Oxbow Habitat Restoration Plan

Buffalo Creek, West Seneca

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Prepared for:

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List of Abbreviations and Acronyms

IPM	Integrated Pest Management
ISCMG	Invasive Species Control and Management Guidance
NYSDEC	New York State Department of Environmental Conservation
OW	Open Water
PEM	Emergent Marsh
PFO	Forested Wetland
SUNY	State University of New York at Buffalo
UPL	Terrestrial Upland
USACE	United State Army Corps of Engineers
VP	Vernal Pool
WM	Wet Meadow
WS	Town of West Seneca

1 Introduction

The Oxbow site is relatively new feature in the Buffalo Creek watershed. It is important to understand its evolution associated with hydraulic modifications, site hydrology, and early successional plant communities. The Restoration Plan is the product of the analysis of existing conditions and evaluation of restoration or enhancement opportunities considering site history, physical modifications, and habitat restoration goals. The approach to Oxbow habitat restoration is based the development of clear, achievable and measureable objectives for biological functional uplift as well as community stewardship.

Elements of the habitat restoration plan have been developed for the Oxbow site in the context of and consistent with watershed and system wide biological characteristics. A restoration plan has been designed to integrate various methodologies that address the Oxbow site's landscape position, modified hydrology, existing conditions, and the potential for effective habitat restoration and enhancement. Restoration and enhancement methods include a variety of practices and techniques selected specifically for this site to complement existing community stewardship resources available and future funding opportunities.

1.1 Oxbow Site History

The configuration of the Oxbow channel as it exists today has developed from channel migration northward as illustrated in aerial photos from 1927 and 1951 (see Figures 1 and 2). Most all acreage since the early 1900s was deforested and in agricultural production with little to no intact riparian vegetation. Buffalo Creek in proximity of the Oxbow site has been subject to a variety of Streambank protection, in-channel improvement, levees, and water control structures between 1946 and 1963. The Oxbow site was initially modified by a flood control project in the early 1950s which separated a significant channel reach from the main stem (see Figure 3). A soil berm along the straightened channel of Buffalo Creek separates the Oxbow site from normal high water recharge from the main stem of Buffalo Creek. A 24" discharge outfall pipe releases water from the site to the Creek and is maintained by the local Soil Water Conservation District. Channel realignment, grade controls, and isolation of the Oxbow was done to alleviate seasonal ice jam flooding and soil erosion. The entire site is presently within the FEMA 100 year flood plain of Buffalo Creek. NYSDEC Wetland #BU-17 covers approximately 50% of the Oxbow site (see Figure 4).

The flood control project completed in the mid 1950s physical and hydraulic impacts to the Oxbow site include:

- Modified surface hydrology
- Armored the right and left descending banks and
- Linear berm along the creek that separates the Oxbow site from the creek.

Agricultural production in the form of row crops, the dominant land use in the area and within the project site boundaries, was determined by analysis of aerial photographs dated 1927 and 1951. Between 1927 and the early 1940s tree and shrub layers were essentially absent from the landscape. In the early 1950s land along the right descending bank remained under cultivation with no riparian buffer. At that time, the Oxbow site interior and left descending bank was densely vegetated with early tree and shrub growth. Much of that species assemblage has been altered by the flood control project due to modified surface hydrology in the form of increased seasonal inundation and hydroperiod extension associated with the controlled discharge structure.

The Oxbow site is in a state of early succession as the result of intensive agriculture land use in the early to mid 20th century. Tree species on the site are estimated to be between 20 and 60 years old. Shrub and herbaceous layers are well developed but do not represent the species diversity that typically occurs in older, late successional floodplain or riparian corridors in the upper Buffalo Creek watershed.

1.2 Elements of the Oxbow Habitat Restoration Plan

The Oxbow site is a combination of terrestrial and aquatic habitat features that are hydrologically disconnected from Buffalo Creek with the exception of a controlled outfall structure near the western boundary of the site. Recharge is limited to direct rainfall, surface water drainage, and small stream input in the northeastern portion of the site. Investigation and data developed on the water budget for the site, water table level combined with soil characteristics and physical impoundments provided guidance for restoration planning and design. Existing vegetation communities, species assemblage, diversity, and wildlife usage were analyzed to develop a habitat restoration site plan. The Habitat Restoration Plan has developed methods to implement site restoration and enhancement activities that are currently underway or in planning stages. The following are considered primary components of the plan:

- Invasive Species Control and Management
- Aquatic Habitat Enhancement
- Terrestrial and Riparian Habitat

- Adaptive Management
- Performance Monitoring

The habitat restoration plan provides a series of options for each work area that can be implemented by project sponsor(s) based on volunteer, municipal, and funding resources that are in place or are expected to be available. This plan is intended to provide science-based, ecological guidance to the project sponsor and project partners as well as practical tools to justify the implementation of measures designed to provide significant functional uplift within existing flora and faunal communities on the site. This plan provides the project team mechanisms to measure and quantify biological uplift in areas of form, function, and process. Restoration and enhancement activities designed and implemented on the Oxbow site may be appropriate and transferrable to other disturbed or otherwise modified, riparian sites within the watershed.

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Figure 1: WS Buffalo Creek Oxbow 1927

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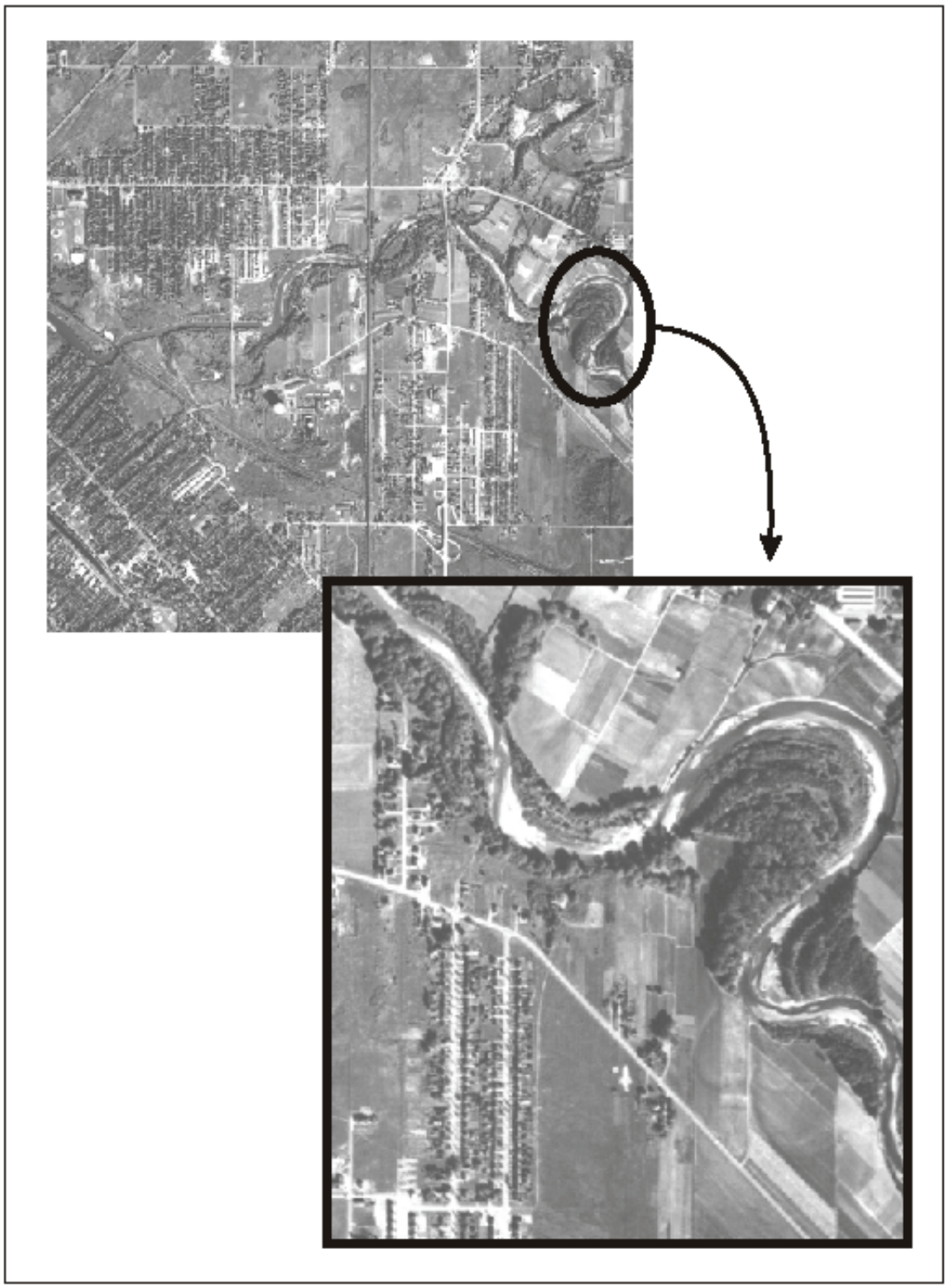

Figure 2: 1951 Oxbow and West Seneca Reaches of Buffalo and Cayuga Creeks

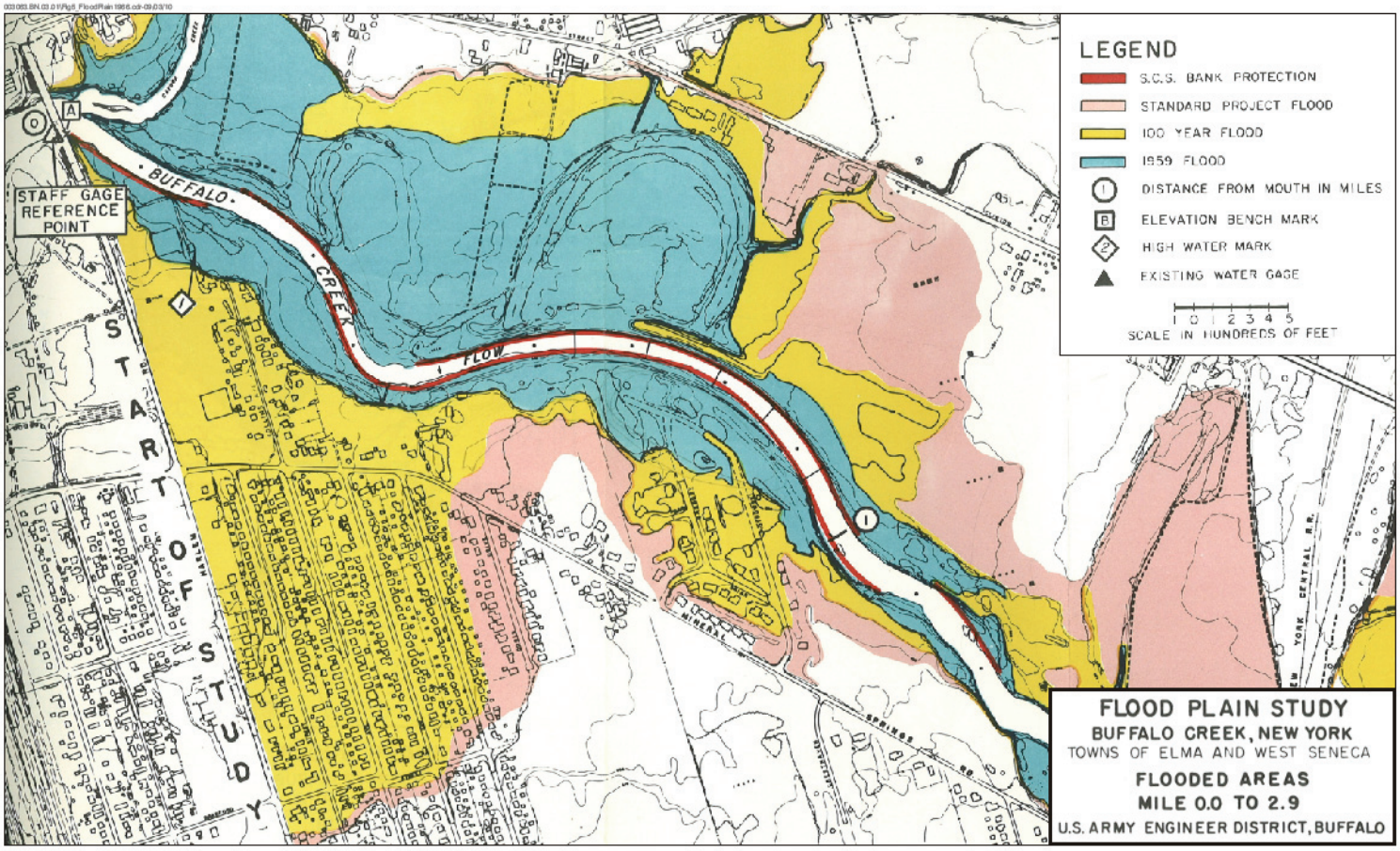

Figure 3 - 1966 ACOE Flood Plain Study

Figure 4: Town of West Seneca, Oxbow Lake, 2008

2 Invasive Species Control and Management

Invasive plants are commonly known as non-natives, exotics, aliens, non-indigenous harmful species and noxious weeds. All of these terms support the basic concept that invasive plants are those that have been introduced into an environment in which they did not evolve. Invasive plant species that are the most problematic have no natural enemies to limit their reproduction and spread.

In the case of the Oxbow site, introduced, aggressive plants have the ability to degrade habitat value in areas by altering native species composition and structure. In addition, invasive species mapped on this site have the potential to dominate existing vegetation cover types and thereby inhibit native plant colonization and succession. Although the species of concern on the Oxbow site are in early development, it is expected without control they will out compete native plants for light, water, and nutrients. The invasive plant species on this site possess one or more of the following traits common to most invasive plants that enable them to rapidly invade, colonize and dominate native plant communities:

- Early maturation
- Profuse reproduction by seeds and/or vegetative structures
- Long life in the soil
- Seed adaptations conducive to spread by natural agents, and by humans
- Growth habit, odor, or taste that is unpalatable to animals Seeds that are the same size and shape as crop seeds, which makes cleaning difficult
- Roots or rhizomes with large food reserves such as Japanese knotweed
- Survival and seed production under adverse environmental conditions
- High photosynthetic and vigorous growth rates

Invasive plant species (IS) on site that warrant control are: bush honeysuckle (*Lonicera tratrica* and *L. morrowii*), Japanese knotweed (*Polygonum japonica,*

Fallopia japonica), mugwort (*Artemesia vulgaris*), purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*).

All IS species are in early stages of colonization on portions of the site. Common reed and Japanese knotweed are expected to be the most aggressive and problematic to manage. Reed canarygrass *(Phalaris arundinacea*) is a native species with an aggressive growth habit and can be invasive in moist soil areas. The Oxbow site open wetland and wet meadow component is dominated by reed canarygrass. This species is not shade tolerant and covers most open area that has no shrub or tree layer. The density and value of reed canarygrass as a cover type and competition for non-native invasive plants will be discussed in greater detail in the restoration plan section.

Without intervention, a combination of seed sources from the existing invasives on-site as well as the extensive invasive species seedbank in the upstream and downstream riparian corridor will continue to inhibit the natural succession and recolonization of native plants. Wildlife usage as well as habitat diversity, function and value will be progressively impacted without implementation of a landscape restoration designed to manage invasive plant communities. Control and management of invasive plant species is critical to implementation of the landscape restoration plan and especially to the long-term success of the site restoration goals and objectives.

An Integrated Pest Management (IPM) is recommended for implementing control methods. An IPM based Invasive Plant Management Guidance (IPMG) is a critical component of the site Restoration Plan.

2.1 Methodology

The Oxbow site IPMG is based in part on protocols developed by the Nature Conservancy (Weed Control Methods Handbook, The Nature Conservancy, Tu et al., version April 2001). The site-specific design of methods and practices within an integrated vegetation management plan for The Oxbow Habitat Restoration Project is based on the following guidelines.

- Establish management goals and objectives for the site
- Determine which plant species or populations, if any, block or have potential to block attainment of the management goals and objectives
- Determine which methods are available to control the weed(s)
- Develop and implement a management plan designed to move conditions toward management goals and objectives
- Monitor and assess the impacts of management actions in terms of their effectiveness in moving conditions toward these goals and objectives and

- Reevaluate, modify, and start the cycle again.

Control and management activities begin after the first three steps have been taken. The IPMG is a critical part of the overall restoration program. It is imperative to design and restore a replacement plant community for areas where removal of alien species is planned. Selected grass and forb species will be planted to provide a quick vegetative cover and function as nurse crop for slower growing species in the Landscape Restoration Plant List and inhibit colonization of undesirable plants. Native plant species of high wildlife value have been selected to restore plant communities that are capable of modifying the conditions (habitat) that support or encourages the colonization of alien species.

(Appendix A is a compilation of species specific account with control and management information.)

A calendar (Table 2-1) provides selected treatment options that involve one or combination of techniques.

Table 2-1 Calendar for Terrestrial Invasive Species Control in Western New York

Species[1]	Mechanical[2]	Chemical	Habitat Modification	Biological	Comments
JK	SP,F,S,W	S,F	SP,S,F		Habitat Modification cost effective; combination of Mechanical and Chemical recommended for short term results; Biological control only recommended for PL
CB	SP,F,S,W	S,F	SP,S,F		
MW	SP,F,S,W	S,F	SP,S,F		
CR	SP,S ,F,	S,F	SP,S,F		
LS	SP,S	SP,S,F	SP,S,F	SP,S	
BH	SP,S,W	SP,S,F	SP,S,F		

[1] JK-*Fallopia japonica*, CB-*Rhamnus cathartica*, MW-*Artemisia vulgaris*, CR- *Phragmites australis*, PL-*Lythrum salicaria*, BH- *Lonicera* sp.

[2] SP-Spring, F-Fall, S-Summer, W-Winter

2.2 Mechanical Removal

Mechanical methods involve a variety of techniques of physical removal or inflicting damage to the target species. This method involves machinery, power tools or hand devices that cut, dig, pull, or till plants. This method of control rarely eradicates undesirable vegetation and as a stand alone operation can only be expected to retard growth rates. In some cases, consistent mechanical control will provide opportunities for desirable vegetation to coexist with more competitive invasive species. The timing of cutting and dedicated resources scheduled to coincide with growth habits and reproductive characteristics of target species is critical to maximize control. Cutting or mowing in the latter part of growing or early fall prior to the onset of dormancy is effective in weakening the ability of target vegetation to translocate nutrients to root systems. Timing of cutting in this manner will reduce plant vigor and diminish its ability to regenerate vegetative

structures the following growing season. Periodic mowing during the growing season disrupts photosynthetic processes, translocation, and nutrient storage activities by reducing foliar mass.

The goal of mechanical removal is control, which usually requires repeated actions during a full growing season or partial removal by tilling and cultivating to permit the establishment of a replacement community.

Some species such as Japanese knotweed can be spread with mechanical tilling or cultivation in well established stands. Root fragments left in soil can sprout and recolonize by such disturbance. Hand digging and removal is an effective method of control in small infestations or around restoration plants or existing, desirable plant material. A combination of mowing or hand cutting with chemical applications is a common practice that can accelerate the site preparation and landscape restoration phase.

2.3 Chemical Treatment

Chemical control in the context of the Oxbow restoration Plan is defined as the use of pesticides to achieve control of targeted invasive species of plants. Herbicides are a form of pesticide designed to provide a level of vegetation control. The variety of herbicides available for use in New York State involves an array of restricted use and unrestricted products which include many over the counter formulations.

Chemical formulations of herbicides are an extremely useful and potent tool in the planning and design restoration of habitat restoration projects. Effective use of herbicides on this site involves the understanding of product and use limitations. Site and project specific conditions that will restrict the use of chemical products include project timeline, regulatory constraints, environmental impacts, and public exposure. Based on project goals and objectives, the IPMG provides an effective action plan for the project that may prescribe use of chemical controls to complement other measures, not replace them.

Herbicides are classified according to chemical families, molecular structure, and activity. The mode of action of herbicides can be defined as follows. Most herbicides have one or more modes of action associated with its use.

- **Soil Active –** herbicides that are active in soil and absorbed through root systems or emerging shoots.

- **Foliar –** herbicides that applied to growing plant parts above ground and are absorbed through leaf structures.

- **Pre emergence –** soil active chemicals applied to soil prior to emergence designed to inhibit seed germination.

- **Post emergence –** herbicides that control weeds after emergence and during above ground growth stages.

- **Selective –** a chemical control that targets only one species or a specific genus without harming others.

- **Non-Selective –** an herbicide that damages all vegetation.

- **Contact –** an herbicide that injures target plants on contact.

- **Systemic –** an herbicide that is absorbed into plant tissue and moves through the plant enabling it to cause injury in plant parts away from the point of initial contact.

The IPMG has evaluated chemical products for use based on mode of action, efficacy, environmental impact on non-target organisms and residual activity or environmental fate. The following herbicide properties and activity were considered in selecting which product to use at the Oxbow site.

- Effectiveness against the target species.

- Mechanisms of dissipation (persistence, degradation, and likelihood of movement via air or water to non-target organisms).

- Behavior in the environment (in soils, water, and vegetation).

- Toxicity to birds and mammals, aquatic species, and to other non-target organisms (including algae, fungi, and soil organisms).

- Application considerations

- Safety

- Human toxicology

NYSDEC Pesticide Certification is required to apply herbicides according to the IPMG and in compliance with NYSDEC regulations for applying pesticides in or near wetlands. NYSDEC regulations require Aquatic Pesticide Certification to apply pesticides within 50 feet of a river or stream and 100 feet of a wetland area.

Glyphosate is an effective herbicide for use to control the invasive species of plants that occur on the Oxbow Site. It is registered for use in New York Sate under trade names of Roundup for terrestrial use and Rodeo for Aquatic applications. This product is effective in controlling most herbaceous invasive plants in our region.

Glyphosate is a non-selective, systemic herbicide that can control most annual and perennial plants. It controls weeds by inhibiting the synthesis of aromatic amino acids necessary for protein formation in susceptible plants. Glyphosate is strongly adsorbed to soil particles, which prevents it from excessive leaching or from being taken-up from the soil by non-target plants. It is degraded primarily by microbial metabolism, but strong adsorption to soil can inhibit microbial metabolism and slow degradation. Photo- and chemical degradation are not significant in the dissipation of glyphosate from soils. The half-life of glyphosate ranges from several weeks to years, but averages two months. In water, glyphosate is rapidly dissipated through adsorption to suspended and bottom sediments, and has a half-life of 12 days to ten weeks. Glyphosate by itself is of relatively low toxicity to birds, mammals, and fish, and at least one formulation sold as Rodeo® is registered for aquatic use. Some surfactants that are included in some formulations of glyphosate, however, are highly toxic to aquatic organisms, and these formulations are not registered for aquatic use. Monsanto's patent for glyphosate expired in 2000, and other companies are already selling glyphosate formulations.

2.4 Biological Control Organisms

This method utilizes one organism to control another. Usually the host organism is host specific or preys only on the target species. Bio control is characterized by a long term mode of action that does not generally eradicate target species completely but reduces populations to manageable levels. The goal of implementation of biocontrol organisms for invasive plants is to introduce populations of control organisms that will eventually reduce the dominance of invasive plant communities to levels that will support a diversity of native species.

Unfortunately, biocontrol organisms are available for only one species of concern within the project area, purple loosestrife. Leaf and root feeding beetles can be introduced to the site in early summer that will be expected to over winter and provide future generations of beetles that will diminish the existing loosestrife populations that currently inhibit natural species colonization. Existing wet meadow and emergent marsh fringe areas have appropriate hydrology, soil moisture detrital matter, and substrate to support overwintering of leaf eating beetles (*Gallerucella calamarensis*). Although purple loosestrife is not a dominant herbaceous species on the site, introduction of leaf eating beetles harvested from nearby sites or purchased for release is recommended to initiate biocontrol.

2.5 Habitat Modification

Habitat modification or cultural control integrated with other methods provides great potential for success on this site. Cultural methods of control of target species of plants is defined as habitat (vegetation) modification. This method involves the introduction of plants, preferably native species, with growth or cultural characteristics that is capable of competing with or altering habitat conditions that are critical to the survival of the targeted invasive plant species. The Oxbow IPMG complements the restoration plan by identifying species for introduction to the site that will generate new tree and shrub vegetation layers. The planting plan complements restoration work already underway and provides

community diversity and complexity in the form of tree canopy and mast production. Introducing new species in all layers is designed to reduce invasive plant communities present within the herbaceous layer. This method initiates long-term cultural control by selective vegetation modification of tree and shrub communities that will also enhance wildlife habitat and provide future seedbank material within the riparian corridor**. Habitat modification** method for invasive species control is an integral component of the Oxbow Habitat Restoration Plan.

3 Oxbow Habitat Restoration – Methods and Techniques Aquatic and Terrestrial Habitat Restoration

The Oxbow site represents a mosaic of early successional aquatic and terrestrial habitat types as well as a number of elevated contours along the riparian corridor of Buffalo Creek. Habitat features and invasive plant communities have been analyzed in the context of a site-wide Habitat Restoration Plan. Each area presents opportunities for either enhancement or restoration of biological form and function. Invasive species control and management presents opportunities to integrate specific bio-engineering techniques to initiate restoration and biological uplift. The Restoration Plan represents an appropriate and feasible approach to implementing a combination of restoration and enhancement activities. Restoration opportunities and methods for each habitat feature are outlined in a level of detail that addresses physical and biological opportunities and constraints. Where applicable, seasonal activities and multi year practices are specified to achieve combined restoration objectives. The Restoration Plan is designed to reset the trajectory of natural succession within a modified site with great potential for functional uplift and increased biological integrity. The plan provides immediate and consecutive year guidance for the project sponsor to engage community stewardship and leverage additional funds to support focused natural resource management practices on the site.

Each habitat feature discussed below exists in a modified state and controlled somewhat by the manipulation of site hydrology in the form of the constructed outfall structure. The discharge structure elevation and size influences discharge volume and hydroperiod duration. The mosaic of habitats and species it supports is significant within the urbanized reaches of Buffalo Creek and especially the Buffalo River downstream. Resource surveys conducted to date illustrate the value of existing riparian habitat. More importantly, the determination that the majority of the site is a NYSDEC jurisdictional wetland combined with the findings of recent habitat investigations clearly support the need for preservation, restoration and enhancement on the site. Most significant are the conclusions derived from the project sponsor's study, investigations and implementation of preliminary restoration designs:

- Invasive plant communities are manageable,

- Habitat restoration and enhancement design can effectively stabilize, improve and initiate functional uplift of flora and faunal communities on the site and

- Improve connectivity and quality of riparian corridor form and function within this section of the watershed.

It is recommended that wildlife usage and interaction with habitat features should be evaluated in the context of a long term restoration strategy. The results of the initial restoration and enhancement activities implemented by the project sponsor in 2010 provide the project team with valuable data and guidance for the implementation of future restoration designs associated with wildlife usage. These activities and all future project work is subject to performance monitoring designed to measure success and provide guidance to the project team to understand uncertainties, adapt to new information, opportunities or changes in physical site conditions.

The following recommendations are based on analysis of information and data collected to date and the stated goals and objectives of the project team. In addition, it is critical that restoration planning for the Oxbow site continue for a minimum of 5 years within an adaptive management framework that will build upon the evaluated results of preliminary restorative activities and solicit funds and resources to develop designs for future implementation. This approach includes the identification of target flora and faunal species of value and the focused creation of compatible habitat and support structure based on existing site physical and hydrological conditions and constraints. Table 2 contains a list of recommended native species for restoration and enhancement of habitat on the Oxbow site.

3.1 Aquatic and Terrestrial Habitat Enhancement and Restoration

3.1.1 Open Water (OW)

This is well defined a horseshoe shaped feature which is essentially the configuration of the Buffalo Creek channel prior to being cut off from the main stem by the 1950s flood control project. It is entirely within the recently mapped NYSDEC jurisdictional wetland. The water feature has limited flow from east to west to the controlled discharge structure (24" corrugated pipe) set at an elevation above mean water level of the creek. Season high water flows from winter snow/ice melt, rain events, and input from small tributary that outfalls into the eastern portion of the Oxbow open water feature are the primary sources of recharge.

Currently, this feature contained large quantities of large woody debris (LWD) from dead falls and windblown trees. Combined with sedimentation and general detritus accumulation, flow and velocity is reduced and during dry summer months impounded in some areas of the channel. Sediment transport mechanisms have been modified by the flood control project and exacerbated by existing LWD

and recent windblown trees. The evolution of this feature will eventually cause standing water and areas of low flow and velocity to fill with silt and organic matter. Without intervention most of this feature will become a combination of forested wetland, emergent marsh, or wet meadow. Maintaining an open water channel for connectivity and additional edge transitional habitat is desirable to support multiple wildlife users.

Recommendations

- Selectively realign LWD in the channel to provide elevated snags and more vertical and horizontal complexity within open water and riparian fringe vegetation communities,

- Use existing beaver drag trails and routes through the channel as a model for creating small open channels in the Oxbow channel to improve flow and sediment transport,

- Excavate deeper open water areas, use dredged material for soil amendment and island creation for introducing tree, shrub and herbaceous species,

- **Spring Seeding:** (March through May) Overseed moist soil and open water fringe area with wetland seed mix ERNST -120 OBL_FACW Mix

- **Spring Planting:** (March through May) Plant OBL live stakes (LS) in fringe areas of open water channel where open water transitions to emergent marsh and wet meadow. Plant submerged aquatic and emergent species

3.1.2 Emergent Marsh (PEM)

PEM habitat features area directly associated with the oxbow channel, NYSDEC wetland, and general site topography. This habitat type is an irregular fringe area that follows the form and is hydrologically connected to the OW feature. PEM also occurs in shallow depressions on the site that occur within the NYSDEC 100' buffer. These areas are subject to seasonal and periodic inundation and subsequent hydroperiod fluctuations associated with the flood control project and its controlled discharge structure. Aquatic plant communities are in early stages of development with species represented in all vegetation layers. Species assemblage on the Oxbow has many native indicator species of high wildlife value. However, species density and diversity is limited compared to upper watershed floodplains and PEM features. Reed canary grass is a dominant species in the herbaceous layer of PEM and wet meadow features on the site. It is expected that density will develop on a successional course by natural recruitment and colonization in the presence of ideal site hydrology and soils. The implementation of control and management of invasive species within all habitat features identified on the site is critical to redirecting succession of native species and functional uplift of habitat.

Recommendations

- Continue IS control and management practices for all occurrences of Japanese knotweed, common reed and other species in or near this feature
- Integrate vegetation restoration practices to coincide IS control and management
- Introduce species from plant list in a variety of propagules; live stake (LS), bare root (BR), container (C) in spring and fall dormant seasons, C can be planted in any soil that is not frozen
- (March through May) Overseed PEM area with wetland seed mix ERNST - 120 OBL_FACW Mix throughout the feature to improve diversity and competition for IS
- Realign LWD from OW areas to create snags and brush pile structures for wildlife

3.1.3 Wet Meadow (WM)

The WM feature occurs in the central portion of the site inside the OW and PEM features and impounded by the flood control project berm along the right descending bank of Buffalo Creek. It expends throughout most of the flat topography that was historically used for cultivated row crops. There are some small, isolated depressions within the WM feature near the wooded portions of the site. This feature is subject to inundation seasonally and during severe rain events. Drawdown is low to moderate after spring snow and ice melt and storm events due to a combination of factors including the capacity of the discharge structure to regulate hydroperiod duration, water table levels and as well as mean water level in the OW feature. Natural succession of vegetation including IS in this feature is subject to hydroperiod fluctuations. Species that exhibit greater plasticity or resilience to soil moisture extremes are flourishing in this feature. Reed canary grass is an indicator species that is dominant in WM areas. It inhibits the recruitment and colonization of IS as well as native species and development of a diverse seedbank. It is extremely beneficial on this site in its capacity to inhibit IS spread by functioning as a nurse crop in which more beneficial species can be planted.

Recommendations

- Continue IS control and management practices for all occurrences of Japanese knotweed, common reed and other species in or near this feature
- Integrate vegetation restoration practices to coincide IS control and management and maintain the integrity of portions of the WM feature. Determine planting plan that will maintain WM feature on parts of the site with reed canarygrass and other herbaceous species as a mixed assemblage

- Introduce species from plant list in a variety of propagules; live stake (LS), bare root (BR), container (C) in spring and fall dormant seasons, (C can be planted in any soil that is not frozen). Create tree and shrub islands within the WM feature incrementally and as funding permits while allowing reed canarygrass to persist as an IS barrier.

- Select only those tree and shrub species from the plant list that are tolerant of periodic inundation and not too aggressive/invasive such as swamp white oak, burr oak, red maple, hackberry, black gum, sycamore, aronia, elderberry, silky dogwood,

3.1.4 Forested Wetland (PFO)

This portion of the site is represented by tree species with a minimal shrub understory that have developed on the site in the last 60 years. Typical riparian and floodplain species occur in the historic floodplain or bottomland areas along OW channel and primarily within the NYSDEC wetland buffer (black willow, eastern cottonwood, green ash). The PFO feature is presently landlocked by steep banks along the right descending bank of the OW feature and upland or terrestrial features in the eastern and southern portion of the site. PFO areas receive hydrologic input from the tributary in the eastern portion of the site and surface rainfall. A combination of surface contours, bottomland topography, seasonally high water table and Hydric or soils with Hydric inclusions provide hydraulic and biological characteristics that support this habitat feature.

Recommendations

- Introduce species from plant list in a variety of propagules; live stake (LS), bare root (BR), container (C) in spring and fall dormant seasons, (C can be planted in any soil that is not frozen).

- Select OBL or FACW canopy and mast producing trees for habitat enhancement of this feature as well as shade tolerant shrubs and herbaceous species from the plant list for understory restoration.

- Consider removing ash species and planting other species due to expected impact of emerald ash borer in the region.

- Screen or fence susceptible trees to prevent herbivory from beaver and deer.

3.1.5 Vernal Pool (VP)

A VP feature does not presently exist on the site. Appropriate siting and analysis could be integrated with IS control and management as well as contour modification within the PFO or WM feature of fringe areas. Creation of VP features requires specific design criteria and planning to provide specific amphibian breeding habitat and refugia for an appropriate period of time in spring. The Ground

Water Table analysis performed by E & E is included in this report and provides preliminary information on surface water flows, duration, and estimated depth to ground water on the site. This data was collected from topographic information and known Buffalo Creek gauge stations in proximity to the Oxbow site.

Recommendations

- Survey UPL area for potential VP siting and construction based on proximity to OW and PEM habitats.
- Establish locations and install piezometers for measurement of seasonal water table fluctuations
- Evaluate candidate sites that may involve invasive plant removal prior to VP construction
- Develop design detail for VP feature based on amphibian species requirements, exiting surface hydrology, hydroperiod, and predation potential.
- Evaluate UPL locations based on piezometer data and VP design criteria. Determine if VP feature is feasible.
- If site constraints do not support VP feature design, consider excavation and contour grading to create seasonal aquatic depressions or isolated OW features to increase plant diversity, edge habitat, and refugia for wildlife users on the site

3.1.6 Terrestrial Upland (UPL)

UPL habitat features occur in the eastern and northern portions of the site on elevated terraces adjacent to the OW and PEM features. Species diversity and density in all vegetation layers similar to the PFO feature. This portion of the site is represented by tree species with an established shrub and herbaceous understory that has developed on the site within the last 60 years. The UPL area represents an important transitional habitat from the predominant aquatic habitat features on the site. The UPL area supports important tree species for a number of hepetofaunal and avian species including regionally significant neotropical migratory songbirds, woodpeckers, and raptors. These species are listed in amphibian and turtle surveys conducted by E & E as well as the baseline conditions report by the SUNY Buffalo Erie Program, the Marsh Monitoring survey results which were part of the Oxbow project natural resource investigations.

Recommendations

- Introduce tree and shrub species adaptable to the UPL area with emphasis on those species that exhibit “plasticity” (ability to grow in a variety of soil, moisture, and exposure regimes).

- Select only indigenous tree and shrub species that are to Buffalo Creek riparian corridor and primary terraces. (Black walnut, sycamore, basswood, hackberry, bur oak, pin oak, red oak)

- Select UPL canopy and mast producing trees for habitat enhancement of this feature as well as shade tolerant shrubs and herbaceous species from the plant list for understory restoration. Consider FACW species for transition zone between UPL and OW/PEM features.

- Consider removing ash species and planting other species due to expected impact of emerald ash borer in the region.

- Sow tree and shrub seed mixes in addition to other propagules in fall to produce uneven age cover types and reduce impacts or herbivory.

- Screen or fence susceptible trees to prevent herbivory from beaver and deer.

3.2 Herpetofaunal Habitat Enhancement and Restoration

Habitat restoration at the West Seneca Oxbow should focus on increasing abundance of species that are known to be present at the site as well as creating habitat for target species (i.e. those known to occur nearby, but are presumed to be absent from the Project Area). The following recommendations are made to increase herpetofaunal habitat suitability within the Project Area for present and target species.

Recommendations

- Increase forest cover

- Increase in Coarse Woody Debris (CWD)

- The creation of vernal pools

For a more detail discussion of restoration concepts as well as a complete report of herpetological study findings within the Project Area, see Appendix E.

4 Adaptive Management

An integral element of the Restoration Plan is incorporation of an adaptive management strategy that allows for adjustment of restoration methods and techniques over time. Local experience and monitoring data informs which methods or techniques provide greatest potential for long term biological uplift and what approaches to problems work best on this specific site, in this watershed.

An adaptive management strategy for restoration planning and design for the Oxbow site includes the following characteristics:

- An iterative, unified planning process that supports continual and sustainable habitat improvement,
- Emphasis on learning by implementing project scale activities, demonstration projects and on experimentation to develop solutions,
- Broad stakeholder participation,
- Development of a methodology for cost benefit analysis to effectively allocate limited resources,
- Integrated, comprehensive data and information management and
- Cooperation and transparency in resource planning, design, implementation and monitoring.

Table 4-1 Tree and Shrub List for Oxbow Restoration and Enhancement

Plant Species	Indicator[3]	Type[1]	Form[2]
Acer rubrum – Red Maple	FAC	T	BR,BB,C
Acer sacharum – Sugar Maple	FACW	T	BR,BB,C
Alnus incana ssp. Rugosa – Speckled Alder	FACW	S	BR,C
Aronia arbutifolia – Red Chokeberry	FACW	S	BB,BR.C
Aronia melanocarpa – Black Chokeberry	FAC	S	BB,BR,C
Celtis occidentalis-Hackberry	FACU	T	BB,C
Cephalanthus occidentalis – Buttonbush	OBL	S	C,BR,LS
Cornus alternifolia – Pagoda Dogwood	FAC	S	BB,C
Cornus amomum – Silky Dogwood	FACW	S	BR,LS,C
Cornus sericea – Redosier Dogwood	FACW	S	BR, LS,C
Ilex verticillata – Winterberry	FACW	S	BB,C,BR
Linders nenzoin – Spicebush	FACW	S	BB, C
Lirodendron tulipfera – Tulip Tree	FACU	T	BB,C
Magnolia accuminata – Cucumber Tree	FACU	T	BB,C
Myrica pennsylvanica – Northern Bayberry	FAC	S	BR,C
Nyssa sylvatica – Black Gum	OBL	T	BB,C
Platanus occidentalis – American Sycamore	FACW	T	BB,C
Prunus pennsylvanica – Pin Cherry	FACU	T	BB,C
Prunus serotina – Black Cherry	FACU	T	BB,C
Q. rubra – Northern Red Oak	FACU	T	BB,C
Quercus bicolor – Swamp White Oak	FACW	T	BB,C
Quercus macrophylla – Bur Oak	FAC	T	BB,C
Quercus palustris – Pin Oak	FAC	T	BB,C
Quercus rubra – Red Oak	FACU	T	BB,C
Rubus allegheniensis – Allegheny Blackberry	FACU	S	BR,C
Salix exigua – Crack Willow	OBL	T	LS, BR, C
Sambucus Canadensis – Elderberry	FACW	S	BB, C
Tilia americana – American Basswood	FAC	T	BB,C
Tsuga canadensis – Eastern Hemlock	FAC	T	BB,C

Notes:

[1] **T-Tree, S-Shrub**

[2] **BB-Ball Burlaped, BR-Bare Root, LS-Live Stake, C-Container**

[3] **Wetland Indicator Status -** Indicator Status Designation signifying its frequency of occurrence in a wetland (Obligate [OBL], Facultative Wetland [FACW], Facultative [FAC], Facultative Upland [FACU], and Upland [UPL]).

5 Performance Indicators for Monitoring and Evaluation of Habitat Restoration Activities

A majority of the Oxbow site has been mapped as a NYS regulated wetland that includes a 100 foot buffer zone. The buffer area around NYSDEC wetlands is designed to preserve and protect aquatic habitat and associated natural resources from biotic stressors or infringement by adjacent land use activities. With minor variance, federal and state wetland delineation methodology requires that aquatic vegetation, hydric soil, and surface hydrology exist on a site to be classified as a jurisdictional wetland. The focus of the Oxbow Restoration Plan is on enhancement and restoration of plant communities within each aquatic and terrestrial habitat type as well as some physical and structural modifications. A thorough understanding of baseline conditions with knowledge of pre settlement vegetation cover types is essential to develop restoration goals and function based design. Uplift in biological diversity and density of enhanced plant communities by restoration planning and design is accomplished by design to improve habitat form and function. Control and management of invasive species is a relatively new science and a critical aspect of the designed modification of vegetation cover types in riparian areas. The Oxbow Restoration Plan represents a resetting of the trajectory of natural succession of plant communities in the context of existing conditions and modified or managed surface hydrology. Performance based monitoring is required in order to measure the success of Oxbow restoration activity that is designed to achieve functional uplift in biotic communities.

The quality of aquatic habitat can be improved through a number of pathways. The following provides brief descriptions of each mitigation or enhancement approach. (Department of the Army, Savannah District, Corps of Engineers 2004, ELI 1993) Each category is relevant to habitat features on the Oxbow site. As restoration planning and design is developed for the Oxbow site, it is recommended that a monitoring protocol for those restoration activities be implemented based on the following criteria and descriptors.

- **Wetland Restoration** – involves the manipulation of a system with the goal of returning natural or historic functions to a former or degraded wetland. There are two categories of restoration as follows: (a) re-establishment, which involves rebuilding a former wetland and results in a gain in wetland area and

(b) rehabilitation, which improves wetland function but does not result in a gain in wetland area.

- **Wetland Creation** – involves the manipulation of the physical, chemical, or biological characteristics present to develop a wetland on an upland or deep-water site, where a wetland did not previously exist. Creation results in an overall increase in wetland area.

- **Wetland Enhancement** – involves the manipulation of a system to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is typically undertaken for specified purposes such as water quality improvement, flood water retention, or wildlife habitat. Therefore, enhancement projects result in a change in wetland function(s) and can result in an increase in overall area.

- **Wetland Preservation** – is the permanent and perpetual protection of existing wetlands.

Wetland Enhancement and Wetland Preservation are most applicable to the Oxbow site.

Gauging the successes of wetland management strategies (above) are a vital part of the Oxbow restoration Plan. Monitoring is method of measuring or quantifying results of restoration projects that is essential to objectively document resource allocation. More importantly project managers will require accurate monitoring data to refine or modify restoration design and implement revised plans based on new information or address unpredictable changes in site conditions. It is important to quantify how restoration activities have improved the ecology of the Oxbow. Tools called *performance standards* are used to measure the effectiveness of restoration techniques. Performance standards contain *metrics*, which are ecosystem characteristics that help describe habitat function and value. Table 5-1 offers possible performance standards and their descriptors which could be adopted for the Oxbow site restoration:

The performance indicators above are calibrated to a period of three years following implementation of a designed restoration effort. The ACOE frequently uses the three year period while regulated constructed wetlands. The first three years are determined to be the most critical, particularly when establishing or removing flora.

Table 5-1 Possible Performance Standards and their Descriptors

	Performance Indicator (proposed)	Metric
1	Invasive plant species composition is reduced to a range between 15 and 29 percent, or less, in the first year; 6 to 15 percent, or less, in the second year; and 0 to 6 percent in the third year	Invasive species (% cover)
2	Individual invasive plant species are targeted to reduce the number of invasive species on site: Japanese knotweed is eradicated completed from the site within the first three years of management	Invasive species (# of species)
3	Native plant species composition increases to a range between 50 and 89 percent, or more, in the first year; 90 and 96 percent, or more, in the second year; and 97 to 100 percent in the third year	Native plant composition (% cover)
4	Historically native plants which have become extirpated from the site are reintroduced from other areas: American basswood and hackberry are transplanted on site and establish reproducing populations within the first ten years	Native plant species (# of species)
5	Open water (OW) increases 200% in the first year; and does not decrease more than 25% in the following two years	Open water area (% area)
6	50 to 100 percent of nuisance large woody debris (LWD) on site is removed during the first year of work; and monitoring over two years does not show the return of nuisance LWD	Large woody debris volume
7	The percentage of suitable wildlife habitat within a radius of 0.5 miles increases 5 to 10 percent over the first three years	Landscape connectivity
8	The percentage of area on site at Oxbow which ponds water for 1 day each year increases 5 to 10 percent	Hydrologic connectivity
9	Herpetofaunal and Avian species surveys – Year one through five surveys for species occurrence, relative abundance and reproduction compared to baseline survey data.	Wildlife usage

6 References

National Research Council. 2001. *Compensating for Wetland Losses under the Clean Water Act*. Washington, D.C.: National Academies Press.

Blossey, B. M. SchwarzlAnder, P. Haflinger, R. Casagrande, and L. Tewksbury. 2002b. Common Reed. In Van Driesche, R., et al. Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04, 413 p. Available at: http://www.invasiveplants.net/biologicalcontrol/9CommonReed.html .

Dow AgroSciences. 2008. Invasive Species Management. Accessed online at: http://www.dowagro.com/ivm/invasive/prod/rodeo.htm .

Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M Olivero (editors). 2002. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

Faber-Langendoen, D., G et al. 2008. Ecological Performance Standards for Wetland Mitigation: An Approach Based on Ecological Integrity Assessments. Arlington, VA: NatureServe. Available online: http://www.natureserveorg/publications/EPA-EcolStdrds-WetlandMitigation_MainReport.pdf

Michigan Department of Natural Resources (MDNR). 2008. A Guide to the Management and Control of Invasive Phragmites. 33 p.

Plant Conservation Alliance Alien Plant Working Group (PCA). 20 May 2005. Fact Sheet: Japanese Knotweed (*Polygonum cuspidatum*). Available online at: http://www.nps.gov/plants/alien/.

National Research Council. 2001. *Compensating for Wetland Losses under the Clean Water Act*. Washington, D.C.: National Academies Press.

The Nature Conservancy (TNC). 2003. The Invasive Species Initiative: Common Reed (*Phragmites australis*), 21pp. Available at: http://tncweeds.ucdavis.edu/esadocs/phraaust.html.

The Nature Conservancy (TNC). 2006. A Review of Literature and Field Practices Focused on the Management and Control of Invasive Knotweed. West Haven VT. 32pp. Available online at: http://tncweeds.ucdavis.edu/esadocs/polycusp.html.

United States Department of Agriculture, US Forest Service (USDA). 2005. Weed of the Week: Common Reed. USDA Forest Service Publication WOW-01-31-05. Available at: http://na.fs.fed.us/fhp/invasive_plants/weeds.

United States Department of Agriculture, Natural Resource Conservation Service (USDA). 2000. Plant Guide: Purple Loosestrife (*Lythrum salicaria*). Available online at: http://plants.usda.gov/plantguide/pdf/pg_lysa2.pdf.

Van Driesche, R., *et al.*, 2002, Biological Control of Invasive Plants in the Eastern

United States, USDA Forest Service Publication FHTET-2002-04, 413 p. Available online at: http://www.invasive.org/eastern/biocontrol/12Knotweed.html.