grass	LG	<i>Leymus arenarius</i>
money plant	MP	
mullein	MN	<i>Verbascum Thapsus</i>
multiflora rose	MR	<i>Rosa multiflora</i>
narrow-leaved cattail	NC	<i>Typha angustifolia</i>
norway maple	NM	<i>Acer platanoides</i>
orange day lily	OD	<i>Hemerocallis fulva</i>
oriental bittersweet	OB	<i>Celastrus orbiculatus</i>
periwinkle	PW	<i>Vinca minor</i>
reed canary grass	RC	<i>Phalaris arundinacea</i>
russian olive	RO	<i>Elaeagnus angustifolia</i>
sawtooth oak	QA	<i>Quercus acutissima</i>
smooth brome	SB	<i>Bromus inermis</i>
white poplar	PA	<i>Populus alba</i>
white sweet clover	WS	<i>Melilotus alba</i>
wild parsnip	WP	<i>Pastinaca sativa</i>
yellow flag	YF	<i>Iris pseudacorus</i>
yellow sweet clover	YS	<i>Melilotus officinalis</i>

CWMA Invasive Species Code Sheet—Page 2 of 2

Invasive Species Network—Species of Concern
Early Detection Rapid Response Species



Common Name	Code	Scientific Name
amur cork-tree	AC	<i>Phellodendron amurense</i>
black alder	BA	<i>Alnus glutinosa</i>
black swallow-wort	VN	<i>Vincetoxicum nigrum</i>
brazilian water-weed	BW	<i>Egeria densa</i>
coltsfoot	CF	<i>Petasites hybridis</i>
cotton thistle	OA	<i>Onopordon acanthium</i>
dotted duck-weed	DD	<i>Landoltia punctata</i>
european frog-bit	FB	<i>Hydrocharis morsus-ranae</i>
european water clover	WC	<i>Marsilea quadrifolia</i>
flowering rush	FR	<i>Butomus umbellatus</i>
giant hogwood	GH	<i>Heracleum mantegazzianum</i>
giant salvinia	GS	<i>Salvinia spp.</i>
hydrilla	HD	<i>Hydrilla verticillata</i>
indian balsam	IB	<i>Lagarosiphon major</i>
japanese hops	JH	<i>Humulus japonicas</i>
japanese stiltgrass	JS	<i>Microstegium vimineum</i>
kudzu	KZ	<i>Pueraria lobata</i>
lesser naiad	LN	<i>Najas minor</i>
mile-a-minute-weed	MM	<i>Polygonum perfoliatum</i>
moneywort	MW	<i>Lysimachia nummularia</i>
musk thistle	MT	<i>Carduus nutans</i>
pale swallow-wort	VR	<i>Vincetoxicum rossicum</i>
parrot feather	PF	<i>Myriophyllum aquaticum</i>
plumeless thistle	PT	<i>Carduus acanthoides</i>
reed manna grass	RM	<i>Glyceria maxima</i>
sacred lotus	SL	<i>Nelumbo nucifera</i>

Common Name	Code	Scientific Name
water chestnut	TN	<i>Trapa natans</i>
water-hyacinth	WH	<i>Eichhornia crassipes</i>
water lettuce	WL	<i>Pistea stratioides</i>
yellow floating heart	FH	<i>Nymphoides peltata</i>

Additions from Field Inventories

Common Name	Code	Scientific Name
houndstongue	HT	<i>Cynoglossum officinale L.</i>
Japanese barberry	JB	<i>Berberis thunbergii</i>
curley leaf pond weed	PC	<i>Pontamogeton crispus</i>
Japanese siltgrass	JS	<i>Microstegium vimineum</i>
himalayan balsam	MB	<i>Glandulifera</i>
wild rose	MR	<i>Rosa multiflora*</i>
mezureum	DM	<i>Daphne mezereum</i>

* Wild rose and multiflora rose are listed with the same code (MR) and Scientific Name.

Upper Peninsula County Codes

AL - Alger County	KC - Keweenaw County
BC - Baraga County	LC - Luce County
CC - Chippewa County	MC - Mackinac County
DL - Delta County	MQ - Marquette County
DK - Dickinson County	MN - Menominee County
GC - Gogebic County	OC - Ontonagon County
HC - Houghton County	SC - Schoolcraft County
IC - Iron County	

Name & Address of Property Owner:

Reason for Visit (circle one: owner request, early detection species/ who solicited?):

Unit description and size of treatment area:

Date & Evaluator name:

General Site Quality

Value:	Low	Moderate	High	Very High
Score:	0	1	2	3

General Site Quality / Does the site have an estimated high floristic quality?

Is there native biodiversity? One doesn't need to calculate the FQI to assess this answer. Consider would there be a native seed bank?.Landscapes composed of greater heterogeneous abiotic conditions should provide greater diversity of habitat niches.

Wetlands or Waterbodies within 100 Feet

Value:	Absent	Present
Score:	0	1

Wetlands or Waterbodies within 100 Feet

This does not include non-connected ditches and non-quality waterways such as small detention / retention basins. Present = natural wetlands connected to other waterways and those that have the potential to host diversity and filter water quality. Waterways have the potential to transport invasive seed.

Invasive Non-Native Species Percent Cover of Defined Zone

Value:	0-5%	6- 25%	26 - 100%
Score:	2	1	2

Invasive Non-Native Species Percent Cover in Defined Management Area

Unit must be defined as treatment potential. If backyard is 2 acres and infestation is only one corner, estimate cover @ 20%.

Potential Spread/Likelihood of Infesting High Quality Area Nearby

Value:	Low	Moderate	High
Score:	0	1	2

Likelihood of Infesting High Quality Area

Is there an adjacent high quality area? What is the surrounding plant communities? Will these areas be protected or developed? Communities with a FQI > 35 within 100 feet. If there is a potential of spread to other high-priority sites = 2. Is it on the edge of a property owner that will not grant access to treat? Is it next to a large infestation.

Community Rank

Value:	S5 - S4	S3	S2 - S1
Score:	0	1	2

Community Rank

State Plant Community Ranking Numbering set forth at <http://mnfi.anr.msu.edu/communities/>
Example: Coastal Plain Marsh S2 = imperiled in the state because of rarity due to very restricted range, very few occurrences

State-listed Species Occurrences

Value:	0	1	2	>3
Score:	0	1	2	3

State-listed Species Occurrences

This would utilize MNFI's occurrences within the defined treatment area.

What happens if none are reported because site has not been assessed?

Potential for Treatment Success

Value:	Low	Medium	High
Score:	0	1	2

Potential for Treatment Success

How many treatments will it take to control population? Greater than 4 treatments = Low Potential for Treatment Success
Are the homeowners able to followup if yes = 2. Is there restoration potential?
Do we need a special type of expensive herbicide to treat the infestation or does glyphosate work?

Homogeneity of Infestation

Value:	Solid	Scattered	Sparse
Score:	0	1	2

Homogeneity of Infestation = the state of having identical cumulative distribution

Isolated patch that is easy to treat = 2

Priority Ranking

Total Score:	0 - 8	9 -12	15 - 17
Priority:	Low	Medium	High

0

Total Score

Form developed by

Scientific name:
Common name:
Region of origin:
Is this a newly introduced pest or one that has been in the area for over 5 years?
Suggested rank:
Name, telephone number, and address of lead researcher on the pest (if established).
Name, telephone number, and address of lead project manager for the pest (if established).

Invasive Species Risk Priority Assessment Matrix

	Threat Low (1-3)	Threat Moderate (4-7)	Threat High (8-10)	Notes
Short term ecological effects of pest				
Long term ecological effects of pest				
Threat to listed endangered and threatened species and/or critical habitat				
Potential of pest to cause mortality in the forest				
Economic impact of pest				
Is pest widespread in the region?				
Potential of the pest to spread				
Is control of pest feasible?				
Has control of this pest been successful in the past?				
Biological controls currently available?				
Short term costs of control?				
Long term costs of control?				
Potential for treatment success?				
Health effects associated with the pest?				
Public perception of pest.				
Impact on individual native plant or animal species				
Total				

Sources:



Common Buckthorn
Rhamnus Cathartica



Eurasian Water Milfoil
Myriophyllum Spicatum



Canadian Thistle
Cirsium Arvense



Garlic Mustard
Alliaria Petiolata

Eurasian Water Milfoil is a perennial, aquatic, submersed herb. Stems are long, slender, branching, hairless, and become leafless towards the base. The plant usually grows between 3-13 feet but can extend up to 32 feet. Each floating node can take root if it comes in contact with mud. Stems are usually pale pink to reddish brown. Leaves are grayish-green and occur in whorls of 3 or 4 with 12-16 pairs of fine, thin leaflets up to 2 inches long. When the leaves are taken out of the water they lose their stability and collapse around the stem. The flowers are small, yellow, with 4 petals and 4 sepals produced on a spike 2-4 inches above the water surface. Flowers are alternate and attached directly to the stem.

Control and Management

Manual-A hand rake can be used for smaller areas, such as around docks and swimming areas. One raking per season should be done at the peak of growing. Otherwise multiple rakings are most effective. Be sure to remove all fragments.

Garlic Mustard is a cool season biennial herb with talked, triangular to heart-shaped, coarsely toothed leaves that give up an odor of garlic when crushed. First year plants appear as a rosette of green leaves close to the ground. Rosettes remain green through the winter and develop into mature flowering plants the following spring. Flowering plants reach from 2-3 ½ feet in height and produce buttonlike clusters of small white flowers, each with four petals in the shape of a cross.

Control and Management

Manual-Hand removal of entire root system of plant is practical for light infestations. For larger infestations cut stems at ground level or within several inches of the ground, to prevent seed production.

Chemical-Herbicide (e.g., Roundup) may be applied for very heavy infestations. Fire can be used but can encourage germination of stored seeds and promote growth of emerging garlic mustard seedlings.

Common Buckthorn a shrub or small tree in the buckthorn family that can grow to 22 feet in height with a 10 inch wide trunk. The crown shape of mature plants is spreading and irregular. The grey to brown bark is rough textured when mature. The inner bark is yellow and the heartwood is pink to orange. Twigs are often tipped with a spine. Leaves are broadly oval, rounded or pointed at the tip, with 3-4 pairs of up curved veins, and have jagged, toothed margins. Leaves appear dark, glossy green on the upper surface and stay green late into the fall. In spring, dense clusters of 2 to 6, yellow-green, 4 petaled flowers emerge from stems near the bases of leaf stalks. Small black fruits are about 1/4 inch in cross-section, contain 3-4 seeds, and form in the fall.

Control and Management

Manual-Remove plants before producing fruit by hand pulling or digging; use control burning in spring and fall.

Chemical-It can be effectively controlled using any of several readily available general use herbicides such as glyphosate or triclopyr. Follow label and state requirements.

Canadian Thistle is a perennial with erect stems 1 ½ - 4 feet tall, prickly leaves and an extensive creeping rootstock. Stems are branched, often slightly hairy, and ridged. Leaves are simple, lance-shaped, irregularly lobed with spiny, toothed margins and are borne singly and alternately along the stem. Fragrant, rose-purple to lavender, or sometimes white flower heads appear from June through October, and occur in rounded, umbrella-shaped clusters. One plant can produce 1,500 to 5,000 seeds that are capable of germinating eight to ten days after flowers open. Fibrous tap roots may extend 6 feet deep. Horizontal roots stemming from the tap roots produce new shoots.

Note-Canadian Thistle is distinguished from all other thistle by 1) creeping horizontal lateral roots; 2) dense clonal growth; 3) small dioecious flower heads.

Control and Management

Manual-Repeated mowing or selective cutting close to the ground can reduce infestations with 3-4 years. Cutting should be done at least 3 times per year. Mowing should be done before flowering or it will help spread seed.



Japanese Knotweed
Polygonum Cuspidatum



Leafy Spurge
Euphorbia Esula



Purple Loosestrife
Lythrum Salicaria



Spotted Knapweed
Centaurea Biebersteinii

Leafy Spurge is an erect, branching, perennial herb growing 2-3 ½ feet tall, with smooth stems and showy yellow flower bracts. Stems frequently occur in clusters from a vertical root that can extend many feet underground. Milky white, sticky, sap seeps from plant when cut. The leaves are small, oval to lance-shaped, somewhat frosted and slightly wavy along the margin. The flowers are very small and are borne in greenish yellow structures surrounded by yellow bracts. The complex root system forms tough woody networks that can reach 15 or more feet into the ground, and may have numerous buds.

Control and Management

Manual-Eradication is difficult because of its persistent nature and ability to regenerate from small pieces of root. Hand-pulling, digging, and tilling succeed only if the entire root system is removed.

Chemical-Can be effectively controlled using any of the several readily available general use herbicides such as glyphosate; apply in June, when flowers and seeds are developing, or in early to mid-September, when plants are moving nutrients downward into the roots.

Spotted Knapweed is a biennial or short-lived perennial. Plants typically form a basal rosette of leaves in its first year and flowers in subsequent years. Rosette leaves are approximately 8 inches long by 2 inches wide, borne on short stalks, and deeply lobed once or twice on both sides of the center vein, with lobes oblong and wider toward the tip. Flowering stems are erect, 8 to 50 inches tall, branched above the middle and sparsely to densely hairy. Stem leaves alternate along the stem, are unstalked, and may be slightly lobed, or linear and unlobed. Leaf size decreases towards the tip of the stem. Flowers are purple to pink, rarely white, with 25 to 35 flowers per head. Flower heads are oblong or oval shaped, 1/4 inch wide and ½ inch across, and are single or borne in clusters of two or three at the branch ends. The taproot is stout and deep.

Control and Management

Manual-Hand-pull small infestations prior to seed set. Use gloves to prevent skin irritation. Remove entire crown and taproot to prevent re-growth.

Chemical-Effectively controlled using any of several readily available general use herbicides such as clopyralid or picloram.

Japanese Knotweed is an upright, shrub like, herbaceous perennial that can grow to over 10 feet height. The base of the stem above each joint is surrounded by a membranous sheath. Stems are smooth, stout and swollen at joints where the leaf meets the stem. Although leaf size may vary, they are normally about 6 inches long by 3-4 inches wide, broadly oval to somewhat triangular and pointed at the tip. The minute greenish-white flowers occur in attractive, branched sprays in summer and are followed soon after by small winged fruits.

Control and Management

Manual-Hand pull young plants; remove all roots and runners to prevent re-sprouting.

Chemical-It can be effectively controlled using any several readily available general use herbicides such as glyphosate or triclopyr. Apply herbicides to freshly cut stems or to foliage. Follow label and state requirements.

Purple Loosestrife is an erect perennial, growing to a height of 3-10 feet. Mature plants can have 1-50 4-sided stems that are green to purple and often branching making the plant bushy and woody in appearance. Opposite or whorled leaves are lance-shaped, stalk-less, and heart-shaped or rounded at the base. Flowers are magenta-colored with five to seven petals and bloom from June to September. The root system consists of a large, woody taproot with fibrous rhizomes. Rhizomes spread rapidly to form dense mats that aid in plant production.

Control and Management

Manual-Small infestations of young purple loosestrife plants may be pulled by hand, preferable before seed set. Older plants can be removed with a shovel. Landfill or burn removed plants.

Chemical-Effectively controlled using any of several readily available general use herbicides such as glyphosate or triclopyr. These herbicides may be most effective when applied late in the season when plants are preparing for dormancy. However, it may be best to do a mid-summer and late season treatment, to reduce seed production.



Scots Pine
Pinus Sylvestris



Common Reed
Phragmites Australis

Common Reed is a tall perennial wetland grass ranging in height from 3-20 feet. Strong leathery horizontal shoots, called rhizomes, growing on or beneath the ground surface give rise to roots and tough vertical stalks. Cane-like stems, 1 inch in diameter, support broad sheath-type leaves that are .5 to 2 inches wide near the base, tapering to a point at the ends. Large dense, featherlike, grayish purple plumes, 5 to 16 inches long, are produced in late June to September. The plant turns tan in the fall and most leaves drop off leaving only the plume-topped shoot. The root system is comprised of rhizomes that can reach to 6 feet deep with roots emerging at the nodes.

Control and Management

Manual-Common Reed can be cut and the rhizomes can be dug up but physical control is difficult because it can reestablish from seed or remaining rhizomes. Frequent mowing is sometimes effective on controlling the reed.

Chemical-It can be effectively controlled using any of several readily available general use herbicides such as glyphosate. Follow label and state requirements.

Scots Pine is a coniferous tree reaching 70 to 120 feet in height and a diameter of 3 to 5 feet. The bark is silvery gray and shiny when young, than becoming reddish brown, fissured and scaly when older. Brittle twigs are dark, yellowish-grey, and smooth. Needles are 1 ½ to 3 ½ inches long, blueish-green or dark green, stout, and born in bundles of 2 or rarely 3. The cones are 1 ½ to 2 ½ inches long, short-stalked, solitary or in pairs, usually pointing backward, and grayish or reddish in color. The root system is made up of horizontal roots close to the surface and a taproot.

Control and Management

Manual-Hand pull young seedlings; cut larger trees.

Chemical-It can be effectively controlled using any of several readily available general use herbicides such as glyphosate or triclopyr. Follow label and state requirements.

Appendix 6. Potential Invasive Plant Species Funding Sources Virtual Rolodex.

FUNDER and PROGRAM: Michigan DNR: Invasive Species Grant Program 2015

Web-link: http://www.michigan.gov/dnr/0,4570,7-153-10370_59996---,00.html

Eligible: local, federal, tribal government, non-profits, educational institutions for work in Michigan

Funds: minimum of \$25,000. Maximum determined by funding availability.

Deadlines: New program. Due Dec 5, 2014 for 2015 funding

Match: 10% required. After meeting that matching up to 50% results in awarded points in 10 percent increments.

Focus: Prevent new introductions of invasive species through outreach and education; Monitor for new invasive species as well as expansions of current invasive species; Respond and conduct eradication efforts to new findings and range expansions; Manage and control key colonized species in a strategic manner.

Other information: For Focus Area 1 (which covers terrestrial invasive plants) must be applying through a Cooperative Invasive Species Management Area or be proposing to form one. Priority species for SW Michigan include phragmites, black and pale swallow-wort, Japanese and giant knotweed, European frogbit, flowering rush, Chinese yam. Public and private lands.

FUNDER and PROGRAM: USEPA, Great Lakes Restoration Initiative (GLRI)

Web-link: <http://greatlakesrestoration.us/>

Eligible: non-profits, local governments, educational institutions, state government

Contacts:

Funds: up to \$635,000

Deadlines: Annual, RFP released in July, Proposal due in August (based on previous years)

Match: Not required but increases competitiveness. In-kind accepted. Volunteer labor valued at State minimum wage.

Focus: Has historically had an invasive species component with significant funding attached, both terrestrial and aquatic. *On-the-ground actions* showing overall ecological strategy, education/outreach component, and partnerships with relevant private agencies and governmental groups. Success measured in acres treated, pounds removed, etc. Refer to GLRI Action Plan 2015-2019.

Other information: For a *for-profit* to be identified in the proposal with their credentials and expertise listed, the for-profit must have an existing contract with the applicant.

FUNDER and PROGRAM: *National Fish and Wildlife Fund (NFWF): Sustain Our Great Lakes.*

Web-link: http://www.nfwf.org/greatlakes/Pages/home.aspx#.VGOUTvnF_lg

Eligible: non-profits, local governments, educational institutions, state government

Funds: \$25,000 to 1 million depending on funding, Reimbursable.

Deadlines: Notice in January. Pre-proposal in February, Full proposal in April

Match: None required but those closer to a 1:1 non-federal match rank higher

Focus: On the ground habitat restoration and enhancement should take most of the budget. May have to cast a project into a particular theme like riparian areas, shoreline, wetlands, etc. depending on the focus areas of a specific year. The funding usually seems to allow for invasive and habitat restoration work

Other information: Public and private lands okay. Submitted online through: www.nfwf.org/easygrants

FUNDER and PROGRAM: *National Fish and Wildlife Fund (NFWF): Five Star and Urban Waters Restoration Grant*

Web-link: <http://www.nfwf.org/fivestar/Pages/home.aspx>

Eligible: public or private entity connected to community partners to monitor and manage project for 5 years. Diverse mix of public and private partners desirable.

Contacts: Carrie Clingan carrie.clingan@nfwf.org Lindsay Vacek lindsay.vacek@nfwf.org Sarah McIntosh sarah.mcintosh@nfwf.org

Funds: \$25,000 to \$50,000

Deadlines: Full Proposal February 3, 2015

Match: Match of 1:1 non-federal mandatory. In-kind volunteer valued by the type of service provided (e.g., legal, scientific analysis, manual labor)

Focus: Incorporate something addressing all of these: 1. On the ground restoration and planning, 2. Five or more partners, 3. Environmental outreach and education, 4. Measurable results, 5. Plan for sustainability for at least 5 years

Other information: Public and private land. Submitted online through : www.nfwf.org/easygrants

FUNDER and PROGRAM: *National Fish and Wildlife Fund (NFWF): Pulling Together Initiative*

Web-link: <http://www.nfwf.org/pti/>

Eligible: local, county, state governments, federal agency field staff, non-profits. For profits encouraged to partner with eligible applicants to apply

Contacts:

Funds: up to \$635,000

Deadlines: Timetable based on previous years Preproposal in July. If invited, full proposal in September. Notification in December.

Match: Match of 1:1 non-federal mandatory. In-kind volunteer valued by the type of service provided (e.g., legal, scientific analysis, manual labor)

Focus: Prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships; and increase public awareness of the adverse impacts of invasive and noxious plants. Measurable outcomes wanted. Having a long range management plan is a plus.

Other information: Submitted online via : www.nfwf.org/easygrants

FUNDER and PROGRAM:

Web-link:

Eligible:

Contacts:

Funds:

Deadlines:

Match:

Focus:

Other information:



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