BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

DRAFT
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New York Power Authority

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Study Area 1
1.2 Background 1

2.0 GOALS AND OBJECTIVES OF THE INVASIVE SPECIES CONTROL HIP 2
2.1 Adaptive Management 2

3.0 HISTORICAL CONDITION 5

4.0 EXISTING CONDITIONS 7
4.1 Plant Resources and Natural Communities 7
4.2 Cover Type Mapping 11
4.3 Monitoring Plots 15

5.0 INVASIVE SPECIES INFORMATION 17

6.0 PRIORITIZATION 18

7.0 CONTROL METHODS 26
7.1 Common Reed 26
7.1.1 Mechanical 26
7.1.2 Chemical 30
7.2 Knotweed Control 35
7.2.1 Mechanical 35
7.2.2 Chemical 36

8.0 SPECIAL CONSIDERATIONS 37

9.0 RECOMMENDED CONTROL METHODS 40
9.1 Overall Approach 40
9.2 Recommend Treatment Options for Common Reed 42
9.2.1 Dense Stands 44
9.2.2 Medium Density Stand Approach 48
9.2.3 Low Density Stand Approach 49
9.2.4 Schedule 50
9.3 Japanese Knotweed Control 52

10.0 MONITORING 53
10.1 Rare, Threatened, and Endangered Species 54
10.2 Annual Monitoring 54
10.3 Five Year Monitoring 55

11.0 LITERATURE CITED 56

LIST OF FIGURES

Figure 1-1: Buckhorn Site Location Map 4
Figure 4.3-1: Buckhorn Fixed Sample Plot Locations 16
Figure 6-1: Group Ranking of Invasive Polygons 25
Figure 9.1-1: Invasive Species Management Flow Chart 42
Appendix B. Buckhorn Cover Type Index Map 61
Appendix B. Buckhorn Cover Type Maping. Sheet 1 of 18 62
Appendix B. Buckhorn Cover Type Maping. Sheet 2 of 18 63
Appendix B. Buckhorn Cover Type Maping. Sheet 3 of 18 64
Appendix B. Buckhorn Cover Type Maping. Sheet 4 of 18 65
Appendix B. Buckhorn Cover Type Maping. Sheet 5 of 18 66
Appendix B. Buckhorn Cover Type Maping. Sheet 6 of 18 67
Appendix B. Buckhorn Cover Type Maping. Sheet 7 of 18 68
Appendix B. Buckhorn Cover Type Maping. Sheet 8 of 18 69
Appendix B. Buckhorn Cover Type Maping. Sheet 9 of 18 70
Appendix B. Buckhorn Cover Type Maping. Sheet 10 of 18 71
Appendix B. Buckhorn Cover Type Maping. Sheet 11 of 18 72
Appendix B. Buckhorn Cover Type Maping. Sheet 12 of 18 73
Appendix B. Buckhorn Cover Type Maping. Sheet 13 of 18 74
Appendix B. Buckhorn Cover Type Maping. Sheet 14 of 18 75
Appendix B. Buckhorn Cover Type Maping. Sheet 15 of 18 76
Appendix B. Buckhorn Cover Type Maping. Sheet 16 of 18 77
Appendix B. Buckhorn Cover Type Maping. Sheet 17 of 18 78
Appendix B. Buckhorn Cover Type Maping. Sheet 18 of 18 79

LIST OF TABLES

Table 4.1-1: Buckhorn Plant List 8
Table 4.2-1: Cover Types Identified During Cover Type Mapping 12
Table 4.2-2: Cover Types Mapped Within Buckhorn Marsh 13
Table 4.3-1: Areal Coverage Classes for Vegetation within Sample Plots 15
Table 4.2-2: Buckhorn Sample Plots 17
Table 6-1: Rankings Used For Individual Stand Prioritization 21
Table 7.1-1: Potential Pros and Cons of Covering Methods 27
Table 7.1-2: Potential Pros and Cons of Hand Pulling Methods 28
Table 7.1-3: Potential Pros and Cons for Cutting Methods 29
Table 7.1-4: Potential Pros and Cons of Burning 30
Table 7.1-5: Potential Pros and Cons for Water Level Management 30
Table 7.1-6: Potential Pros and Cons of Stem Injection/Clip and Drip Methods 32
Table 7.1-7: Potential Pros and Cons of Hand Swiping Method 32
Table 7.1-8: Potential Pros and Cons for Backpack Herbicide Application 33
Table 7.1-9 Potential Pros and Cons to Wick/Dauber Application 34
Table 7.1-10: Potential Pros and Cons of Boom Spray Herbicide Application Methods 34

Table 7.1-11: Potential Pros and Cons for Aerial Application Methods 35
Table 9.2.1-2: Potential Plant Species for Use in Planting Plans 47
Table 9.2.4-1: Treatment Schedule Based on Stand Type* 51
Table 9.3-1: Knotweed Control Approach 53

LIST OF APPENDICES

Appendix A: Winter Survey Report 59
Appendix B: Cover Type Mapping 60
Appendix C: Invasive Species Descriptions 80
Appendix D: Survey Data 88
Appendix E: Priority Ranking Matrix 108

1.0 INTRODUCTION

The New York Power Authority (NYPA) is undertaking several habitat improvement projects (HIPs) as part of the Niagara Power Project Comprehensive Relicensing Settlement Agreement. One of these HIPs involves the control of invasive wetland plants within Buckhorn Island State Park (Figure 1-1). This Invasive Species Action Plan is based on inventory work conducted during the winter and summer of 2008, and research into potential control methods. This plan serves to outline management measures and implementation strategies to control and monitor invasive wetland species in targeted areas to promote the growth of functionally valuable wetlands characterized by a diverse community of native wetland vegetation.

1.1 Study Area

Buckhorn Island State Park is owned and operated by the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP). The park is located at the northern edge of Grand Island and is bisected by Interstate 190 (I-190). The park includes a variety of habitats ranging from upland forests dominated by oak and cottonwood to sedge-dominated marsh habitats. The study area for the Action Plan (Plan) at Buckhorn Island State Park is focused on the open marsh portion, hereafter referred to as Buckhorn Marsh or Buckhorn (Figure 1-1).

1.2 Background

Within Buckhorn the primary species of concern is Common reed (*Phragmites australis*). Common reed is a vigorous invader and spreads rapidly via vegetative growth through a vast underground system of rhizomes. While Common reed can reach heights of fifteen feet, the majority of the yearly plant biomass (80%) is contained underground (MDNR, 2008). The ability of Common reed to spread and out-compete native vegetation for growth medium, water, and light makes it a serious threat to natural ecosystems. Common reed has been controlled through the use of mechanical treatments, but the most effective management efforts utilize herbicide treatment (see Section 7.0).

As discussed in greater detail in Section 3.0, Buckhorn contains a valuable remnant sedge meadow marsh cover type, and the main objective of this HIP (Section 2.0) is to control and monitor

Common reed and to prevent Common reed from overtaking these native marsh areas. The Action Plan that follows presents the most recent advances and techniques in the field of Common reed control. While a number of potential methods for control are reviewed (Section 7.0), specific methods are recommended for use within the Buckhorn Marsh (Section 8.0) based on a variety of factors. The control of any invasive community is a challenge and our knowledge of the most effective control techniques is constantly changing. Therefore, this Plan utilizes an adaptive management strategy where treatment and monitoring methods may be modified in order to better achieve stated goals while avoiding unnecessary ecological costs (Section 2.1).

2.0 GOALS AND OBJECTIVES OF THE INVASIVE SPECIES CONTROL HIP

As identified in the conceptual HIP descriptions included in the Settlement Agreement, the objective of the Invasive Species Control HIP is to:

Control and monitor invasive wetland species in targeted areas to promote the growth of functionally valuable wetlands characterized by a diverse community of native wetland vegetation. It should be noted that the control of exotic species can be difficult and realistic goals have been set with regard to control efforts. Typically reducing further spread and reducing dominance in targeted areas is a reasonable goal; eradication is usually not achievable at the landscape level (NYPA, 2005).

2.1 Adaptive Management

An ecologically-based adaptive management strategy was used as the basis for this invasive species Action Plan in order to meet the stated objectives. The focus of adaptive management is the adjustment of management techniques over time in response to monitoring and information gathering in order to reach management goals.

The initial steps of the Action Plan are specifically designed to monitor the effectiveness of control techniques and assess their success at a small scale before moving forward and beginning to treat additional sites on a larger scale (the specific Action Plan steps are detailed in Section 9.0). The Action Plan uses a “phased” approach where the highest priority sites are treated first. Since invasive species can always re-invade controlled areas, treated areas will regularly be monitored to assess

effectiveness and the need for spot applications. As such, even when the second phase is in progress, the monitoring and spot treatments (as necessary) will still include the Phase I areas. Adjustments to control techniques will be made according to what is learned during prior treatments.

A thorough review of existing techniques for Common reed and Japanese knotweed control was conducted and, based on these findings, recommended control methods were selected for use within Buckhorn. Deviation from these methods is an option, within an adaptive management framework, if the assessment of effectiveness monitoring suggests a change in technique is merited.

Figure 1.1 Buckhorn Site Location Map

Figure 1.1
Buckhorn Site Location Map

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3.0 HISTORICAL CONDITION

According to historical accounts, Buckhorn Marsh was associated with a secondary channel of the Niagara River separating the northern shore of Grand Island from Buckhorn Island to the north (NYSDEC, 1995). In general, vegetation within the marsh was restricted to areas along the shore, bordering the deep channel between Buckhorn Island and Grand Island. Accounts noted a dense mixture of Hard-stem bulrush (*Schoenoplectus acutus*), Three square (S*cirpus americanus*), Arrowhead (*Sagittaria latifolia*), Swamp arrowhead (*Sagittaria rigida*), and Creeping spike rush (*Eleocharis palustris*) away from the shore in deeper water. Narrow-leaved cattail (*Typha angustifolia*) was noted as being prevalent along the shores of Grand Island and Buckhorn Island (Muenscher, 1929).

Buckhorn, as visible in aerial photography (1938), contained open areas of water both west and east of the I-190 Bridge with the channel narrowing toward the confluence with Woods Creek. As late as 1959, photographs indicate that the Marsh was still dominated by open water and marsh species (rushes, sedges, and aquatic vegetation) other than cattail. By 1985, aerial imagery shows the rapid colonization of the marsh by Narrow and Broad-leaved cattail (NYSDEC, 1995). Cattail marsh communities now dominate Buckhorn (See Section 4.0). Based on surveys completed in 1995, wet meadow communities contained primarily Tussock sedge (Carex *stricta*), Lake bank sedge (*Carex lacustris*), and Canada blue joint (*Calamagrostis canadensis*) with occasional clumps of Swamp rose (*Rosa palustris*) (NYSDEC, 1995).

Starting in 1995 and ending in 1998, the NYSOPRHP and the New York Department of Conservation (NYSDEC) permitted and completed excavation of channels and two water control structures within Buckhorn Marsh to improve existing habitat. Channels increased edge habitat and increased patchiness of open water edge within the cattail dominated marsh (NYSDEC, 1995). This habitat improvement project enhanced habitat for a wide range of fish and wildlife, including wading birds, waterfowl, and northern pike, that require interspersion of open water and marsh emergent vegetation. Additionally in 2000, the NYSDEC mapped Common reed within Buckhorn Marsh. The NYSDEC survey identified 12 polygons and 4 points (totaling 16 features) containing Common reed, with the polygons ranging in size from less than 0.01 acres to 1.4 acres. Subsequent to this mapping

effort, Common reed appears to have become established throughout the marsh primarily along areas of side-cast materials left near the created channels (Section 4.0). The size of the sites observed in 2000 has also increased, most notably in the two largest Common reed patches (near the I-190 toll booth and the large patch on the western shore of the Marsh).

4.0 EXISTING CONDITIONS

4.1 Plant Resources and Natural Communities

Table 4.1-1 lists plants observed within monitoring plots (Section 4.3) specifically as well as species observed within the marsh generally. Global and state rarity rankings were included for each species. The survey did not identify any threatened or endangered plant species. The rarity rankings, which are related to the conservation status of a species or ecosystem, are designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global, N = National, and S = Subnational or State). The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable
4 = apparently secure
5 = secure

For example, G1 would indicate that a species is critically imperiled across its entire range (*i.e.*, globally). In this sense the species as a whole is regarded as being at very high risk of extinction. A rank of S3 would indicate the species is vulnerable and at moderate risk within a particular state or province, even though it may be more secure elsewhere (Natureserve 2009).

A search of the New York Natural Heritage Program (NYNHP) did not identify any threatened or endangered plants within the study area. Giant St. Johnswort (*Hypericum ascyron*) which appears on the Natural Heritage Program's watch list was identified within the marsh. While not identified during the search of the NYNHP database, Southern Blue flag (*Iris virginica* var. *shrevei*), is known to occur in the area and may potentially occur within the marsh. Southern Blue flag is State endangered in New York (S1). Pre-treatment plant surveys (Section 10.0) will ensure that this and any other potentially occurring rare species are not present prior to treatment. Additionally the NYNHP identified that the survey area is in the vicinity of a historical observation of a rare (but not listed - *i.e.*, not on the State threatened and endangered species list) Odonate, the Mocha emerald

(*Somatochlora linearis*). The Mocha emerald is designated G-5, S-2 (globally secure, state imperiled). Breeding habitats for this species are small to medium sized streams with a sandy or gravelly substrate that flow through woods and swamps. Based on the habitat available in the marsh and along Woods Creek, there is a low potential that the Mocha emerald may be present since most of the stream substrates are fine-textured. Based on the work proposed in this Action Plan it is not expected that the Mocha emerald would be impacted since precautions (*i.e.*, not spraying when there is potential for wind-drift, using only chemicals approved for aquatic habitats, using techniques that keep overspray to a minimum) will be employed. Additional species not identified by the NYNHP, but found in similar habitats to those found in Buckhorn (*i.e.*, sedge wren, harriers), will be included in pre treatment surveys (Section 10.0).

TABLE 4.1-1: BUCKHORN PLANT LIST

Common Name	Scientific Name	Rarity Rank (Global/State)
Red maple	*Acer rubrum*	G5/S5
Sweet flag	*Acorus americanus*	G5/S5
Purple giant hyssop	*Agastache scrophulariaefolia*	G4/S4
Garlic mustard	*Alliaria petiolata*	Exotic
European alder	*Alnus glutinosa*	Exotic
Speckled alder	*Alnus incana*	G5/SNR
Indian hemp	*Apocynum cannabinum*	G5/S5
Swamp milkweed	*Asclepias incarnata*	G5/S5
Aster sp.	*Aster sp.*	G5/S5
Bur marigold	*Bidens cernua*	G5/S5
River bulrush	*Bolboschoenus fluviatilis*	G5/S5
Canada bluejoint	*Calamogrostis canadensis*	G5/SNR
Marsh bellflower	*Campanula aparinoides*	G5/S5
Carex sp.	*Carex sp.*	-
Lake bank sedge	*Carex lacustris*	G5/S5
Tussock sedge	*Carex stricta*	G5/S5
Button bush	*Cephalanthus occidentalis*	G5/S5
Water hemlock	*Cicuta maculata*	G5/S5
Canada thistle	*Cirsium arvense*	GNR/SNR
Hedge bind weed	*Convolvulus sepium*	G5/SNR

Table 4.1-1: BUCKHORN PLANT LIST (Cont'd)

Common Name	Scientific Name	Rarity Rank (Global/State)
Silky dogwood	*Cornus amomum*	G5/SNR
Red oiser dogwood	*Cornus sericea*	G5/SNR
Queen Annes lace	*Daucus carota*	G5.SNR
Teasle	*Dipsacus sylvestris*	Exotic
Hairy willow herb	*Epilobium hirsutum*	Exotic
Joe-pyed weed	*Eupatorium maculatum*	G5/SNR
White boneset	*Eupatorium perfoliatum*	G5/S5
Japanese knotweed	*Falopia japonica*	Exotic
Green ash	*Fraxinus pennsylvanica*	G5/S5
Rough bedstraw	*Galium asprellium*	G5/S5
Bedstraw species	*Galium sp.*	-
Avens species	*Geum sp.*	-
Swamp rose mallow	*Hibiscus moscheutos*	G5/SNR
Great St. Johnswort	*Hypericum ascyron*	G4/S3*
Marsh St. Johnswort	*Hypericum virginicum*	G5/S5
Jewel weed	*Impatiens capensis*	G5/S5
Soft rush	*Juncus effusus*	G5/SNR
Yellow iris	*Iris pseudacorus*	Exotic
Blue flag iris	*Iris versicolor*	G5/S5
Rice cut grass	*Leersia oryzoides*	G5/S5
Swamp privet	*Ligustrum vulgare*	Exotic
Honeysuckle	*Lonicera sp.*	-
Marsh purslane	*Ludwigia palustris*	G5/S5
Bugleweed species	*Lycopus sp.*	-
Tuffted loosestrife	*Lysimachia thyrsiflora*	G5/S4
Purple loosestrife	*Lythrum salicaria*	Exotic
Wild mint	*Mentha arvensis*	G5/SNR
Water lily	*Nuphar spp.*	-
Evening primrose	*Oenothera biennis*	G5/S5
Sensitive fern	*Onoclea sensibilis*	G5/S5
Virginia creeper	*Parthenocissus quinquefolia*	G5/S5
Common reed	*Phragmites australis*	Exotic
Clear weed	*Pilea pumila*	G5/S5
Grass species	*Poa sp.*	-
Ladie's thumb	*Polygonum persicaria*	G4/S5
Tearthumb	*Polygonum sagittatum*	G5/S5
Polygonum sp.	*Polygonum sp.*	-
Cottonwood	*Populus deltoides*	G5/S5

Table 4.1-1: BUCKHORN PLANT LIST (Cont'd)

Common Name	Scientific Name	Rarity Rank (Global/State)
Pondweed sp.	*Potamegaton sp*	-
Swamp rose	*Rosa palustris*	G5/S5
Rumex sp.	*Rumex sp.*	-
Arrow head	*Sagittaria latifolia*	G5/S5
Willow sp.	*Salix sp.*	-
Soft stem bulrush	*Schoenoplectus tabernaemontani*	G5/S5
Dark geen bulrush	*Scirpus atrovirens*	G5/S5
Scirpus sp	*Scirpus sp.*	-
Wool grass	*Scripus cyperinus*	G5/S5
Marsh skullcap	*Scutellaria epilobiifolia*	G5/S5
Water parsnip	*Sium suave*	G5/S5
Burreed	*Sparganium sp*	-
Bittersweet nightshade	*Solanum dulcamara*	Exotic
Lance-leaved goldenrod	*Solidago graminifolia*	G5/S5
Goldenrod sp	*Solidago sp.*	-
Field sow thistle	*Sonchus arvensis*	Exotic
Meadow sweet	*Spiraea latifolia*	G5/S5
Steeplebush	*Spiraea tomentosa*	G5/SNR
Marsh fern	*Thelyptris palustris*	G5/S5
Narrow-leaved cattail	*Typha angustifolia*	G5/S5
Broad-leaved cattail	*Typha latifolia*	G5/S5
Mullien	*Verbascum thapsus*	GNR/SNR
Blue vervain	*Verbena hastata*	GNR/SNR
Viburnum sp.	*Viburnum sp.*	-
Wild raisin	*Viburnum cassinoides*	G5/S5
Northern arrowwood	*Viburnum recognitum*	G4/S5
Grape sp.	*Vitis sp.*	-

Four natural communities occur within the Study area. These natural communities are identified by the NYNHP as Deep Emergent Marsh, Shallow Emergent Marsh, Shrub Swamp, and Sedge Meadow. Deep emergent marsh occurs on mineral soils or fine-grained organic soils (muck or well-decomposed peat); the substrate is flooded by waters that are not subject to violent wave action. Water depths can range from 6 in to 6.6 ft (15 cm to 2 m); water levels may fluctuate seasonally, but the substrate is rarely dry, and there is usually standing water in the fall. Shallow emergent marsh occurs on mineral soil or deep muck soils (rather than true peat), that

are permanently saturated and seasonally flooded. This marsh is better drained than a deep emergent marsh; water depths may range from 6 in to 3.3 ft (15 cm to 1 m) during flood stages, but the water level usually drops by mid to late summer and the substrate is exposed during an average year. Shrub swamps are an inland wetland dominated by tall shrubs that occurs along the shore of a lake or river, in a wet depression or valley not associated with lakes, or as a transition zone between a marsh, fen, or bog and a swamp or upland community. The substrate is usually mineral soil or muck (Edinger, 2002). All of the communities identified within the study area are ranked G5/S5. Sedge Meadow occurs here as a wet meadow community that has organic soils (muck or fibrous peat). Soils are permanently saturated and seasonally flooded; there is usually little peat accumulation in the substrate, but must have deep enough peat (usually at least 20 cm) to be treated as a peatland, otherwise it may be classified as a mineral soil wetland such as shallow emergent marsh. Peats are usually fibrous, not sphagnous, and are usually underlain by deep muck. The dominant herbs must be members of the sedge family (Cyperaceae), typically of the genus *Carex* (Edinger, 2002). Sedge Meadow communities are ranked G5/S4.

Bordering the survey area are mapped communities of Silver maple-Ash Swamp. These areas are a hardwood basin swamp that typically occurs in poorly-drained depressions or along the borders of large lakes, and less frequently in poorly drained soils along rivers. These sites are characterized by uniformly wet conditions with minimal seasonal fluctuations in water levels. The dominant trees are usually silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*). This community is ranked G3G4/S1S2, while this community is not within the actual survey area it borders a large portion of the marsh and should be considered when addressing access concerns and foliar spraying.

4.2 Cover Type Mapping

Two surveys were completed within Buckhorn; initial cover type mapping was completed during a winter survey that took place over several days in January 2008. The majority of the Common reed patches within Buckhorn Marsh were mapped during this winter survey (Appendix A). The second visit, completed in July 2008, identified additional cover types not mapped during the

winter, establish fixed monitoring plots, and located additional (if any) stands of invasive species missed during the winter survey. Work was completed by a team of scientists over the week of July 14th. Based on this work a basic cover type classification scheme was developed and is shown in Table 4.2-1. Appendix B contains cover type mapping for the Buckhorn study area based on both the winter and summer observations.

TABLE 4.2-1: COVER TYPES IDENTIFIED DURING COVER TYPE MAPPING

Cover Type	Description
Common Reed Dominated	> 75% Common reed
Mixed Species Common Reed Present	Mixed native species with Common reed present
Japanese Knotweed	> 75% Japanese knotweed
Cattail Dominated	>75% Cattail, < 25% native non-invasive cover
Mixed Species Marsh Dominated by Natives	>75% Native mixed non-invasive cover
Open Water	>50% Open water
Scrub-Shrub	Various species, dominated by shrubs
Forested	Forested community
Upland Shrubs/Disturbed Soils	Shrubs and areas of cut/fill or debris
Mowed	Manicured or developed land
Other	Boardwalks, parking areas, etc.

Using methods described in the winter survey report (NYPA, 2008), field crews surveyed Buckhorn to map vegetation according to Table 4.2-1. In addition, field maps with aerial imagery and cover type mapping were used to sketch or note approximate changes to cover types in the field. Also any cover types that were previously missed, including invasive species (Common reed, Japanese knotweed, etc) were mapped if located. All mapping of invasive species stands were completed on the ground using sub-meter accurate GPS.

Results from the summer survey were used to refine data collected during the initial winter cover type mapping, and a summary of the results is presented in Table 4.2-2. Overall, *Cattail Dominated Marsh* is the most dominant marsh cover type accounting for 87.4 acres (40.6%) of the survey area. *Open Water* occupies 19.1 acres (8.9%) of the total survey area. *Common Reed*

Dominated Marsh accounts for 6.8 acres (3.2%), *Mixed Species Common Reed Present* accounts for 1.4 acres (0.7%), *Mixed Species Natives* accounts for 20.7 acres (9.6%), and the stand of Japanese knotweed accounts for 0.03 acres (0.01%). The remaining 79 acres (37%) include *Forested*, *Mowed*, *Scrub-shrub*, *Other* (paths, walkways, etc), and *Upland Shrub/Disturbed Soils*.

Invasive cover types identified during the survey account for approximately 8.2 acres or 4% of the total wetland area (Table 4.2-2). In Buckhorn, Common reed was the primary invasive species present. Reed canary-grass (*Phalaris arundinacea*), Purple loosestrife, Japanese knotweed, European alder (*Alnus glutinosa*) and other species (Appendix C) occurred at very low densities. Common reed was present in 66 of the 67 invasive polygons.

TABLE 4.2-2: COVER TYPES MAPPED WITHIN BUCKHORN MARSH

Cover Type	Mapped Polygons	Acres	Percent
Cattail Dominated Marsh	22	87.4	40.6
Forested	12	40.5	18.8
Scrub-Shrub	58	27.6	12.8
Mixed Species Marsh Dominated By Natives	21	20.7	9.6
Open Water	11	19.1	8.9
Mowed	16	8.4	3.9
Common Reed Dominated Marsh	**38**	**6.8**	**3.2**
Upland Shrub/Disturbed Soils	1	2.0	0.9
Mixed Species Common Reed Present	**28**	**1.4**	**0.7**
Other	5	1.0	0.5
Japanese Knotweed	**1**	**0.03**	**0.01**
Total	213	215.1	100.0

Note: Invasive cover types are shown in bold.

Although invasive species (especially Common reed) are common in the marsh, there are large numbers of native species mixed in. *Mixed Species Marsh Dominated by Natives*, including remnant areas of native sedge meadow, actually comprises more area than marsh cover types

containing Common reed. However, as mentioned earlier, Common reed appears to be steadily overtaking other covertypes. In mixed stands, native vegetation (particularly *Solidago*, spp) was prevalent. In stands dominated by Common reed, native vegetation was present, but in limited areal coverages (*i.e.*, natives generally comprise less than 10% of the total areal coverage).

The large area of native sedge meadow (*Mixed Species Marsh Dominated by Natives*) in the north-central and northeastern portion of the marsh was surveyed during the summer to develop a general species list for the area (Figure 1-1). The sedge meadow area was moist to saturated during the visit on July 15, but did not have any standing water. The dominant species within the meadow was Lake bank sedge (*Carex lacustris*), Tussock sedge (*Carex stricta*), and Canada bluejoint (*Calamagrostis canadensis*). The sedge meadow is bordered by *Cattail Dominated Marsh* and portions of *Scrub-shrub* (swamp rose - *Rosa palustris*). It appears that some portions of the sedge meadow area may be dry enough during the growing season to allow shrub species such as Swamp rose and European alder to encroach.

The marsh north and east of Woods Creek is a combination of *Scrub-Shrub* (Swamp rose), *Cattail Dominated Marsh*, and *Mixed Species Marsh Dominated by Natives*. Mixed areas consisted mainly of Tussock sedge, Canada blue joint, and Swamp milkweed (*Asclepias incarnata*). Along the immediate bank of Woods Creek a number of European alders (*Alnus glutinosa*) (an invasive) were observed (Figure 1-1).

The western shore of Buckhorn Marsh adjacent to the Chippawa Channel consists of a large band of *Mixed Species Marsh Dominated by Natives*. Closer to the river bank, River bulrush (*Scirpus fluviatilis*) is common along with Narrow-leaved cattail, Hairy willowherb (*Epilobium hirsutum*), Sweet flag (*Acorus americanus*), and Tussock sedge. Common reed is not present within this area; however a number of Yellow flag irises (*Iris pseudacorus*) were observed (Figure 1-1). (Yellow iris is commonly regarded as an exotic and invasive wetland species but did not appear to be spreading invasively at Buckhorn at the time of this survey). The area of *Mixed Species Marsh Dominated by Native* community along the western shore of the marsh was very diverse, possibly due to an annual disturbance regime that includes ice action and flooding. This area transitioned into a *Cattail Dominated Marsh* moving easterly away from the Chippawa Channel.

4.3 Monitoring Plots

In order to further document the baseline condition and allow for future effectiveness monitoring, including documentation of the results of control efforts, eight permanent vegetation sample plots were established. Sample plot locations were randomly located within predetermined cover type polygons. Plots were located within invasive cover types (*Mixed Species Common Reed Present, Common Reed Dominated, and Japanese knotweed*). A permanent pin (rebar) was installed in the southeast corner of each plot and marked with marking paint. Plot locations were also marked with the Trimble GEO-XH GPS. A pre-constructed PVC 1 meter sq plot frame was used to delineate the monitoring plot with the corner of the frame placed over the driven plot stake. Figure 4.3-1 shows the location of the sample plots. At each sample plot, vegetation was identified to species; the percent of area covered by each species was also recorded as an areal cover class (Table 4.3-1). Vegetation observed within the sample plots as well as within the Marsh is included in Table 4.1-1. For sample plots with invasive Common reed (or other invasive species) stem counts were completed. Photographs of each monitoring plot were taken looking from the southeastern pin. Copies of monitoring data sheets and plot photos are included as Appendix D.

TABLE 4.3-1: AREAL COVERAGE CLASSES FOR VEGETATION WITHIN SAMPLE PLOTS

Percent of Area Covered	Mid Point (Areal Cover Class)
1-5%	3
6-15%	10.5
16-25%	20.5
26-50%	38
51-75%	63
76-95%	85.5
96-100%	98

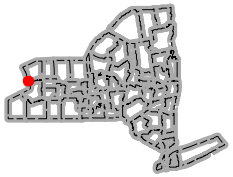
Figure 4.3-1 Buckhorn Fixed Sample Plot Locations

N

1 inch = 1,000 feet

0 500 1,000 Feet

Figure 4.3-1
Buckhorn Fixed Sample Plot Locations



Y:\GISMaps\sknapp\Buckhorn\mxd\Figure 4.2-1.mxd 7/9/2009 2:02:59 PM

Table 4.2-2 identifies the eight sample plots, including the mapped cover type where they occur. Common reed was the most common invasive species identified within the sample plots. Purple loosestrife (*Lythrum salicaria*) was present in plots B-1 and B-2 at trace levels. Plot B-6 was dominated by Japanese knotweed (*Falopia japonica*) and Plot B-8 had 12 stems of Garlic mustard (*Alliaria petiolata*). Species identified within sample plots as well as during cover type mapping are presented in Table 4.1-1.

TABLE 4.2-2: BUCKHORN SAMPLE PLOTS

Plot Number	Cover Type
B-1	Mixed Species Common Reed Present
B-2	Common Reed Dominated
B-3	Mixed Species Common Reed Present
B-4	Common Reed Dominated
B-5	Common Reed Dominated
B-6	Japanese Knotweed
B-7	Common Reed Dominated
B-8	Mixed Species Common Reed Present

5.0 INVASIVE SPECIES INFORMATION

Currently a number of exotic and invasive species are present within Buckhorn Marsh, including Common reed, Purple loosestrife, Narrow-leaved cattail (*Typha angustifolia*), European alder, Yellow iris, Garlic mustard, Japanese knotweed, and invasive bush honeysuckles (*Lonicera spp*.). More detailed species information is presented for some of the more common species present in Buckhorn Marsh in Appendix C.

Common reed poses the greatest threat to the structure and function of Buckhorn Marsh wetlands and appears to be increasing its extent rapidly relative to other invasive species (Section 3.0 and Section 4.0). As such, Common reed was identified as the highest priority species for control measures at Buckhorn.

Purple loosestrife is present in Buckhorn and is a wetland species capable of inhabiting the native marsh cover types at Buckhorn. Because Purple loosestrife is not widespread in the marsh and given that the NYSDEC has pursued biological control releasing beetles (*Galerucella sp*) in the area, this species is no longer considered a significant threat and is ranked as a low priority. Yellow iris is not rapidly spreading or posing a significant threat at present. Both Broad-leaved cattail (native, invasive) and Narrow-leaved cattail (exotic, invasive) occur in the marsh and are sometimes intermixed in the same stand. It is therefore possible that hybrid cattails known as *Typha x glauca* are present as well. Broad and Narrow-leaved cattails have been a dominant fixture in this marsh and surrounding areas since historical surveys conducted more than 80 years ago (NY Conservation Department, 1928). These cattails provide some habitat value and are not viewed by the NYSDEC and other stakeholders as being as significant a threat as Common reed (NYSDEC, personal communication, ESC meeting, December 2007). Japanese knotweed is present as only a single small patch along the western shore of the marsh. Since this invasive species is of concern in New York as a threat to shoreline habitats and wetland edges, knotweed was identified as a species that should be controlled in Buckhorn before it becomes more widely established. Japanese knotweed was, therefore, identified as the second highest control priority for Buckhorn Marsh after Common reed. Lastly, European alder is present. While European alder can act invasively it was considered to be less of a threat to the marsh than Common reed and Japanese knotweed, due to the slower rate of invasion. Currently European alders are primarily located along Woods Creek.

Additional species, such as garlic mustard and the invasive bush honeysuckles, are mainly restricted to the upland environment and are not a threat to the native marsh areas. Since an objective of this HIP is to protect valuable native wetland habitat types from invasives, these upland species were considered to be a low priority for control.

6.0 PRIORITIZATION

Sixty-six stands of invasive Common reed and a single stand of Japanese knotweed were located within Buckhorn. Each stand was given a simple numerical site number (1 through 67) to simplify sorting of stands. In order to efficiently control these stands of invasive species an in-depth decision framework was developed. This framework uses a basic ranking scheme in order to sort stands based on a number of factors affecting the efficiency and relative benefits of control at specific

locations. Because the variables that were used are mostly independent (*i.e.*, accessibility is independent of stand density) the values were not weighted. One exception is that the "potential to expand" and the "adjacency to native habitat" are dependant. In order to focus on patches that have the highest potential to expand, the variable for expansion potential includes four ranking categories (0-3) to allow a lower priority for patches adjacent to walkways, deep channels, or other obstructions to expansion. Remaining variables have three ranking categories. This ranking framework was used as a tool for selecting a phased approach for the control of stands within Buckhorn and is described in detail below.

Prioritization was completed for Common reed only. Additional invasive species within the marsh are not considered within this prioritization framework, as they are currently not actively invading the marsh. Since there was only a single stand of Japanese knotweed located within the marsh, that stand has been included as a high priority. In order to ensure that a phased implementation would address the highest priority sites first, each of the 66 stands containing Common reed in Buckhorn marsh was evaluated and a basic method to prioritize them for treatment was developed. First, a number of key factors were independently rated using the numerical assignments indicated in Table 6-1. The system relied on three values (0, 1, or 2) for each measured variable for size, accessibility, areal cover, and adjacency to sensitive habitat. Lower values result in a higher priority ranking and higher values result in a lower priority ranking (for example, stands with a greater potential to expand were assigned a 0 for that variable). For the expansion variable four values were used (0, 1, 2 or 3). Stands with a very low possibility for expansion (*i.e.*, stands adjacent to deep channels or paved walkways) were given a value of 3. This resulted in a slight weighting for the "potential to expand variable." Based on the sum of the individual factors, each stand was given a priority ranking ranging from 0-11. These scores were then used to develop group rankings described in detail below.

The decision framework and subsequent rankings were based on field observation as well as GIS analysis of data for each patch. The reasons that particular variables were chosen are outlined later in this section. The following is a brief summary of information used to rank variables for each stand:

Size: Acreages for each stand were calculated within the GIS. The calculated acres were used to rank stands based on the size range presented in Table 6-1.

Access: The accessibility of a given stand was based on proximity to walkways, roads, channels, or uplands. In cases where stands were near or adjacent to walkways, roads or trails access was considered easy (Rank 0). In situations where stands were near channels (for access by boat) or upland access was considered moderate (Rank 1). For the remaining stands that were isolated (*i.e.*, surrounded by marsh) access was considered not easy (Rank 2).

Areal Cover: Estimates of areal cover were made in the field for each mapped polygon of invasive species. These estimates were used to rank stands based on the information provided in Table 6-1.

Potential to Expand: Expansion potential was based on a number of characteristics specific to each stand. Stands adjacent to mixed native marsh areas have a high probability to expand, expansion risk was considered very high (Rank 0). For stands largely bordering areas of dense cattail (Cattail is nearly as competitive as Common reed and may also form dense mono-cultures that result in slower invasion of Common reed), but partially bordering barriers to expansion such as open water or walkways/roads, expansion potential was considered moderate (Rank 1). For stands with more limited potential for expansion (due to longer borders with channels, walkways, dense cattail, etc.) the risk for expansion was considered low (Rank 2). The remaining stands are primarily those isolated in areas of dense cattail, bordering open water, or dense shrub/forest and were given a very low chance for expansion (Rank 3).

Adjacency to Sensitive Habitat: Stands were examined within the GIS to determine the adjacency to areas of sensitive native habitat (sedge meadow). Areas directly adjacent to these habitats were given high priority (Rank 0). Stands within 100 feet of these areas were given

moderate priority (Rank 1). The remaining stands were given a low priority (Rank 2).

Note that the first three variables are independent variables whereas the last two (adjacency to native habitat and potential to expand) are dependent. This results in a weighting toward prioritizing stands near mixed native habitat. This was considered to be consistent with the goals and objectives of this HIP (Section 2.0).

TABLE 6-1: RANKINGS USED FOR INDIVIDUAL STAND PRIORITIZATION

Size	**Rank**
Large (> 0.50 acres)	2
Medium (0.1 - 0.499 acres)	1
Small (< 0.1 acres)	0
Accessibility	**Rank**
Not easily accessible	2
Moderately accessible	1
Easily Accessible	0
Areal Cover of Common Reed	**Rank**
High (≥ 75%)	2
Moderate (> 30% < 75%)	1
Low (≤ 30%)	0
Potential To Expand	**Rank**
Very Low	3
Low	2
Moderate	1
High	0
Adjacent to Sensitive Habitat	**Rank**
Far from (> 100' from native habitat)	2
Close Proximity (within 100' of native habitat)	1
Adjacent (adjacent to native habitat)	0

The following discussion outlines how ratings were assigned for various factors within the prioritization system. Adjacency to sensitive habitat is an important factor since a primary objective of this HIP is to protect native wetland habitats from Common reed encroachment. Sensitive habitat refers to the "*Mixed Species Marsh Dominated by Natives*" cover type, primarily the sedge meadow area in the eastern portion of Buckhorn. Only two Common reed sites occur adjacent to or within the largest areas of sedge meadow habitat and these two sites, in spite of their inaccessibility, will be treated first (Phase 1). Additional sites are near smaller patches of sedge meadow and other native cover types; these will also be targeted in Phase 1. Additionally Site Number 50, the large stand near the toll booth, will be included in Phase 1 regardless of the calculated priority. While this stand ranked as low priority, the easy access combined with the stands obstruction of views from the trail make it an important stand to address. This stand was the original stand of Common reed in Buckhorn Marsh (NYS DEC, meeting with NYS OPRHP and DEC, June 2009).

The ability of Common reed to expand is key to the invasion of native habitats, and its use as a key component of the ranking system. This variable was weighted more than the other variables in that: 1) The range of values for this factor was 0-3 instead of 0-2 for other variables, and 2) this variable is not wholly independent because adjacency to sensitive native habitat contributes to expansion potential. The sedge meadow is dominated by relatively short-stature sedge and rush species that do not compete well with Common reed and cattail. As such, Common reed has the potential to quickly overtake these areas and out-compete the shade-intolerant native marsh vegetation. Cattail, unlike other native marsh species, is a vigorous competitor itself in marsh habitat and where Common reed shares an interface with cattail, the Common reed will generally only be able to advance slowly. As such, any stand containing Common reed that is surrounded by open water and *Cattail Dominated Marsh*, for example, should be increasing its size relatively slowly. Significant barriers to expansion included open water, forest, and impervious surfaces like highways and the paved bike path. In general it makes sense to give priority to those patches that threaten to expand most rapidly.

The size of the stand was considered an important factor in the prioritization because controlling smaller stands of invasives is considered to have a higher level of efficiency than larger stands. Achieving successful control of small stands is assumed to be more likely due in part to the

ability to ensure all stems are treated (*i.e.* smaller areas result in fewer total stems to treat). In general, smaller stands are more recently established and their expansion can often still be "nipped in the bud" with less effort; larger stands, on the other hand, are on average more likely to have slowed their expansion by encountering barriers to spread. While the likelihood of successful treatment is not a specific factor used in this prioritization framework, small stands are assumed to have a higher likelihood of success are therefore given high priority. Sites that can be easily accessed would also be given priority for treatment, though no site that posed an immediate threat to a *Mixed Species Marsh Dominated by Natives* cover type would be left untreated in the Phase 1 treatment.

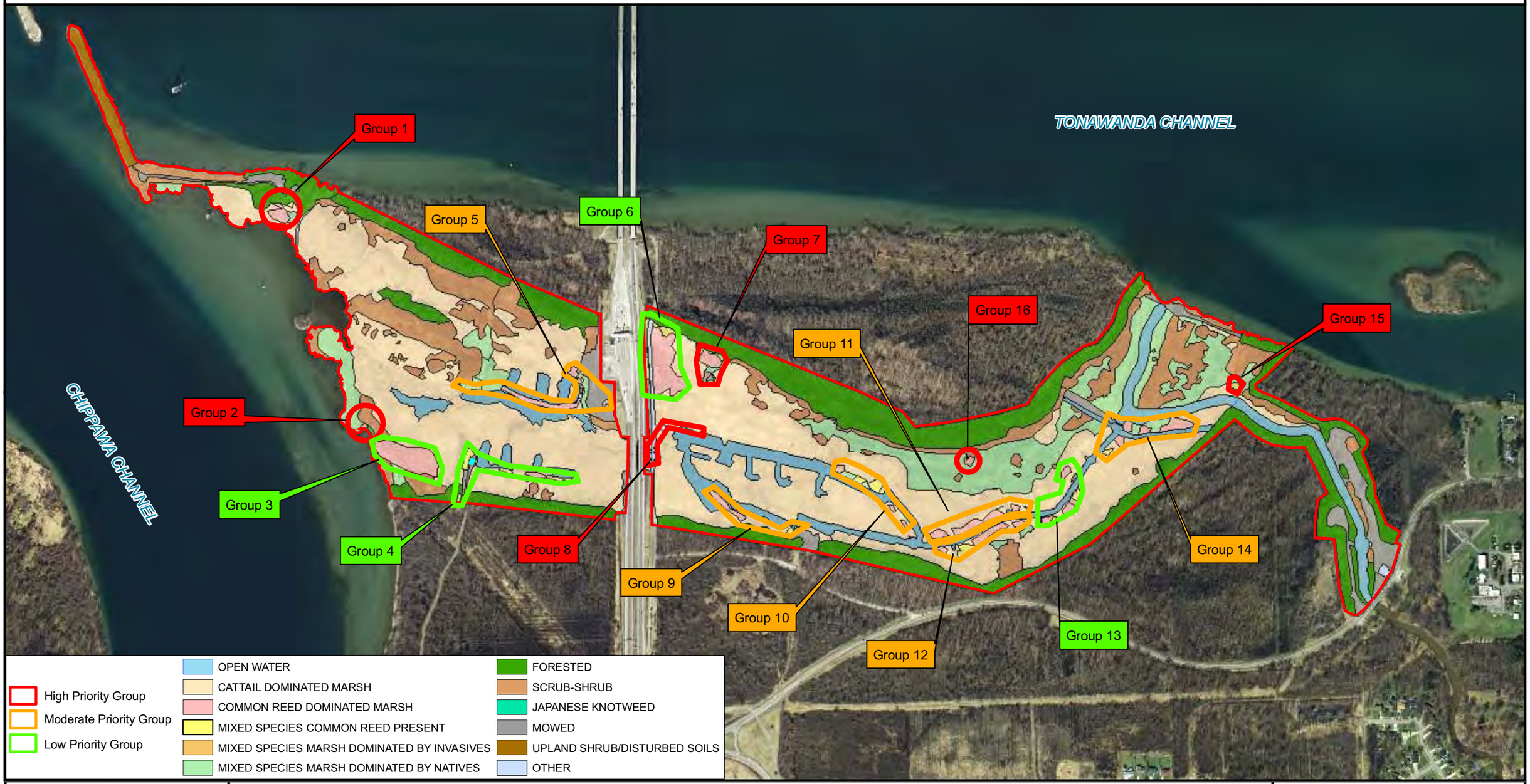
For the single patch of Japanese knotweed no prioritization method was needed. This stand will likely be treated along with the Phase 1 Common reed sites.

In order to efficiently manage the control of the invasive species within Buckhorn Marsh and ensure the highest priority stands are treated, the first step was to prioritize individual stands based on the criteria outlined above. Based on site specific characteristics each individual stand was given a priority rank (Appendix E, Table 1). The second task identified groups of stands that were within close proximity to each other. Once each group was identified the individual stand ranks were averaged to generate the priority score for each of the groups (Appendix E, Table 2). Ranking by groups (Figure 6-1), recognizes that it is more efficient to treat a group of nearby stands at the same time regardless of the individual stand rankings.

The priority ranking of each invasive group was determined using the average of the group's individual stand ranks. The results are shown in Figure 6-1 and Appendix E. Groups with an average priority rank of less than 5 are given highest priority. The high priority groups (1, 2, 7, 8, 15, and 16) include all invasive stands near sensitive habitats and should be treated during Phase 1. Groups with an average rank between 5 and 7 (Groups 5, 9, 10, 11, 12, and 14) are considered of moderate priority, and should be targeted during Phase 2. The remaining groups (3, 4, 6, and 13) all have average ranks higher than 7, and represent the low priority groups. The low priority groups will be addressed only after the successful treatment of higher ranked groups.

This method will allow managers flexibility in planning and execution of control methods within the Marsh. It should be noted that priority groups may not all be completed within a single year (*i.e*. multiple years may be required to sufficiently treat all priority groups). The ranking of these groups simply provides managers with a prioritized list from which to work.

Group Ranking of Invasive Polygons



N

1 inch = 650 feet

Feet

0 325 650

Figure 6-1
Invasive Species Groups and Rank

New York Power Authority

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7.0 CONTROL METHODS

An extensive review of current literature related to the control of Common reed (and other invasive species) was conducted as part of the preparation of this Action Plan. Commonly used control techniques are described below and are similar throughout much of the literature. While methods generally focus on using chemical or mechanical (and sometimes biological) mechanisms for control, the specific approach and the extent to which these methods are used may differ greatly. In some cases, extensive aerial herbicide application is used to treat large areas while smaller areas may be more effectively treated with more targeted chemical or mechanical methods. Each method for the control of an invasive species carries the risk of damaging non-target species, with some methods carrying greater risk than others to the native environment. The best approach to the management of Common reed attempts to balance the environmental and economic impact and management goals set in place.

7.1 Common Reed

Common reed control methods primarily fall into one of two major categories: Mechanical or Chemical. Currently there is no viable biological control method for Common reed (TNC, 2003). It should be noted that while each method has particular benefits the most successful management plans utilize multiple methods in tandem (MDNR, 2008).

7.1.1 Mechanical

The primary mechanical control methods are covering, mowing, burning, cutting, pulling, or any variety of plant removal based on labor intensive control methods. Pulling is commonly used in conjunction with small hand tools and targets small infestations. Mowing and cutting are generally used in larger infestations targeting the above ground portion of the plant. Mechanical control of Common reed is undertaken with the aim being to eliminate the ability of the plant to photosynthesize which results in an increase in stress leading to the elimination of the plant if repeated frequently enough.

Covering: Covering stands of Common reed with black plastic can be effective in small stands (i.e., <100 plants), with low to medium density (1 to 75% areal coverage). Plants die off within 3 to 10 days, depending on sun exposure, but prolonged control is necessary and stems must be cut prior to covering (TNC, 2003). This method can be labor intensive, typically requires other control measures to achieve success, and its use in combination with herbicide application does not significantly improve the success rate of herbicide control (See Table 7.1-1). Also, great attention must be paid to ensuring that absolutely no culms extend past the cover that would allow plants beneath the plastic to continue to photosynthesize (TNC, 2003).

TABLE 7.1-1: POTENTIAL PROS AND CONS OF COVERING METHODS

Pros	Cons
When properly executed appears to eliminate stems beneath plastic (TNC, 2003).	Labor Intensive (cutting of stems, then covering with plastic) (TNC, 2003).
No concerns with effect of herbicide use such as public perception or unknown biological effects.	Plastic may rip or deteriorate allowing stems to push through (TNC, 2003).
	Requires frequent monitoring to treat growth extending out from the edge of plastic (TNC, 2003).
	Does not improve effectiveness of using herbicide.
	Eliminates all plants covered including non-target natives (unlike selective herbicide application).

Hand Pulling: Hand pulling Common reed can be effective in small stands (i.e., < 100 plants) where soils are loose and sandy (TNC, 2003). This technique attempts to target the rhizomes of the Common reed, in order to prevent growth and spread. Common reed rhizomes are often very extensive below ground, therefore this method is extremely labor intensive and typically requires long-term repeated treatments (See Table 7.1-2). Hand pulling could be used effectively in limited cases where a single stem may be observed during monitoring or when other activities are taking place. Large scale use of this method is not recommended, as it is labor intensive and not cost effective.

TABLE 7.1-2: POTENTIAL PROS AND CONS OF HAND PULLING METHODS

Pros	Cons
Pulling to a depth of 3' was shown to result in sparse re-vegetation the following year (TNC, 2003)	Very labor intensive (TNC, 2003).

Cutting/Mowing: Cutting of Common reed stems can be effective when used in combination with herbicide treatment. The most successful mechanical treatments also include an application of herbicide either before or after mechanical cutting have taken place. Cutting Common reed in mid summer to weaken plants and stimulate additional sprouting followed by a late season (September) herbicide application can be effective (George Spak personal communication, 2008). In contrast, herbicide application first followed later by a mechanical removal has also been proven to be effective (MDNR, 2008; TNC, 2003). In this case, cutting or mowing should begin two weeks after the initial herbicide application (MDNR, 2008). Soil disturbance should be kept to a minimum, therefore mechanical methods involving large equipment should occur during time frames when the least amount of soil disturbance will occur. The remaining thatch from cut stems can be removed once cutting is complete to allow for re-vegetation from the native seed bank. It is important to note that if not done correctly, cutting and mowing alone may stimulate the growth of Common reed. However, cutting in combination with herbicide treatment is considered effective (MDNR, 2008; TNC, 2003). In order to avoid rapid reed regeneration, cutting should take place in the late summer or fall unless combined with herbicide treatment. While soil disturbance is generally avoided when treating Common reed, disking in some cases may enhance mechanical control methods. Mowing regimes over several years (during the summer) followed by disking in the late summer and fall may be effective (TNC, 2003). It should also be noted that caution should be used when disking as cut rhizome materials can still spread. Serious soil disturbance is not an appropriate control method and should be avoided as it may worsen the invasion, remove native vegetation, and impact wetland habitat. All machinery used in any mechanical control program should be thoroughly cleaned to avoid transplanting Common reed. When used properly in combination with herbicide, cutting can be a very effective tool in controlling Common reed (MDNR, 2008; TNC, 2003). The U.S. Fish and Wildlife Service (USFWS) operates an amphibious harvester in New York State that is specifically designed to remove marsh vegetation. This vehicle is a track vehicle with pontoons and a cutter attachment that can actually operate in and cross over shallow open water. While the availability of

an amphibious harvester is not known at this time, it may be a potential supplemental method of control. Potential draw-backs and benefits of this method are presented in Table 7.1-3.

TABLE 7.1-3: POTENTIAL PROS AND CONS FOR CUTTING METHODS

Pros	Cons
Cutting can be effective if used in combination with herbicide (MDNR, 2008).	Cutting several times (or during the wrong time) may result in an increase in stand density (MDNR, 2008; TNC, 2003).
Cutting while shoots are submerged in June has been proven to be effective (TNC, 2003; Smith, 2005)	May negatively impact native wetland vegetation (MDNR, 2008).
Manual cutting tools (such as weed whips or hand tools) can be effective after or prior to herbicide in low density stands (MDNR, 2008).	May require special permitting for mechanical mowing of areas below the high water mark.

Burning: A prescribed fire can be an effective management tool for Common reed control when used in conjunction with herbicide treatment (See Table 7.1-4). In areas where a prescribed burn can be implemented safely, burning offers a cost effective form of control. Burning is recommended for dense stands and only after the use of an approved herbicide. Prescribed fire should be conducted the year following herbicide treatment in late summer or winter (MDNR, 2008). A burn conducted as a second year treatment in later summer is ideal. Burning in the late summer destroys seed heads, removes accumulated thatch, and helps to kill stems that may have survived the initial herbicide treatment. The large amount of accumulated thatch and dead stems causes Common reed stands to burn quickly and at high temperatures. The preparation of a burning plan is important to the safe use of fire as a treatment method (MDNR, 2008). Approval from local fire officials will be required before any burn takes place and all fires must be overseen by properly trained personnel. Burning is a very effective tool for the removal of thatch following herbicide application (MDNR, 2008).

TABLE 7.1-4: POTENTIAL PROS AND CONS OF BURNING

Pros	Cons
Cost effective and ecologically sound method for thatch removal (MDNR, 2008).	Requires additional permitting and oversight from fire control officials/experts.
Proven successful when used in combination with herbicide (MDNR, 2008)	Smoke may become an issue in populated areas (reducing visibility and air quality).
Burning as a post treatment to herbicide can increase species diversity (MDNR, 2008; Ailstock, 2001).	If not done correctly burning may stimulate growth of Common reed (MDNR, 2008; TNC, 2003).
Removes thatch and allows light penetration (MDNR, 2008; Ailstock, 2001).	Common reed stands burn quickly and at high temperatures making safety a serious concern (MDNR, 2008).

Water level control: Flooding can be used to control Common reed (See Table 7.1-5), but is only effective when used with additional control measures (MDNR, 2008). Smith (2005) noted success in Common reed control using cutting combined with flooding within marshes in Cape Cod. In this particular study breaking off and removing Common reed stems below the water surface resulted in as much as a 99% decrease (59%-99% range in decrease for treated stands) in the total population size of Common reed. The study concluded that repeated underwater breakage and removal of stems significantly reduced Common reed population size the following year.

TABLE 7.1-5: POTENTIAL PROS AND CONS FOR WATER LEVEL MANAGEMENT

Pros	Cons
Common reed is intolerant of extended flooding (MDNR, 2008).	May require construction of water retention structures as well as ongoing management requirements.
Flooding in combination with cutting below the water surface has met with success (TNC, 2003; Smith 2005).	Flooding may destroy non target native communities (TNC, 2003).

7.1.2 Chemical

Chemical control of Common reed primarily relies upon one of two broad spectrum herbicides, using Glyphosate and Imazapyr formulations, both of which are available commercially. The aquatic approved formulations of herbicides must be used when treating stands in marsh or wetland habitats. In order to ensure that the applied herbicide is taken up by the plant, a non ionic

surfactant should be used along with the herbicide. The surfactant must be state approved. Additionally, mixing of herbicides requires the use of clean, preferably distilled, water to prevent the herbicide from binding to sediments. Glyphosate binds tightly to sediments and will be rendered ineffective if mixed with un-clean water (TNC, 2003). Methods of application should wet the leaves and flowers (when present). Excessive application should be avoided as this will result in damage to non target species. While herbicide may be a cost effective form of control, special consideration should be given to the method of application to limit the potential for drift. For any herbicide application the instructions provided by the manufacturer on the product label must be followed at all times. An individual trained and certified as a Category 5a pesticide applicator should be acquired to conduct any work utilizing herbicides in wetlands. **It should be noted that current NY Regulations require that herbicide dilutions follow the manufacturer's specifications provided on the product label. At no time should these mixing instructions be modified, unless the manufacturer develops supplemental labeling materials approved by the State.**

A number of application methods have been used and tested to limit the exposure of non target species and ensure adequate application to target Common reed stems. These control methods include:

Cut Stem Method: Stems are cut to waist height and a directed spray of herbicide is added to the hollow stems by spray bottle. Herbicide is applied in a diluted concentration (mixed) into the stem cavity. This particular method is suggested for scattered or isolated stems of Common reed or in areas where the potential for impacts to native herbaceous plants exists. This method has been used to successfully treat small patches of Common reed while limiting exposure to non-target species. Based on the review of the literature this method is highly recommended for small and low density stands of Common reed. Typically, in low density stands less volume of the herbicide is needed. Considerations for the use of this method are presented in Table 7.1-6.

TABLE 7.1-6: POTENTIAL PROS AND CONS OF STEM INJECTION/CLIP AND DRIP METHODS

Pros	Cons
Can work well on isolated stems or small patches and low density patches (e.g. 0-30% areal cover) (TNC, 2003).	May require special permitting or certification for application (MDNR, 2008).
Reduced impact to non-target species and limits potential for drift (TNC, 2006; Kiviat, 2006).	Labor intensive.
No need to carry water as herbicide is applied at full strength in small doses.	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
May be used in combination with cutting and burning (Kiviat, 2006).	May need to remove cut stems. Some information suggests leaving cut stems may negatively impact native vegetation (Kiviat, 2006).
	The stem injection/cut stem method using undiluted herbicide is not currently approved for use by NYSDEC
	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).

Hand Swiping: Stems are covered with diluted herbicide by wiping them with a cotton wicking glove worn over a chemical resistant glove. Herbicide formulations should follow mixing instructions provided on the product label. As with stem injection this method is labor intensive and best used on scattered or isolated stems of Common reed (Table 7.1-7). This method is also effective when trying to avoid impacts to non target species. While this method can be an effective form of control it is not recommended for large scale patches and/or dense patches.

TABLE 7.1-7: POTENTIAL PROS AND CONS OF HAND SWIPING METHOD

PROS	CONS
Can work well on isolated stems or small patches and low density (e.g., 0-30% areal cover) patches.	May require special permitting and certification for application (MDNR, 2008).
Reduced impact to non-target species and limits potential for drift.	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).

Backpack Spray Application: Herbicide is applied by the use of a pressurized backpack spray unit. The most effective technique applies herbicide under low pressure at a close distance to the leaves. This particular application method can be used effectively in moderately dense to dense stands of Common reed (Table 7.1-8). Concentrations of herbicide should follow the formulations provided on the chemical label for low volume spray application. In order to avoid impacts to non

target species application should take place on low wind days using flat fan nozzles. Low volume backpack sprayers have an increased potential for drift when compared to the cut-stem technique. However, in larger more dense patches of Common reed this method can efficiently treat and limit impacts to the environment. This method is recommended for large dense stands where more labor intensive methods (cut-stem, wiping, etc) would not be cost effective.

TABLE 7.1-8: POTENTIAL PROS AND CONS FOR BACKPACK HERBICIDE APPLICATION

PROS	CONS
Can reduce non-target impact and drift when compared to broadcast spray or aerial application (TNC, 2003).	May require special permitting and certification for application (MDNR, 2008).
Requires minimal equipment (Herbicide and PPE) (DowAgro, 2008).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
Effective in moderate (e.g. 30-75% areal cover) density stands (DowAgro, 2008).	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).
Solution volumes between 5-30 gallons per acre (DowAgro, 2008).	Suggested application for heights of less than 6-8 ft (DowAgro, 2008).

Wick/Dauber Application: Diluted Herbicide (mixed according to product labeling instructions) is applied by saturating absorbent materials attached to a low pressure spray apparatus attached to an ATV or tractor. This method reduces non-target impacts due to over-spray by saturating materials (rags, towels, or other absorbent materials) attached to a boom. The material is saturated by diluted herbicide and is transferred from the boom to the plant as the ATV or tractor drives through the stand. This method can be used in moderate to dense stands (primarily greater than 1 acre) of Common reed. Areas treated by this method must be covered twice (once in each direction) (Table 7.1-9). Stems damaged by equipment will not be affected by the herbicide application. This method targets primarily Common reed as the saturated Wick/Dauber avoids herbicide impacts non target species of shorter stature than the Common reed. The majority of Common reed patches on Buckhorn are not readily accessible. This, combined with the increased potential for non-target impacts, due to the potential for damage from ATV or tractor use, limits the usefulness of this method.

TABLE 7.1-9 POTENTIAL PROS AND CONS TO WICK/DAUBER APPLICATION	
Pros	**Cons**
Effective in medium density stands (e.g., 30-75% areal cover) (Avers et al, 2008).	Requires special permitting and certification for application (MDNR, 2008).
Reduces drift and impacts to short stature vegetation (MDNR, 2008).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
Time efficient, providing access is available.	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).
	Requires patches be accessible by equipment and located at drier sites.

Boom Sprayer Application: Diluted Herbicide (Mixed following product label instructions and concentrations) application takes place using a boom that is attached to an ATV or tractor. This method involves uninterrupted spraying, and can be used in dense stands (> 75% aerial cover) as well as large stands (greater than an acre). Application is most effective when using low pressure application on low wind days to prevent drift. Stems damaged by equipment (*e.g.*, broken stems) will not be affected by the herbicide application as herbicide will not be effectively trans-located to rhizomes from the stems. In some cases very large stands of Common reed, that are easily accessible by ATV, may be treated by this method. This method is not recommended for large scale use, but may be effective given certain circumstances (Table 7.1-10).

TABLE 7.1-10: POTENTIAL PROS AND CONS OF BOOM SPRAY HERBICIDE APPLICATION METHODS	
Pros	**Cons**
Treats high density stands (e.g., 75-100% areal cover) effectively (DowAgro, 2008).	Requires special permitting and certification for application (MDNR, 2008).
Can be used on heights greater than 6-8 feet (DowAgro, 2008).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
Time efficient when equipment access is available.	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).
	Greater potential for non-target impacts and drift.
	Requires patches be accessible by equipment and located at drier sites.

Aerial Application: Application of herbicide occurs from the use of helicopter boom sprayers using appropriate droplet size, boom length, and nozzle type. Typically this type of application is used only on patches exceeding 5 acres in size (Table 7.1-11). This type of application may result in major impacts to native communities due to drift that occurs during application and is

generally only used to treat large (> 5 acres) stands because of drift; aerial application is also intended for remote areas, not frequented by the general public.

TABLE 7.1-11: POTENTIAL PROS AND CONS FOR AERIAL APPLICATION METHODS

Pros	Cons
Treats large (Greater than 5 acres) dense stands (MDNR, 2008).	Requires special permitting and certification for application (MDNR, 2008).
Can be used on heights greater than 6-8 feet (DowAgro, 2008).	High potential for non target impacts and drift (MDNR, 2008).
Time efficient.	Suggested only for stands 5 acres or greater in size (MDNR, 2008).

7.2 Knotweed Control

Common control methods for Japanese knotweed depend on the extent of the population. Generally control methods fall into two major categories: Chemical or Mechanical. No known biological control method for Japanese knotweed currently exists in the United States (Van Driesche 2002). Special care should be taken when working to manage Japanese knotweed populations as all existing rhizomes may re-sprout if not removed or killed. Currently the extent of the Japanese knotweed within Buckhorn is very limited (≈ 1200 sq ft). Based on the size of the patch it is recommended that it be treated, although it is not the priority species.

7.2.1 Mechanical

The primary goal of mechanical control is to remove or starve the root system of the knotweed. Based on the ecology of Japanese knotweed mechanical methods alone are not suggested as viable control options (unless the patch is very small, *i.e.* ≤ 25 stems). Mechanical methods used to control Japanese knotweed are very labor intensive and require multiple applications over a number of growing seasons. Primary methods of mechanical control follow below:

Hand Cutting: Labor intensive cutting of knotweed patch through the use of a machete, loppers, or pruning shears. Stems are cut to the ground surface as often as possible, but no less than every 2-3 weeks from April through August. Cut stems should be piled in an area where they will quickly dry.

Mowing: Using a brush saw or mower, cut stems as low as possible at least every 2-3 weeks from April through August. Care should be taken to ensure that stems and root fragments are not scattered onto moist soil or into the water.

Digging/Pulling: If the knotweed patch is established in a soft or sandy soil, pulling the plant and major rhizomes can be effective in controlling small patches. Pulling should focus on removing as much of the root system as possible. After the initial pulling of materials, visits should be made weekly (and at least 20 feet away from the original plant) to up-root any new sprouts. Root materials should be disposed of in an appropriate manner to prevent further spread of the knotweed.

Covering: To begin, knotweed stems are cut to the ground surface. Immediately after cutting, the cut stems are covered with thick black plastic extending beyond the plant base and stems at a minimum of 2 meters beyond the outside stems. Weigh down the plastic and periodically check for stems growing from under the edge of the plastic. It may be necessary to leave the patch covered for at least one entire growing season. Covering should only be used as a control method for very small patches.

7.2.2 Chemical

A variety of herbicides have been tested on knotweed to determine effectiveness; all work to some degree depending on many factors. Knotweed prefers riparian environments so herbicide application must take into account the proximity of water as well as valuable native vegetation. A successful chemical control method must have active ingredients that are designed to move the chemical from the leaves into the root system at sufficient levels to kill the root tissue. Field tests may be required to identify the appropriate levels of herbicide and the method of application. Herbicides with an active ingredient of Glyphosate have been shown to have success in control of knotweed. Chemical control is the preferred method of treatment based on a review of knotweed control information (TNC, 2006). **It should be noted that current NY Regulations require that herbicide dilutions follow the manufacturer's specifications provided on the product label. At no time should these mixing instructions be modified, unless the manufacturer develops supplemental labeling materials approved by the State.** Herbicide application may follow one of the following methods:

Wipe/Painting: This method of application relies on direct application of the herbicide to plant tissue using sponges or brushes to apply the herbicide. This method is slow and is only efficient in small patches, but does limit the amount of damage to non target vegetation. Proper control requires multiple applications during the growing season.

Cut Stem Method: A slow method that reduces potential drift from herbicide application and may be useful in areas where plants are established near sensitive areas. Initially plants are cut just below the third node from the ground. After the initial cut, diluted herbicide is added to the stem cavity.

Stem Injection: Direct stem injection of herbicide requires the introduction of herbicide directly. Larger stems may require larger amounts of herbicide (5 ml) while smaller stems may require lower amounts (1 ml). Injection tools are currently available for application. Mixing of herbicide for direct injection should follow mixing instructions provided on the product label.

8.0 SPECIAL CONSIDERATIONS

This section discusses important considerations for selecting recommended control methods for Buckhorn. For effective control of Common reed, ease of access is particularly important for using mowing equipment or larger ATV mounted spraying equipment so as not to damage marsh habitat. In addition, studies have indicated some risk associated with the use of herbicides to amphibian communities (Kiviat, 2006). In order to avoid potential impacts, herbicide application instructions should be followed. Application during periods of low wind or utilizing appropriate application techniques can help reduce the amount of drift. Special care should be given when spraying in aquatic environments to avoid direct application into water. Generally use of this equipment would only be advisable in large patches. In Buckhorn, the two largest patches of Common reed are both accessible and border non-wetland cover types. Much of the marsh is not effectively accessed by large equipment or ATVs because deep channels and sensitive wetlands either cannot or should not be crossed. For the majority of the 66 total patches, access by larger equipment is limited. The amphibious harvester has limited potential to access some of the stands within Buckhorn. While the harvester has some potential to be used in mechanically treating larger stands, it is not recommended for use within Buckhorn. The amphibious harvester may damage existing marsh

vegetation and further spread invasive Common reed within Buckhorn. The benefit of quickly mowing large patches in easily accessible areas may be lost due to the damage caused to the marsh and the potential to disperse Common reed rhizomes and seeds into additional areas of the Marsh.

Flood management is a feasible method of control in some areas, as discussed above, but at Buckhorn it is not a viable option. Currently the water control structures within the eastern portion of the marsh would need to be expanded and extensively modified in order to flood the existing stands of Common reed. Additionally many of the stands of Common reed occur atop side cast berms that are much higher than the current water surface elevation. The western portion of the marsh is currently not regulated by a water control structure. Water level control at Buckhorn would require significant construction efforts aimed at the modification and creation of water control structures. This HIP does not include improvements or creation of infrastructure and therefore water level control is not recommended as a control method.

Controlled burning has been proven as a beneficial method for efficient thatch removal after initial herbicide treatment (MDNR, 2008). Burning can increase the amount of native vegetation re-growth after treatment has taken place. Due to the location of Buckhorn and its close proximity to the I-190 highway, burning may not be feasible. Additionally, approval and permits from State and Local officials will be necessary as well as a professionally prepared burn plan and cooperation with local fire departments.

Covering of Common reed requires significant effort to control even small infestations. Based on the need to cover in combination with multiple visits to ensure plastic does not deteriorate, this method is not recommended for use within Buckhorn. The method is not recommended primarily because of the high level of labor required and high cost for control of very small areas relative to effectiveness.

Buckhorn does not contain any one stand of Common reed greater than 1.6 acres and the vast majority of stands (45 out of 66) are less than 0.1 acres in size. Aerial herbicide application has been used effectively in large (> 5 acres) stands (MDNR, 2008; TNC 2008). While aerial application may

be effective in stands greater than 5 acres, based on the data collected in the Marsh, it is not recommended within Buckhorn.

The use of ATV sprayers may be feasible on some patches, provided that access is available. The vast majority of patches can only be accessed by boat or by crossing extensive portions of the marsh interior. In these areas treatment through the use of ATV or other machinery (for cutting or herbicide treatment) is not recommended within the Marsh. In some of the larger patches the use of machinery may increase efficiency as the patches are close (or adjacent to) areas of access. The two largest patches (Site Number 50 and 63) of Common reed within Buckhorn are adjacent to non-wetland areas and easy access. Site 50 will be included in Phase 1, regardless of the priority score.

9.0 RECOMMENDED CONTROL METHODS

9.1 Overall Approach

In general, treatment will focus foremost on Common reed. While Japanese knotweed is included this is primarily because it occurs on such a small scale to make it's control feasible. Although the *Common Reed Dominated* and *Mixed Species Common Reed Present* cover types are present within Buckhorn, they only occupy a small amount (8.2 acres or 4%) of the total acreage (215.0 acres) of cover types identified within the study area. Within Buckhorn, Common reed patches range both in size and density; therefore different management strategies for patches of various sizes must be considered. Long-term management and monitoring are required to ensure that management goals are achieved. The planned actions selected are expected to reduce the presence of Common reed in specific locations and facilitate the re-vegetation of native species in those areas.

In order to best meet the goals of this Action Plan set forth in Section 2.0, monitoring and management of strategies particularly suited to Buckhorn are outlined in this section. For Buckhorn, given the limitations and considerations identified in Section 7.0, herbicide application in combination with mechanical methods such as cutting is the most appropriate approach. This approach targets Common reed stands for treatment using herbicide and mechanical means in order to protect native plant diversity by removing and controlling invasive patches of Common reed. Common reed stands will be managed based on the specific priority rank given to each group, with those groups of high priority being treated first. A phased approach will be used to control Common reed within Buckhorn (Figure 9.1-1).

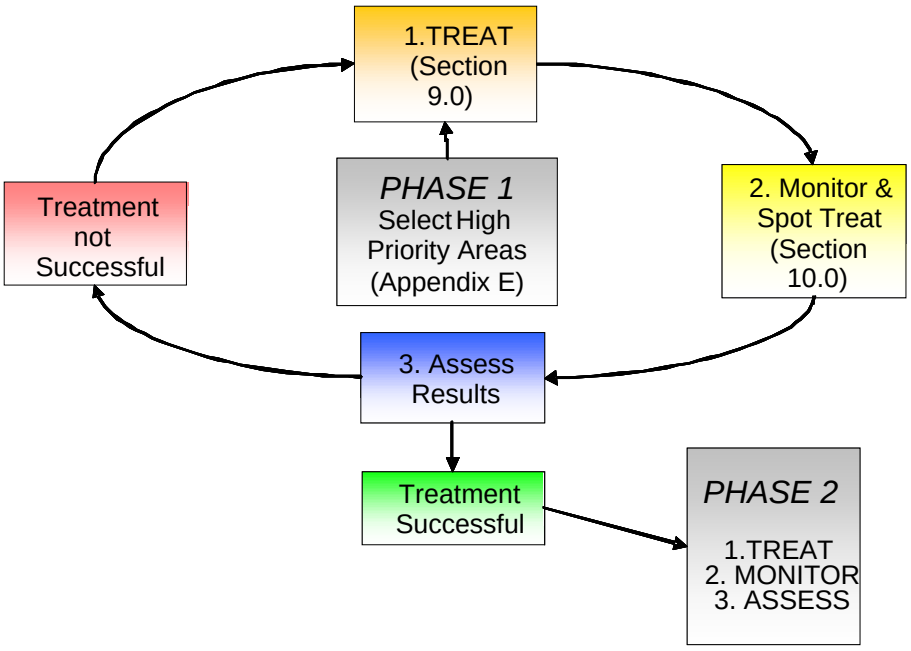
Phase 1 will consist of the selection and treatment of high priority groups. Phase 1 will include one year of initial treatment starting with high priority groups (1, 2, 7, 8, 15, and 16). Each stand will receive a recommended treatment (Sub-sections 9.2.1 and 9.2.2). The following year monitoring of vegetation and continued spot treatment will occur. Monitoring within these polygons will determine the effectiveness of the initial treatment (Section 10.0). Following vegetation data collection, these areas will receive the second year spot treatment targeting new growth or individuals missed during the initial treatment. A second year "spot" treatment increases the level of control within stands of Common reed and will be used for all treatments. In subsequent years, the need for

spot treatment will be dictated by monitoring results (TNC, 2003; MDNR, 2008; Kiviat, 2006). Phase 2 will begin within 1-2 years of the initial Phase 1 treatment, however Phase 1 sites will continue to be monitored and treated (as necessary) even when Phase 2 has been initiated. If even a few rhizomes are left the entire treated area can potentially return to Common reed (TNC, 2003); therefore it must be ensured that all treated areas are continually monitored and spot treated as necessary.

Continual monitoring following the year of initial treatment will allow for adjustments of methodologies (if needed). Additional Phases will consist of the initial treatment of the highest priority groups remaining. Subsequent groups will be selected based on their assigned rank, focusing on those groups with the highest priority ranking first (Appendix E). As above, after the initial treatment takes place, monitoring and the follow up spot treatment will occur. Based on observations and an assessment of the results a determination of whether the stands have been treated successfully will be made. The success criteria of any given patch will be based on 100% elimination of the Common reed within the patch.

It is more effective to successfully treat fewer polygons than unsuccessfully treat many since if any live plants are left, Common reed (and potentially other invasives as well) can potentially re-invade the treated area. The adaptive management approach is intended to ensure that the most successful control methods are used and that treated areas do not return to Common reed. Complete control is often not achievable on a landscape scale, but may be achievable for small, isolated stands (Section 2.0). Treatment methods commonly suppress Common reed growth for 2-3 years after the second year of spot treatment (Ailstock, 2001; MDNR, 2008; TNC, 2003).

FIGURE 9.1-1: INVASIVE SPECIES MANAGEMENT FLOW CHART



Control Steps:

- Select treatment areas based on priority ranking (Appendix E)
- Treat selected areas utilizing recommended methods (or modifications of these based on results from Phase 1)
- Monitor treated stands and complete spot treatment
- Determine additional stands to be targeted the following year (based on success and resources available)
- Repeat above steps and continue annual monitoring of all treated areas

9.2 Recommend Treatment Options for Common Reed

Common reed control is most effective when multiple stresses are introduced through the use of multiple treatments (MDNR, 2008). Based on the research of current control methods for Common reed and the conditions at Buckhorn Marsh, a combination of herbicide treatment, and mechanical removal have been selected as the primary control mechanism. It should be noted that any method requiring the use of herbicide will require the use of a qualified (Category 5A certified) herbicide applicator. Permits for mechanical or chemical control within a wetland will also be required.

Specifically a Joint Application (NYSDEC and U.S Army Corps of Engineers) for freshwater wetlands will need to be obtained in accordance with Article 15, Title 3 of the Environmental Conservation Law and Parts 327 and 328 of the New York Code of Rules and Regulations. Additionally the use of herbicide within the vicinity of development may be limited by State or County regulations. At a minimum Erie County, NY requires a 48 hour notification of neighbors for certain commercial applications of herbicide (NNL, Chapter 285 of the Laws of 2000, Sections 33-1004 and 33-1005). Currently at Buckhorn all adjacent lands to the Marsh are owned and operated by the NYSOPRHP except the I-190 right of way that bisects the study area. Permissions should be obtained from both the NYSOPRHP and NY State Department of Transportation (NYDOT) prior to the start of any planned herbicide application. Because this application would take place with the potential for public exposure (*i.e.*, along trails and overlooks) an ENB (Environmental Notification Bulletin) may be required. This bulletin would be posted in a local news publication with a 30 day public comment period. Proper signage, following DEC regulations, would also be required. More information pertaining to herbicide application and associated regulations within the State of New York is available on the NYDEC website (http://www.dec.ny.gov/25.html).

For all herbicide applications the formulation of herbicide should follow the manufacture's instructions (see herbicide label) and be an aquatic approved formulation with a state approved non-ionic surfactant (MDNR, 2008). **It should be noted that current NY Regulations require that herbicide concentrations follow the manufacturer's specifications provided on the product label. At no time should these mixing instructions be modified, unless the manufacturer develops supplemental labeling materials approved by the State.** Application of the herbicide will take place in September, which is when plants are translocating nutrients from above ground and the herbicide is most effective. Mechanical cutting may enhance the effectiveness of control efforts. Cutting will be completed prior to herbicide application and it should take place in summer (late July) using mowers, brush-saws, or hand tools After cutting, plants should be allowed to re-grow for approximately two months before herbicide application takes place (late summer or early fall). Monitoring (See Section 10) and spot treatment will continue until Common reed is no longer observed within the stand. Following the second year monitoring, a September spot treatment of new growth will be conducted by backpack spray application of an approved aquatic Glyphosate based herbicide. A low pressure backpack sprayer with fan nozzles will be used to apply herbicide to the

new shoots of Common reed. All subsequent spot treatments to control new growth will be accomplished by backpack spray application of a Glyphosate based, aquatic-approved herbicide.

In general, thatch removal will not take place unless additional resources become available. If additional resources are available, such as volunteer workers, thatch removal may be a viable option. In the event that it is not possible to remove thatch it will be left within the existing stand. Thatch removal can be beneficial to the re-growth of native vegetation, but in some cases increased biodiversity has been attributed to remnant thatch (Ailstock, 2001).

9.2.1 Dense Stands

Dense stands (>75% areal cover) are divided into two separate approaches (Approach 1 and 2) as detailed below, because large (greater than 0.5 acres) stands require a different approach to control than those dense stands that are small or medium (less than 0.5 acres).

Approach 1, Large (0.5 acres or greater) Dense Stands:

Control measures for large dense stands (≥75% aerial cover) of Common reed will include a combination of herbicide treatment and mechanical treatment to weaken stands prior to herbicide application. Table 9.2.1-1 outlines those patches targeted for this approach. This method calls for an initial treatment using mechanical cutting in late July followed by a herbicide application in late summer or early fall when Common reed is translocating nutrients and energy into its rhizomes. The initial mechanical treatment should be completed using brush saws or other hand tools. Due to the large size of some of these patches alternative methods (such as mowers) will be addressed on a case by case basis. Because these stands occur within marsh areas all precautions to avoid impacts to the marsh will be considered. Following the mechanical treatment, herbicide will be applied to the stands in early fall. Because of the larger scale of these dense stands the herbicide may be applied using a boom sprayer attached to an ATV (See Section 7.1.2). In areas that may have access constraints, alternate application methods may be required (*i.e.* back-pack sprayers) as evaluated on a case by case basis. It should be noted that large dense stands will only be treated once the higher priority groups have been successfully controlled with the exception of Stand bh phrag 28 (Site Number 50). Large patches may also require the development of a planting plan to ensure that additional invasive species

do not re-invade after the disturbance caused by treatment of Common reed. Large dense Common reed stands are not the highest priority stands. During the early stages of this control plan, these large dense stands will primarily be lowest in priority (Appendix E).

TABLE 9.2.1-1: IDENTIFIED STANDS FOR DENSE STAND TREATMENT (APPROACH 1 AND 2)

Site Number	Cover Type	Invasive Cover %	Acres	Approach
3	JAPANESE KNOTWEED	95	0.03	1
15	COMMON REED DOMINATED MARSH	90	0.04	1
21	COMMON REED DOMINATED MARSH	75	0.08	1
31	COMMON REED DOMINATED MARSH	100	0.03	1
32	COMMON REED DOMINATED MARSH	100	0.12	1
33	COMMON REED DOMINATED MARSH	95	0.41	1
34	COMMON REED DOMINATED MARSH	100	0.05	1
35	COMMON REED DOMINATED MARSH	100	0.29	1
36	COMMON REED DOMINATED MARSH	85	0.08	1
37	COMMON REED DOMINATED MARSH	90	0.05	1
38	COMMON REED DOMINATED MARSH	90	0.01	1
39	COMMON REED DOMINATED MARSH	95	0.1	1
40	COMMON REED DOMINATED MARSH	95	0.1	1
41	COMMON REED DOMINATED MARSH	95	0.08	1
42	COMMON REED DOMINATED MARSH	90	0.31	1
43	COMMON REED DOMINATED MARSH	95	0.1	1
44	COMMON REED DOMINATED MARSH	75	0.07	1
45	COMMON REED DOMINATED MARSH	95	0.03	1
46	COMMON REED DOMINATED MARSH	95	0.07	1
47	COMMON REED DOMINATED MARSH	95	0.06	1
48	COMMON REED DOMINATED MARSH	90	0.08	1
49	COMMON REED DOMINATED MARSH	98	0.29	1
50	COMMON REED DOMINATED MARSH	100	1.64	2
51	COMMON REED DOMINATED MARSH	75	0	1
58	COMMON REED DOMINATED MARSH	95	0.25	1
59	COMMON REED DOMINATED MARSH	98	0.01	1
60	COMMON REED DOMINATED MARSH	85	0.01	1
61	COMMON REED DOMINATED MARSH	85	0.09	1

TABLE 9.2.1-1: IDENTIFIED STANDS FOR DENSE STAND TREATMENT (APPROACH 1 AND 2) (Cont'd)

Site Number	Cover Type	Invasive Cover %	Acres	Approach
63	COMMON REED DOMINATED MARSH	95	1.49	2
64	COMMON REED DOMINATED MARSH	98	0.46	1
65	COMMON REED DOMINATED MARSH	75	0.28	1
66	COMMON REED DOMINATED MARSH	80	0.03	1
67	COMMON REED DOMINATED MARSH	75	0.09	1
Total			6.83	

It should be noted that treatment of large dense stands of Common reed could result in exposure of bare substrates that may require additional work in order to ensure the establishment of native vegetation. Monitoring will be an important factor in determining whether additional plantings are necessary to prevent re-invasion of treated stands by Common reed and other invasive species. In cases where the removal of Common reed results in the loss of the majority of vegetative cover (large scale mowing or soil disturbance) native plantings may be used to ensure the establishment of beneficial native species. Seed mixes or plugs should be obtained from a plant nursery specializing in native marsh vegetation. Mixes should include native marsh species that provide benefit to the marsh as well as wildlife. Potential species to be considered for planting include, but are not limited too, those in Table 9.2.1-2.

TABLE 9.2.1-2: POTENTIAL PLANT SPECIES FOR USE IN PLANTING PLANS

Common Name	Scientific Name	Habitat
Lake bank sedge	*Carex lacustris*	Marsh
Wool grass	*Scirpus cyperinus*	Marsh
Sweet-flag	*Acorus calamus*	Marsh
Canada blue joint	*Calamagrostis canadensis*	Marsh
Three-way sedge	*Dulichium arundinaceum*	Marsh
Three square	*Schoenoplectus americanus*	Marsh
Blue flag	*Iris versicolor*	Marsh
Blue vervain	*Verbena hastata*	Marsh
Soft rush	*Juncus effusus*	Marsh
Softstem bulrush	*Schoenoplectus tabernaemontani*	Marsh
Arrowhead	*Sagittaria latifolia*	Deep Marsh
Pickerel weed	*Pontederia cordata*	Deep Marsh
Speckeld alder	*Alnus incana*	Shrub
Button bush	*Cephalanthus occidentalis*	Shrub
Red osier dogwood	*Cornus stolonifera*	Shrub
Wild raisin	*Viburnum cassinoides*	Shrub
Arrow wood	*Viburnum recognitum*	Shrub

Approach 2, Small to medium (0.0-0.5 acres or less) Dense Stands:

Some small (>0.5 acres) dense (≥ 75% areal cover) stands may be of high priority especially if near sensitive native habitats and easily accessible. The smaller size of these patches makes the use of heavy equipment impractical due to inefficiencies accessing sites and associated damage to the surrounding habitat. Therefore, a combination of mechanical cutting and foliar application using backpack sprayers is most appropriate. The density of these stands also limits the efficiency of the cut stem method or wiping (even though the stands are small in size there may be hundreds or thousands of stems). Table 9.2.1-1 outlines those patches targeted for this approach. In situations where stand size is less than 0.5 acres and areal cover of Common reed is identified as being greater than or equal to 75%, mechanical cutting and foliar application of Glyphosate based, aquatic-approved herbicide will be the primary method of control. Cutting will take place in summer (late July) using brush saws or other hand tools. Following the initial mechanical treatment herbicide should be applied in late summer or early fall. The effectiveness of this foliar application will be determined by monitoring (Section 10.0)

9.2.2 Medium Density Stand Approach

Stands of medium density are those identified as having an estimated areal cover of greater than 30% and less than 75%. The control method for medium density stands is the same regardless of the patch size. Table 9.2.2-1 identifies stands targeted for the medium density approach. These stands will be treated using a combination of mechanical cutting and foliar application of herbicide using hand equipment, such as backpack sprayers, as detailed in Section 7.1.2. Cutting will occur in summer (late July) using brush saws, or other hand tools. Following the cutting, once new growth has become established (late summer or early fall), herbicide should be applied following the methods above. The effectiveness of this foliar application will be determined by monitoring (Section 10.0).

Table 9.2.2-1: STANDS IDENTIFIED FOR MEDIUM DENSITY STAND APPROACH

Site Number	Cover Type	Invasive Cover %	Acres
1	MIXED SPECIES COMMON REED PRESENT	45	0.09
2	MIXED SPECIES COMMON REED PRESENT	45	0.08
4	MIXED SPECIES COMMON REED PRESENT	50	0.16
5	MIXED SPECIES COMMON REED PRESENT	45	0.01
6	MIXED SPECIES COMMON REED PRESENT	45	0.06
7	MIXED SPECIES COMMON REED PRESENT	45	0.06
8	MIXED SPECIES COMMON REED PRESENT	45	0.03
9	MIXED SPECIES COMMON REED PRESENT	50	0.13
10	MIXED SPECIES COMMON REED PRESENT	50	0.06
11	MIXED SPECIES COMMON REED PRESENT	45	0.05
12	MIXED SPECIES COMMON REED PRESENT	40	0.01
13	MIXED SPECIES COMMON REED PRESENT	45	0
18	MIXED SPECIES COMMON REED PRESENT	35	0.04
19	MIXED SPECIES COMMON REED PRESENT	55	0.01
22	MIXED SPECIES COMMON REED PRESENT	40	0.02
23	MIXED SPECIES COMMON REED PRESENT	40	0
24	MIXED SPECIES COMMON REED PRESENT	50	0.02
62	MIXED SPECIES COMMON REED PRESENT	70	0.14
Total			0.97

9.2.3 Low Density Stand Approach

Stands of low density are those identified as having an estimated areal cover of less than 30% Common reed (Table 9.2.3-1). The control method for low density stands is the same regardless of the patch size. Low density stands will be treated using cut stem method of herbicide application, using the approved mixture provided on the product label. This method is an effective tool, both ecologically and economically. The direct application of herbicide to the cut stem reduces the chances of non-target impacts greatly (TNC, 2003; Kiviat 2006).

Initial treatment of the identified stands will begin in late July, with the stems of Common reed cut with clippers, brush saws or other hand tools (*i.e.*, no tractors or riding mowers). Following the initial cutting, stems will again be cut approximately waist high in early fall (September). After cutting the stem, a diluted herbicide will be applied to the cut stem directly using small plastic spray bottles. As an alternative the swiping method (Section 7.1.2) can be used if conditions are such that it is more efficient.

TABLE 9.2.3-1: STANDS IDENTIFIED FOR LOW DENSITY STAND APPROACH

Site Number	Cover Type	Invasive Cover %	Acres
14	MIXED SPECIES COMMON REED PRESENT	15	0.01
16	MIXED SPECIES COMMON REED PRESENT	20	0.01
17	MIXED SPECIES COMMON REED PRESENT	20	0.1
20	MIXED SPECIES COMMON REED PRESENT	25	0.03
25	MIXED SPECIES COMMON REED PRESENT	0	0.14
26	MIXED SPECIES COMMON REED PRESENT	0	0.05
27	MIXED SPECIES COMMON REED PRESENT	15	0.01
28	MIXED SPECIES COMMON REED PRESENT	30	0.02
29	MIXED SPECIES COMMON REED PRESENT	20	0.07
30	MIXED SPECIES COMMON REED PRESENT	20	0.02
52	COMMON REED DOMINATED MARSH	>75	0.002
53	COMMON REED DOMINATED MARSH	>75	0.002
54	COMMON REED DOMINATED MARSH	>75	0.002

TABLE 9.2.3-1: STANDS IDENTIFIED FOR LOW DENSITY STAND APPROACH (Cont'd)			
Site Number	**Cover Type**	**Invasive Cover %**	**Acres**
55	COMMON REED DOMINATED MARSH	>75	0.002
56	COMMON REED DOMINATED MARSH	>75	0.002
57	COMMON REED DOMINATED MARSH	>75	0.002
Total			0.472

9.2.4 Schedule

Table 9.2.4-1 outlines the general schedule for Common reed treatment. As outlined in Section 10.1, monitoring is continual and ongoing to ensure Common reed does not return to treated stands.

TABLE 9.2.4-1: TREATMENT SCHEDULE BASED ON STAND TYPE*

		Dense Stand Approach 1	Dense Stand Approach 2	Medium Density Stand Approach	Low Density Stand Approach
Year 1	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun				
	Jul	Mechanical Cutting			
	Aug				
	Sep	Foliar Application of Herbicide Using ATV	Foliar Application of Herbicide Using Backpack Sprayer		Cut Stem Herbicide Application
	Oct				
	Nov				
	Dec				
Year 2	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun	Annual Monitoring			
	Jul				
	Aug				
	Sep	Herbicide Spot Treatment			
	Oct				
	Nov				
	Dec				
Year 3+	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun	Annual Monitoring of Treated Areas with Plot/Invasive Monitoring Occurring every 5 Years			
	Jul	Treatment as dictated by monitoring results			
	Aug				
	Sep				
	Oct				
	Nov				
	Dec				

* Table adapted from Avers et al, 2008

9.3 Japanese Knotweed Control

Japanese knotweed was only identified in one patch located along the western shore of the Buckhorn marsh. While Common reed is the priority species targeted for treatment within the marsh, the patch of knotweed has also been selected for management. Currently the patch is small and will allow cost effective treatment options to take place before the patch expands or becomes mobile within the marsh. Based on the location of the patch, proximity to water, and density, the recommended control method is the cut stem method. **It should be noted that current NY Regulations require that herbicide dilutions follow the manufacturer's specifications provided on the product label. At no time should these mixing instructions be modified, unless the manufacturer develops supplemental labeling materials approved by the State.** If this method has not been approved by State Agencies prior to implementation, the wiping method (Section 7.2.2) should be used as an alternative.

In mid-July the initial cut stem application will take place. Knotweed stems will be cut below the third node using clippers or loppers. Immediately following the cut, an approved dilution of an aquatic approved Glyphosate based herbicide will be applied to the stem cavity. Additionally a small portion of herbicide will be applied to the cross sectional cut of the stem. Herbicide will be delivered to the stem by laboratory squirt bottles. A follow up foliar application will take place in the fall of the same year to treat new growth. Foliar spray will be completed using a low pressure backpack. Cut stems must be dealt with in an appropriate manner to prevent further spread within the marsh or elsewhere. Stems will be placed directly into rugged plastic bags with great care being taken to avoid spreading plant materials away from or adjacent to the site. Knotweed materials should be disposed of in an appropriate manner at either a licensed DOT disposal facility, rotted within the bags, dried on racks or pavement, or burned. Management of cut stems is a significant portion of the overall control effort for knotweed within Buckhorn Marsh.

TABLE 9.3-1: KNOTWEED CONTROL APPROACH

		Knotweed Approach
Year 1	Jan	
	Feb	
	Mar	
	Apr	
	May	
	Jun	Annual Monitoring
	Jul	Cut Stem Method (Glyphosate Based Herbicide)
	Aug	
	Sep	
	Oct	Spot Treat with Glyphosate Based Herbicide
	Nov	
	Dec	
Year 2	Jan	
	Feb	
	Mar	
	Apr	
	May	
	Jun	Annual Monitoring
	Jul	Cut Stem Method (Glyphosate Based Herbicide)
	Aug	
	Sep	
	Oct	Spot Treat with Glyphosate Based Herbicide
	Nov	
	Dec	
Year 3+	Jan	
	Feb	
	Mar	
	Apr	
	May	
	Jun	Annual Monitoring or Five Year Monitoring
	Jul	Spot Treat with Glyphosate Based Herbicide (If Needed)
	Aug	
	Sep	
	Oct	Spot Treat with Glyphosate
	Nov	
	Dec	

10.0 MONITORING

In order to effectively control Common reed and Japanese knotweed (only the single patch) within Buckhorn, monitoring will be required to determine success as well as identify potential new infestations. Adaptive management strategies rely heavily on information gathered after treatments have occurred. This data allows control methods to be refined and allows

adjustments to be made in response to challenges that may occur. Monitoring will occur during the summer (June or July) before any mechanical treatment or spot treatment activities have taken place. During the summer of 2008 fixed monitoring plots were established within Buckhorn marsh. A description of these plots is included in Section 4.3 and the baseline data sheets have been included as Appendix D. Figure 4.3-1 shows the location of the established monitoring plots.

10.1 Rare, Threatened, and Endangered Species

The application of herbicide within any natural environment poses some risk to native flora and fauna. It is important to ensure that all measures are taken to avoid impacts to non-target organisms. In order to ensure that no RTE species (particularly plants and birds) are impacted by this invasive species action plan, a survey will be completed prior to any activities within stands slated for treatment. Monitoring will occur on an annual basis within stands targeted for treatment. Monitoring will focus on plants (and other RTE species as applicable) to ensure that no valuable species are negatively impacted. Special emphasis will be given to the stand directly within the area of sedge meadow (Group 16) due to the fact that RTE species such as Sedge Wren and Northern Harrier have been known to use this habitat historically.

10.2 Annual Monitoring

Annual monitoring will focus on all treated sites and continue until the area has completely re-vegetated and no Common reed is present for as long as it takes up to the term of the license. This monitoring will be qualitative and designed to determine whether new growth of invasives has occurred and whether follow-up spot treatment is required. This monitoring will involve stem counts if stems are few (e.g., < 100 stems) and a qualitative estimate of percent areal cover if stems are numerous (e.g., > 100 stems). This monitoring will also evaluate soil disturbance and re-establishment of native vegetation and any recommendations for native plantings would be made as necessary.

10.3 Five Year Monitoring

Five years after the first treatment, the first five year monitoring will take place and then continue every five years until the successful completion of the project. This monitoring will be more intense than the annual monitoring. Five year monitoring will include data collection at each of the sample plots (8) established in 2008. Plot monitoring will include species identification, stem counts of invasive species, estimate of areal cover percent, and photographs of each sample plot. Additionally the entire Marsh area will be re-surveyed on foot during the winter to allow for easier access to the Marsh interior. The purpose of the five year monitoring will be to identify any new establishment of Common reed within the Marsh and evaluate the fixed monitoring plots. At this time corner stakes at all fixed monitoring plots will be located and orange paint marking these will be refreshed.

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APPENDIX A: WINTER SURVEY REPORT

WINTER SURVEY REPORT AVAILABLE FROM NYPA UPON REQUEST

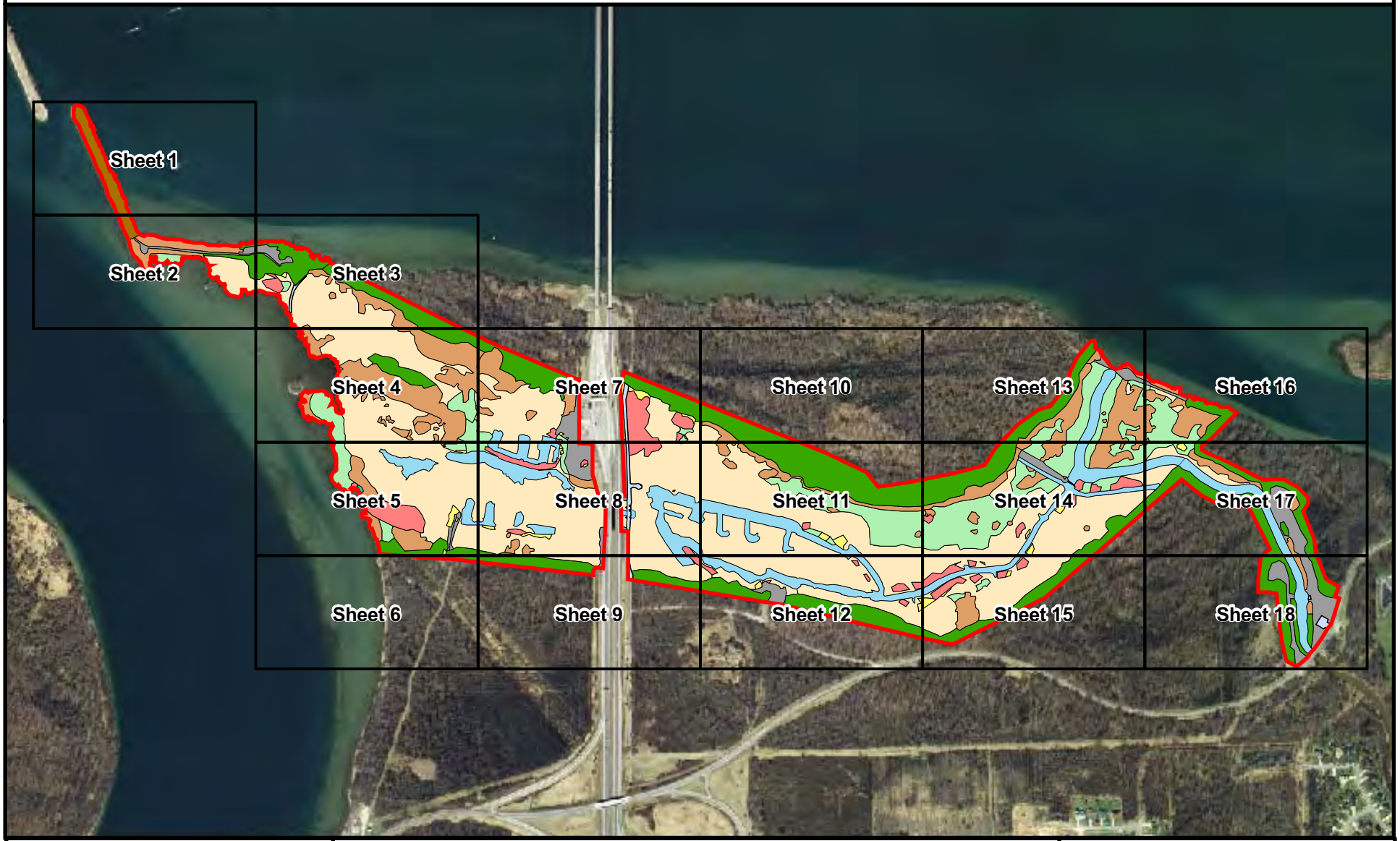
ENVIRONMENTAL DEPARTMENT

123 MAIN STREET

WHITE PLAINS, NY 10601

APPENDIX B: COVER TYPE MAPPING

Buckhorn Cover Type Mapping



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Appendix B.
Buckhorn Cover Type
Index Map

New York Power Authority

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Buckhorn Cover Type Mapping

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- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

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Text Low Priority

Appendix B.
Sheet 1 of 18

New York Power Authority

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- JAPANESE KNOTWEED
- MOWED
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- OTHER

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Appendix B.
Sheet 2 of 18

New York Power Authority

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- UPLAND SHRUB/DISTURBED SOILS
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Appendix B.
Sheet 3 of 18

New York Power Authority

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- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

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Appendix B.
Sheet 4 of 18

New York Power Authority

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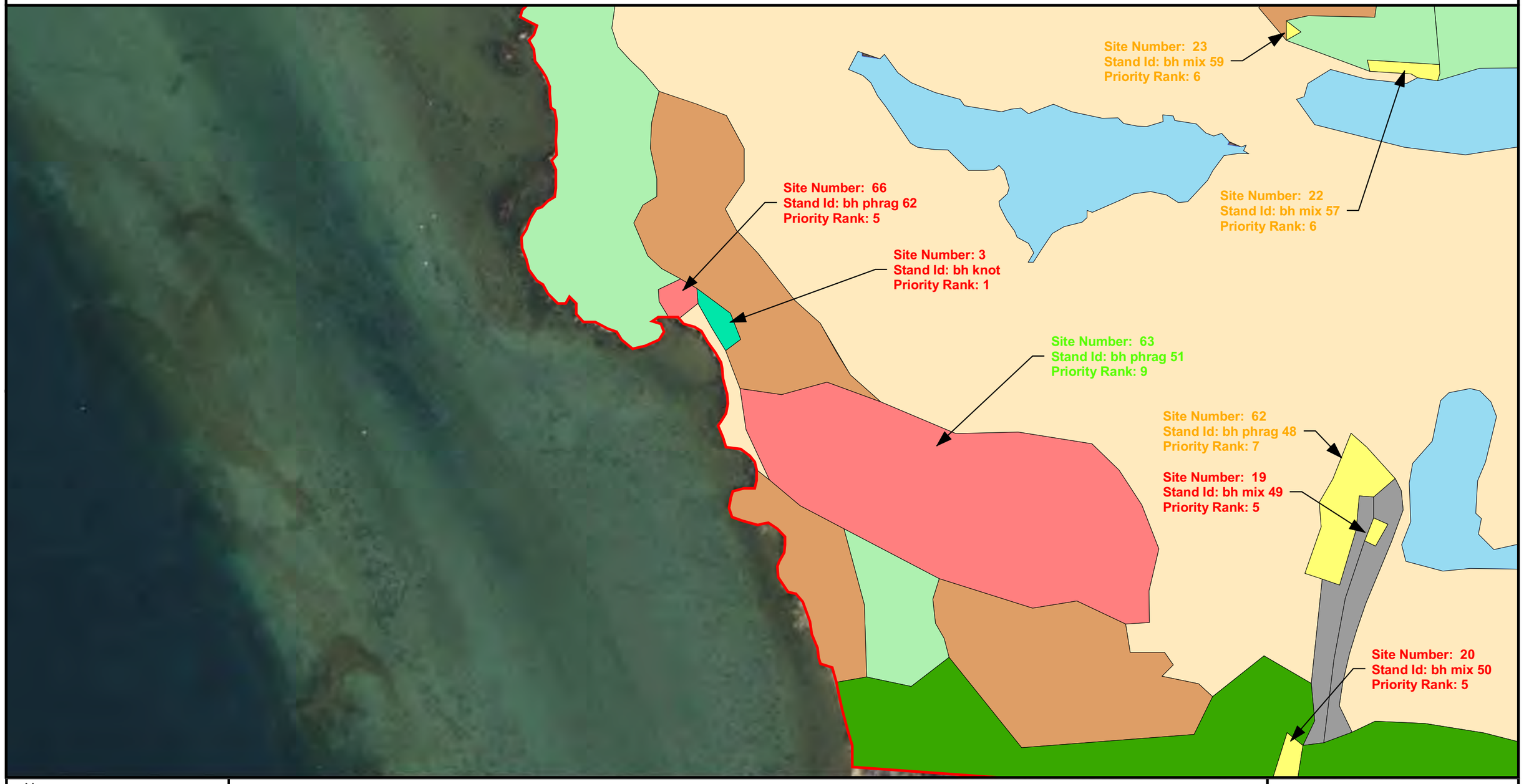

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Appendix B.
Sheet 5 of 18

New York Power Authority

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Appendix B.
Sheet 6 of 18

New York Power Authority

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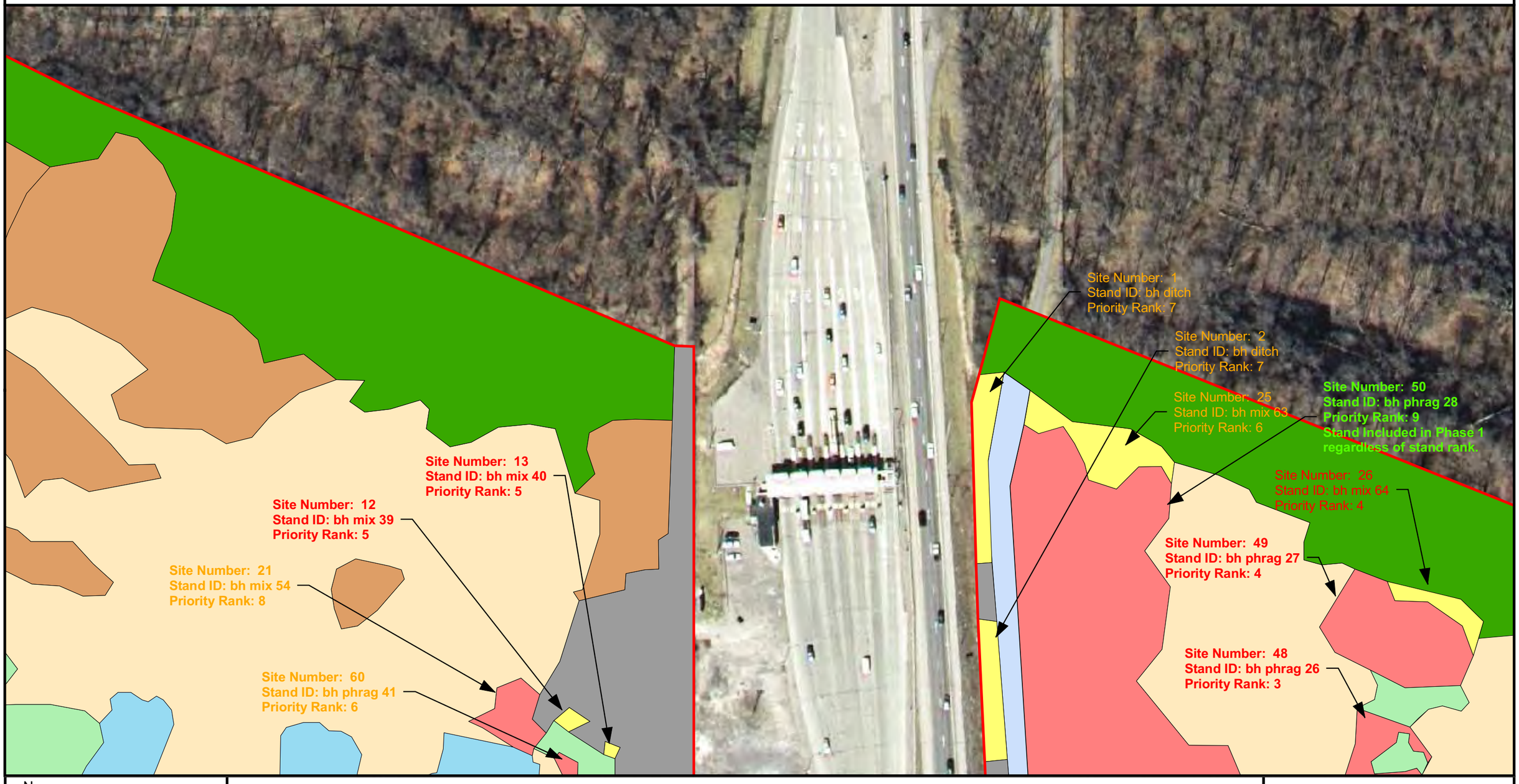

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Appendix B.
Sheet 7 of 18

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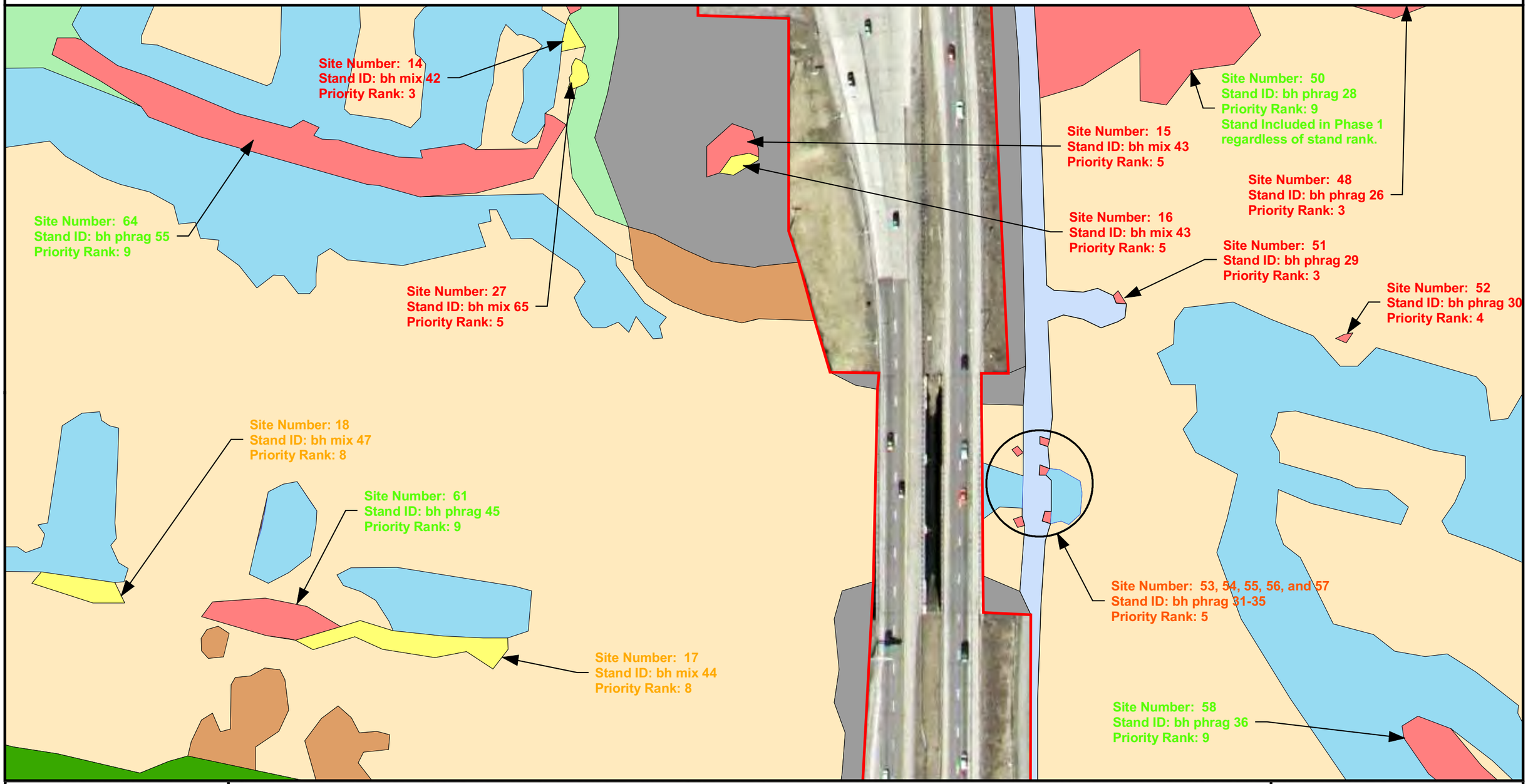

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Appendix B.
Sheet 8 of 18

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Appendix B.
Sheet 9 of 18

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- UPLAND SHRUB/DISTURBED SOILS
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Appendix B.
Sheet 10 of 18

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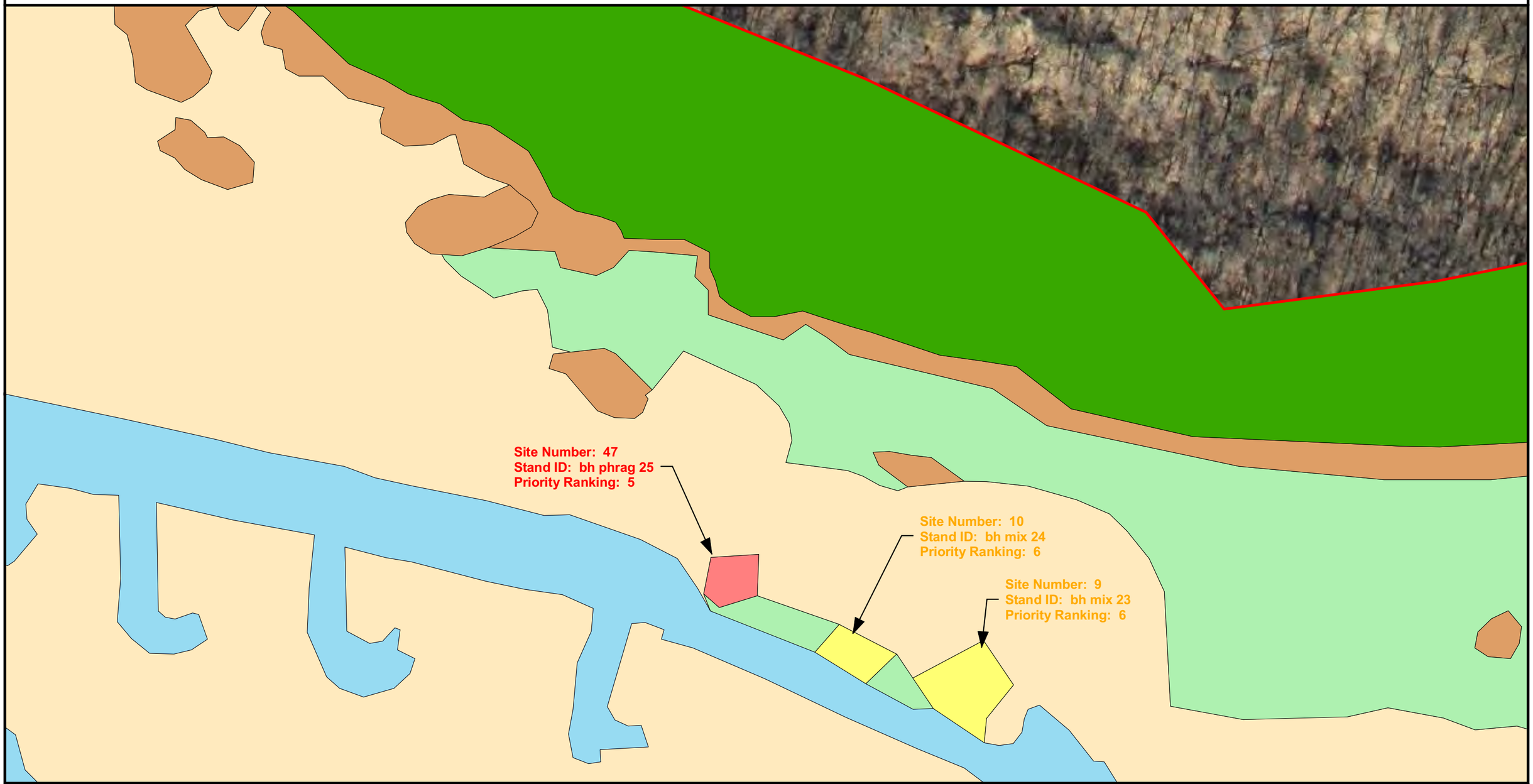

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Appendix B.
Sheet 11 of 18

New York Power Authority

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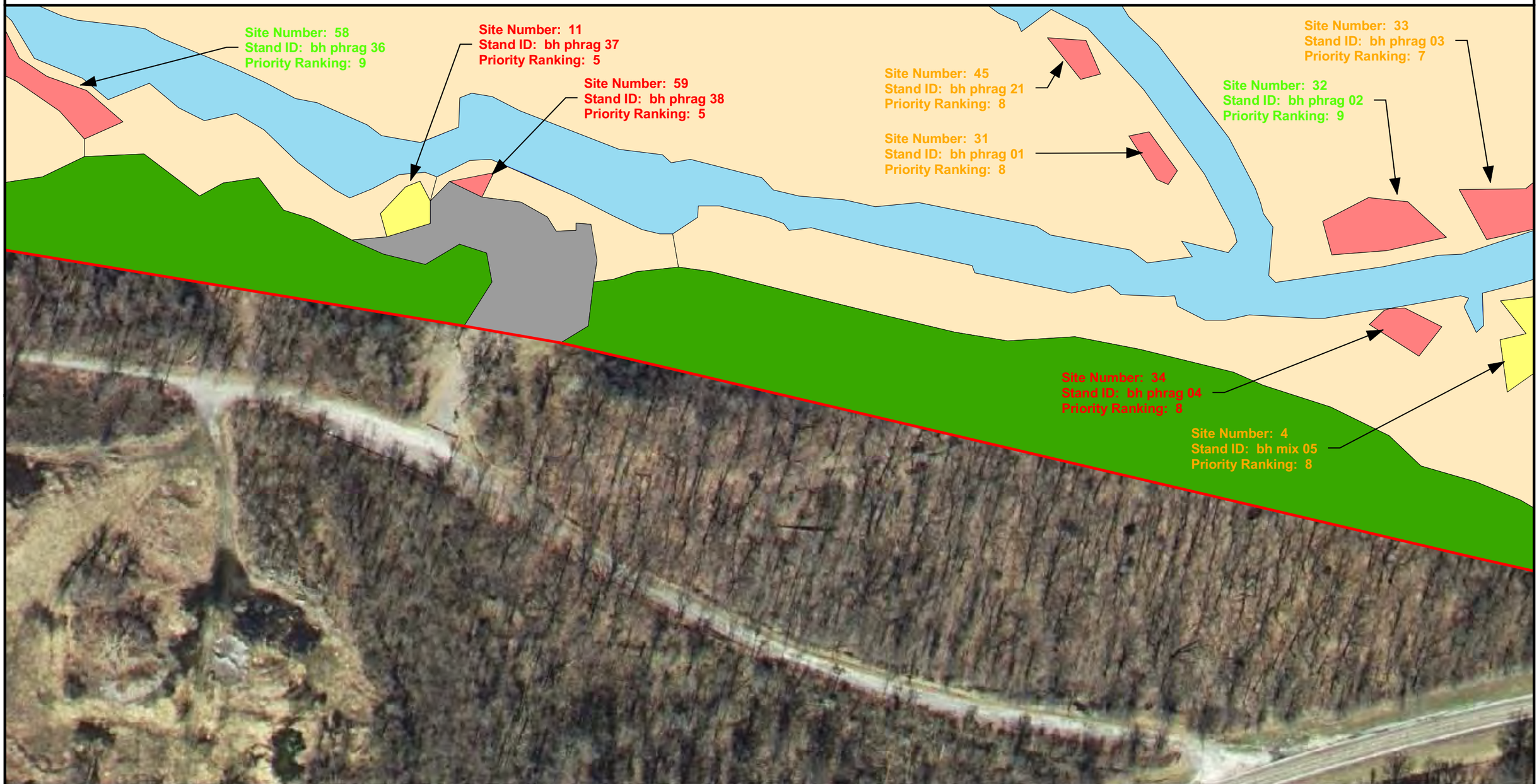

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- UPLAND SHRUB/DISTURBED SOILS
- OTHER

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Appendix B.
Sheet 12 of 18

New York Power Authority

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- UPLAND SHRUB/DISTURBED SOILS
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Appendix B.
Sheet 13 of 18

New York Power Authority

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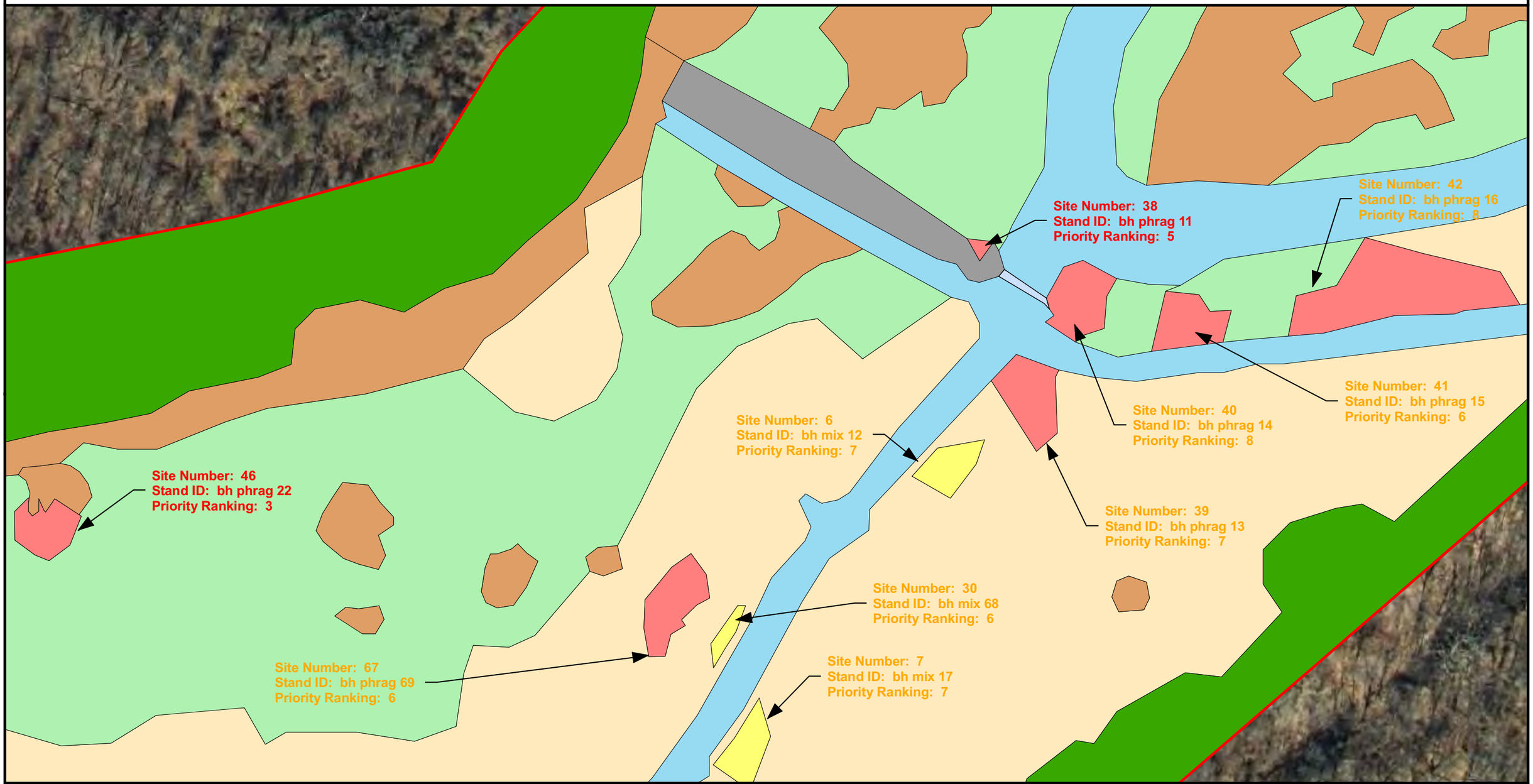

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Appendix B.
Sheet 14 of 18

New York Power Authority

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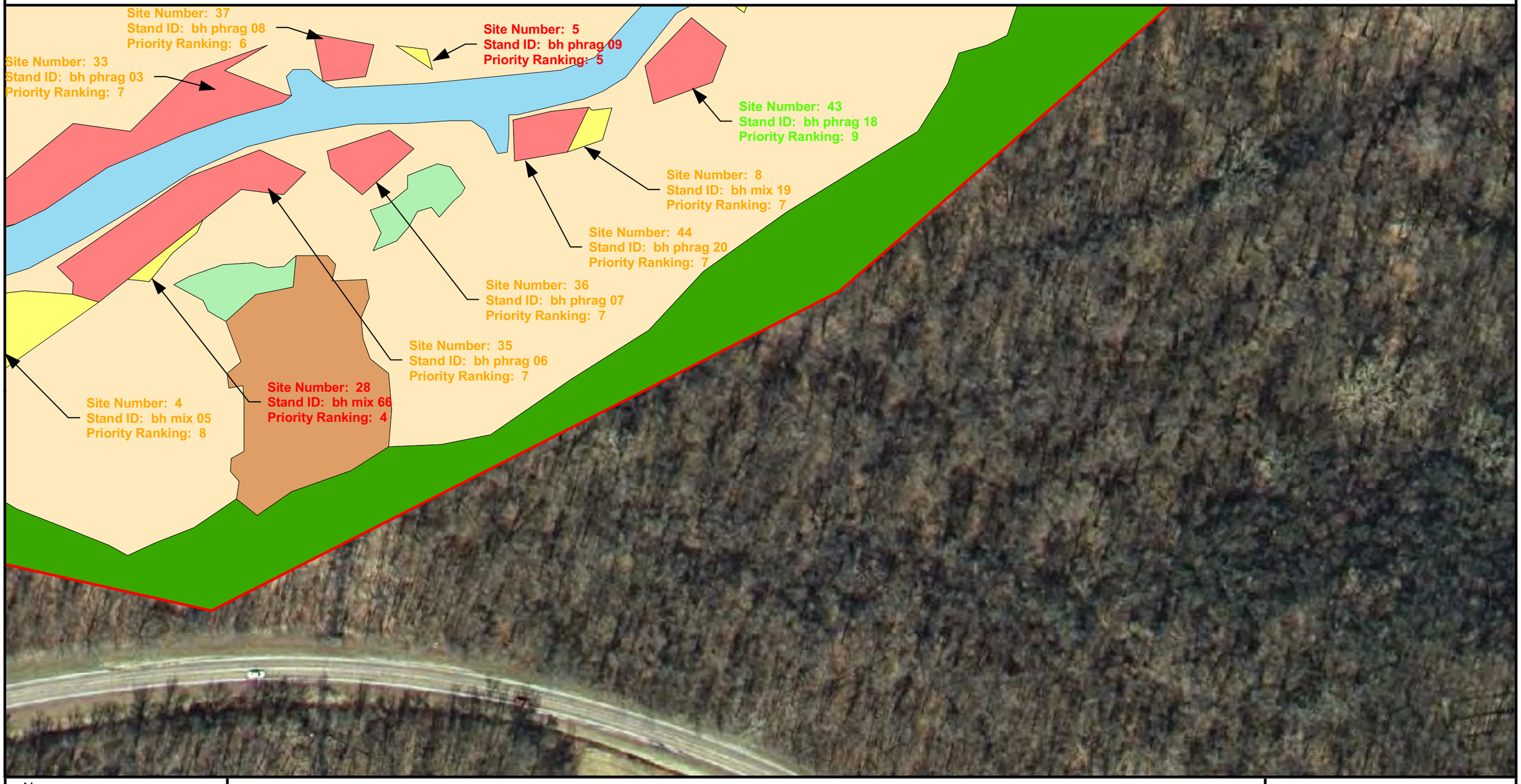

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Appendix B.
Sheet 15 of 18

New York Power Authority

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- MOWED
- UPLAND SHRUB/DISTURBED SOILS
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Appendix B.
Sheet 16 of 18

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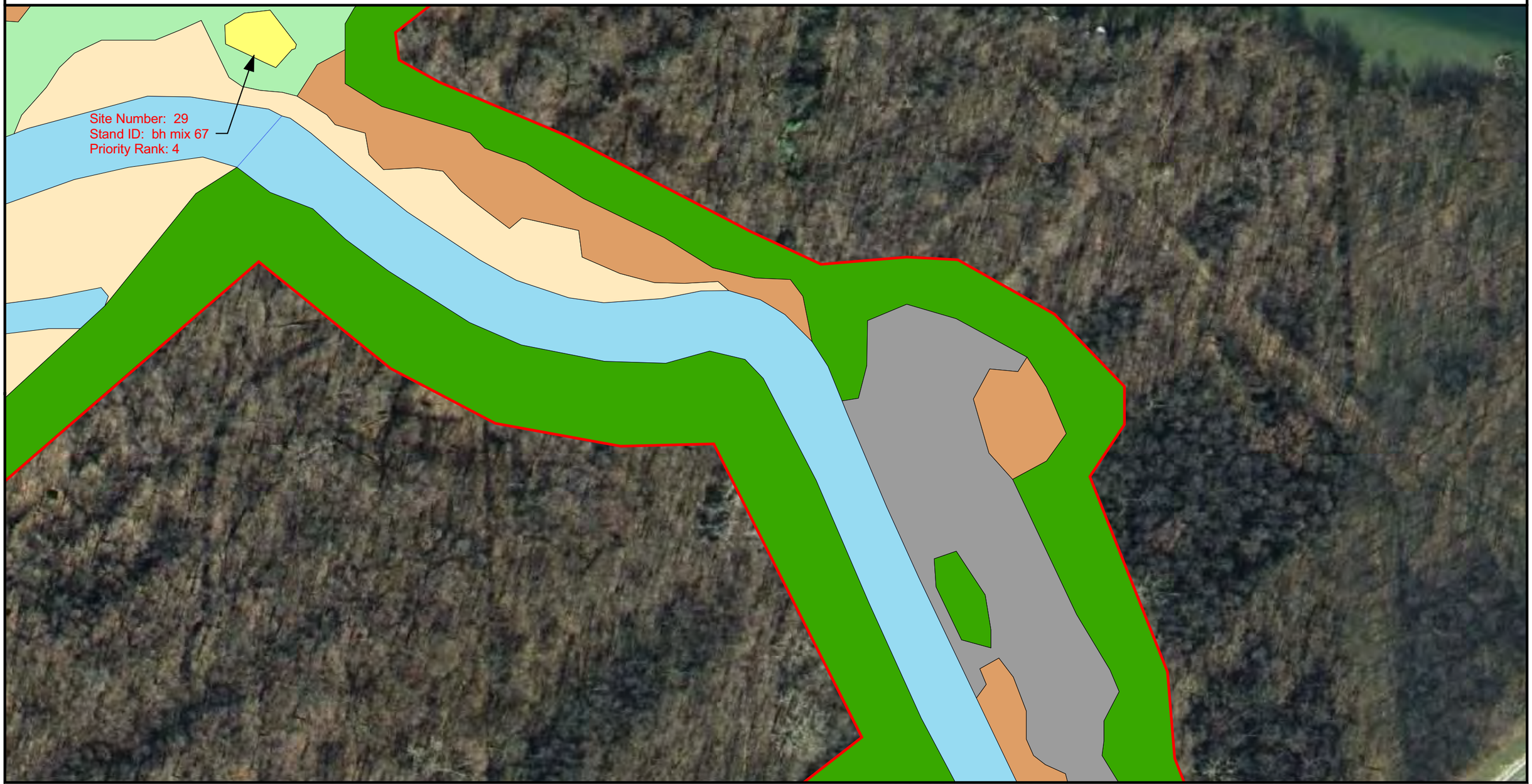

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- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

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Appendix B.
Sheet 17 of 18

New York Power Authority

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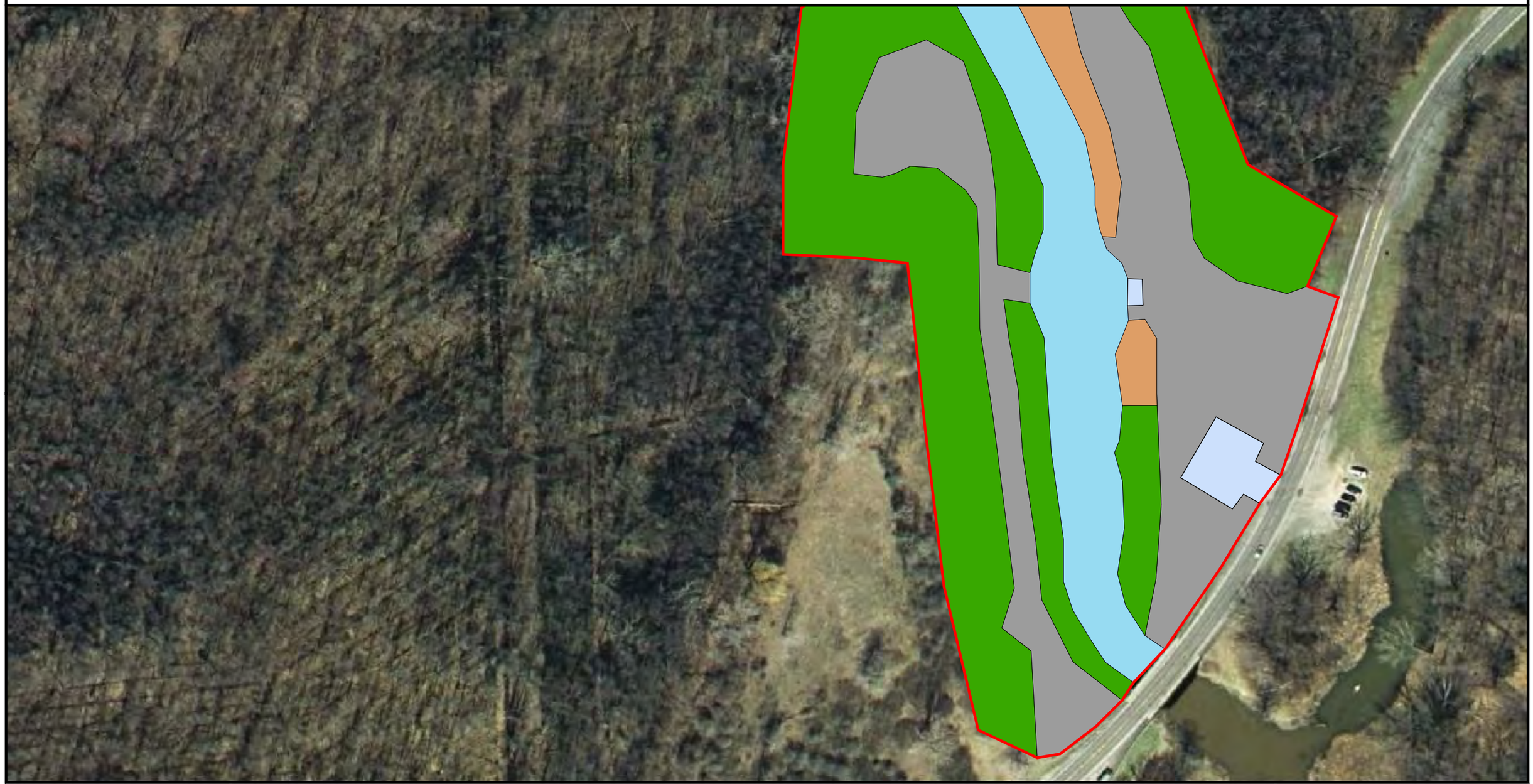

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- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 18 of 18

New York Power Authority

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APPENDIX C: INVASIVE SPECIES DESCRIPTIONS

Species Descriptions

Common reed (*Phragmites australis*)

Common reed is a grass species that ranges across Europe, Asia, Africa, America, and Australia. Over the last 50 years, Common reed has become increasingly prominent in many wetland types throughout the U.S. and, until recently, was considered an exotic species in North America. However, current genetic analysis has identified 27 halotypes, or lineages, of Common reed occurring in North America, 11 of which have been determined to be native (Blossey, 2002b). The remaining halotypes are non-native, being primarily of European ancestry and were likely introduced into North America prior to the 20th century. These non-native lineages have proven to be exceedingly invasive, forming dense, cloned stands that displace diverse assemblages of native wetland vegetation. Halotype M is of European ancestry and appears to be responsible for most invasive occurrences of Common reed in the U.S. In fact, type M has greatly increased in abundance over the past 100 years and has nearly replaced many native halotypes in New England and northeastern United States (Saltonstall, 2002).

Common reed is a perennial grass with stout, hollow, woody culms between 3–20 feet in height (USDA, 2005a). Common reed often forms dense colonial stands with rhizomatous roots. The leaves are flat, long acuminate and between 1/2 to 2 inches m wide and 6 to 8 inches in length. The multiple, branching inflorescence (panicle), or seed head, is between 8 and 16 inches in length with silky hairs along the flowers axis giving the inflorescence a tawny, plume-like appearance (Texas Cooperative Extension, 2007).

The non-native variety of Common reed is an extremely aggressive plant that has the capacity to quickly form monocultures, thereby, out competing native vegetation and altering ecological processes. However, native types of Common reed can be regarded as a stable,

natural component of a wetland community. Many native populations of Common reed are "benign" and pose little or no threat to other species and should be left intact. Native versus non-native halotypes can be identified positively through genetic analysis and with some accuracy in the field.

Common reed is a problem when and where stands appear to be spreading while other species typical of the community are diminishing. Disturbances or stresses such as pollution, alteration of the natural hydrologic regime, dredging, and increased sedimentation favor invasion and continued spread of Common reed (Roman *et al*., 1984).

Japanese knotweed *(Polygonum cuspidatum)*

Japanese knotweed is a member of the buckwheat family and a native to Eastern Asia. The growth form of Japanese knotweed is shrub like, growing upright and reaching heights over 10 feet. The stems of Japanese knotweed are smooth and become stout or swollen along joints were the leaves meet the stem. Leaf size is variable; commonly leaves are 6 inches long and 3-4 inches in width. Leaves are broadly oval and sometimes triangular with a pointed tip. Flowers appear greenish white in color and are found in branched sprays in summer. Flowers are followed by small winged fruits (PCA, 2005).

The current distribution of Japanese knotweed includes 36 of the lower 48 states, ranging from Maine to Wisconsin and south to Louisiana. Knotweed is also found scattered throughout the Midwest and western states. It is thought that knotweed was introduced to the United States at some point in the late 1800's. Common names also include Crimson beauty, Mexican bamboo, Japanese fleece flower, or Reynoutria. It was originally introduced as an ornamental shrub with some use as erosion control or landscape screening (PCA, 2005).

Japanese knotweed emerges from underground rhizomes in the early spring after over wintering. Emergence occurs in March or April followed by a period of rapid growth which allows full height to be attained by late July. In native ranges reproduction is accomplished predominantly by insect pollination, sexual reproduction, and wind dispersal of seed. Introduced populations rely heavily on vegetative reproduction (TNC, 2003). Seeds that are produced by introduced populations rarely germinate in the wild. Knotweed is capable of sprouting from rhizomatic tissue as well as from internodal tissues. Dispersal of knotweed is dependent on transportation of rhizome fragments by way of water or through soils contaminated with rhizomes (Van Driesche 2002).

Japanese knotweed is tolerant of a wide range of conditions including full shade, high temperatures, high salinity, and drought. Commonly it is found near water sources, such as along streams and rivers, in lowlands, waste places, and utility rights-of-way (PCA, 2005). Knotweed has been observed in a variety of soil types including silt, loam, and sand. Generally pH levels ranging from 4.5 to 7.4 are tolerated. Knotweed aggressively spreads after escaping cultivation (Van Driesche, 2002).

Japanese knotweed primarily acts to exclude native plants species by quickly forming dense thickets. These dense thickets shade out native vegetation and offer little value to wildlife. Rhizome systems of knotweed can exceed 15 to 20 meters in length allowing the plant to achieve early emergence and great height in a short amount of time, which results in a shading of natural species and the resultant drop in plant diversity. Knotweed begins to senesce following the first frost and the remaining dead stems create an obstacle that further inhibits native plant regeneration and leaves infested areas vulnerable to erosion. This increased erosion potential acts to facilitate the further spread by exposing rhizomes to flowing waters, which can lead to further infestations (Van Driesche, 2002). Currently, losses due to Japanese knotweed are thought to be substantial, but they have not been quantified. Knotweed often enters wetland habitat and therefore can become a particular concern in these areas.

Yellow flag Iris (*Iris pseudacorus)*

Yellow flag Iris is an herbaceous perennial that ranges from 2 to 5 feet tall. Commonly Yellow flag grows in upright clumps in water up to 10 inches in depth. Leaves are large flat and "sword" like in appearance. Leaves are commonly ¾ inches wide with parallel veins. In colder climates leaves die back during the winter but may persist in warmer areas. The roots of Yellow flag grow 4 to 12 inches in length and the plant also sends out quickly spreading rhizomes. Flowers of the Yellow flag consist of three showy yellow petals with dark brown markings and three smaller yellow petals; flowering occurs during summer. Typically flower stalks grow to 3 to 4 feet with one to many flowers per stem.

Yellow flag is currently distributed throughout the majority of the United States. Yellow flag was introduced as an ornamental flower during the 1900s and escaped cultivation. Additionally Yellow flag was planted as a means of erosion control and as plantings in sewer treatment systems. Yellow flag is widespread in the U.S. and occupies wet meadows and wetland margins. Yellow flag forms dense mats by spreading quickly and out-competing native vegetation. Spread of Yellow flag occurs either by seed, rhizome, or transportation of rhizome materials. Wide ranges of pH and soil moisture are tolerated by Yellow flag. Yellow flag can cause gastroenteritis in cattle, pigs, and humans. It may also cause skin irritation in people (USDA, 2006b).

While Yellow flag was observed within Buckhorn at low densities in isolated locations, it is not functioning as an invasive. Therefore, surveys did not include Yellow flag as a mapped cover type and it is not considered a priority species that should be targeted for control.

European Alder *(Alnus glutinosa)*

European alder, also known as Black alder, is a fast growing member of the birch family (*Betulaceae*) reaching heights of 30 to 50 feet. Black alder generally has a multi-stemmed trunk with a narrow upright crown. The bark of the Black alder is smooth and grayish green in color when new then changes grayish brown with warty horizontal stripes and irregular fissures. Leaves are leathery and alternate occurring as simple oval leaves 2 to 5 inches in length and 2 to 4 inches wide. Flowers appear on the Black alder before new growth in the early spring. Black alder is monoecious, with both male and female flowers occurring on the same tree. Fruits appear by the fall and are cone-like catkins, Black alder reproduces almost entirely by seed dispersal. The average number of seeds per tree is 240,000 (USDA, 2006a).

Currently Black alder is reported in 17 of 50 states and is listed as invasive in New York, along with Illinois, Indiana, Michigan, Pennsylvania, and Wisconsin (USDA, 2006a). Historically Black alder has been cultivated in the northeast since colonial times. Escapes from cultivation are noted as early as the 1870s on Long Island. Black alder is a pioneer species that takes advantage of open ground. It has the potential to be dispersed by water and often develops mono-specific stands that pose a threat to native vegetation. Black alder prefers wet soils with full exposure to sunlight and is often found along streams, rivers, ponds, or wetland margins. The Black alder is a nitrogen fixer and does well in poor soils. Tolerance of pH ranges from 5.5 to 7. Black alder is a shade intolerant species (USDA, 2006a).

In Buckhorn, the majority of the Black alder observed was located along Woods Creek. These individuals were located directly adjacent to the creek. While the species is listed as invasive in New York, the current distribution in Buckhorn is not as extensive as Common reed and it does not pose as major a threat to the marsh area. Native vegetation currently covers the vast majority of the marsh and therefore the lack of open ground for

colonization by Black alder is limited. The Black alder is not considered a priority species and was not mapped during the inventory.

Purple loosestrife *(Lythrum salicaria)*

Purple loosestrife is an erect perennial herb that inhabits swamps, marshes, stream banks, river banks, and other open wet habitats. The plant ranges from 2 to 6 feet in height. The stem is square in cross-section and can be glabrous to pubescent. The roots of Purple loosestrife can form a dense mat that may produce as many as 30-50 stems annually. The leaves are simple and narrow occurring as either whorled or opposite. Flowering occurs in late June through September as a tall spike of magenta-purple flowers. Flowers have 5-7 petals and are borne on upright stalks. The fruit occurs as a capsule containing 100 or more small dark seeds (Khan, 2005).

The densest infestations occur in the northeast in cattail marshes, sedge meadows, and open bogs. Purple loosestrife is native to Eurasia and was first recorded along the coast of northeastern North America in 1814. Loosestrife was well established along the New England seaboard by 1830. Loosestrife inhabits a variety of habitats, but prefers soils high in organic material. Full sun is not a requirement and loosestrife will grow in partial shade. Dense stands of Purple loosestrife will effectively force out native vegetation. A single plant has the potential to generate 2.7 million seeds per year, which results in a massive seed bank. If conditions favor loosestrife, often populations will explode dramatically from a large seed bank that remains viable for 10 to 15 years (Khan, 2005). In some cases shoots damaged by fire, herbicide, or mechanical removal can regenerate from root stock. Stem cuttings and remains of root stock may also re-sprout (USDA, 2000b).

Purple loosestrife within Buckhorn marsh is not considered a priority species. The distribution of Purple loosestrife within the marsh is currently at levels that are not invasive. Field observations during the summer survey noted that beetles were feeding on Purple

loosestrife stems within the Marsh and that loosestrife density within the marsh was low. Based on these observations, Purple loosestrife was not mapped and is not considered a priority species.

Garlic mustard *(Alliaria petiolata)*

Garlic mustard is a cool season biennial herb and is a member of the mustard family (Brassicaceae). Leaves are stalked, heart-shaped, coarsely toothed and give off an odor of garlic when crushed. First year plants appear as a rosette of green leaves close to the ground, and can be confused with V*iola sp.* (the garlic odor however, is distinctive). The first year rosettes remain green throughout the winter, developing into flower plants in the spring. The flowering plants reach heights of 2 to 3 ½ feet and produce small clusters of button like flowers. Flowers have four petals and resemble a cross. Seeds are produced in slender pods becoming shiny black when mature. Seeds produced vary from plant to plant, but can range as much as 14 to several thousand per plant (USDA, 2005).

Garlic mustard originated in Europe and was introduced to the United States for herbal and medicinal uses. The first recording in the United States was in 1868 in Long Island, New York. Currently Garlic mustard has invaded 28 of 50 states and is prevalent along the east coast (Rhoads, 2002). Garlic mustard prefers moist and shaded soils common along river banks, forests, and roadsides. Areas of disturbance are prone to infestations by Garlic mustard. A rapid colonizer, Garlic mustard once established will out compete native vegetation for light, moisture, nutrients, soil and space.

Garlic mustard is not a dominant species in Buckhorn marsh. Garlic mustard is an upland species that is restricted to higher micro-sites within the marsh and the surrounding uplands. Based on this, this species is not a significant threat to marsh structure and function and was not identified as a priority species to control in Buckhorn marsh.

APPENDIX D: SURVEY DATA

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers: SEK, AEH, JDG, JPM Date: 7-14-08

Plot ID: B-1

Northing: 114354.8 Easting: 1041686.4

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	20.5	17
Broad leaved cattial	*Typha latifolia*	3.0	3
Joe-pye weed	*Eupatorium maculatum*	3.0	
Goldenrod sp.	*Solidago sp.*	38.0	
Rice-cut grass	*Leersia oryzoides*	10.5	
Jewelweed	*Impatiens capensis*	10.5	
Purple loosestrife	*Lythrum salicaria*	10.5	25
Rough bedstraw	*Galium asprellium*	TR	
Lake bank sedge	*Carex lacustris*	3.0	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

Photo: Plot B-1

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers: SEK, AEH, JDG Date: 7-14-08

Plot ID: B-2

Northing: 1114407.9 Easting: 1041842.4

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	20.5	13
Broad leaved cattial	*Typha latifolia*	3.0	4
Goldenrod sp.	*Solidago sp.*	63.0	
Horse tail sp.	*Equisetum sp.*	TR	
Sensitive fern	*Onoclea sensibilis*	3.0	
Rice-cut grass	*Leersia oryzoides*	3.0	
Jewelweed	*Impatiens capensis*	TR	
Purple loosestrife	*Lythrum salicaria*	3.0	5
Polygonum sp.	Polygonum sp.	TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: P. loosestrife is stunted; native sedge meadow in a small pocket to
The south-east.

Photo: Plot B-2

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers : SEK, AEH, JDG, GE Date: 7-15-08

Plot ID: B-3

Northing: 1114780.2 Easting: 1041076.7

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	38.0	36
Canada thistle	*Cirsium arvense*	20.5	
Field-sow thistle	*Sonchus arvensis*	10.5	
Blue vervain	*Verbena hastata*	3.0	
Joe-pye weed	*Eupatorium maculatum*	3.0	
Polygonum sp.	*Polygonum sp.*	3.0	
Poa sp.	*Poa sp.*	10.5	
Geum sp.	*Geum sp.*	TR	

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Spoil pile side-cast; lots of thistle 85% phrag, 15% thistle

Photo: Plot B-3

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers : SEK, AEH, JDG, GE Date: 7-15-08

Plot ID: B-4

Northing: not collected Easting: not collected

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	98	55
Clearweed	*Pilea pumila*	3.0	

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

Photo: Plot B-4

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers : SEK, AEH, JDG,GE Date: 7-15-08

Plot ID: B-5

Northing: 1115477.5 Easting: 103926.9

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	98	57
Virginia creeper	*Parthenocissus quinquefolia*	TR	

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

Photo: Plot B-5

General Plot Information

Observers : SEK, AEH, JDG, GE Date: 7-15-08

Plot ID: B-6

Northing: 1115121.1 Easting: 1037677.8

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Japanese knotweed	*Polygonum cuspidatum*	98	28
Bindweed	*Convolvulus sepium*	TR	
Willow sp.	*Salix sp.*	3.0	

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Bindweed wrapped around knotweed stems; Salix overhanging plot stem not within sample plot.

Photo: Plot B-6

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers : SEK, AEH, JDG, GE Date: 7-15-08

Plot ID: B-7

Northing: 1115121.1 Easting: 1037677.8

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	98.0	20
Bittersweet nightshade	*Solanum dulcamara*	3.0	4
Bedstraw sp.	*Galium sp.*	TR	
Bindweed	*Convolvulus sepium*	TR	
Jewelweed	*Impatiens capensis*	3.0	
Bugleweed	*Lycopus sp.*	TR	

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

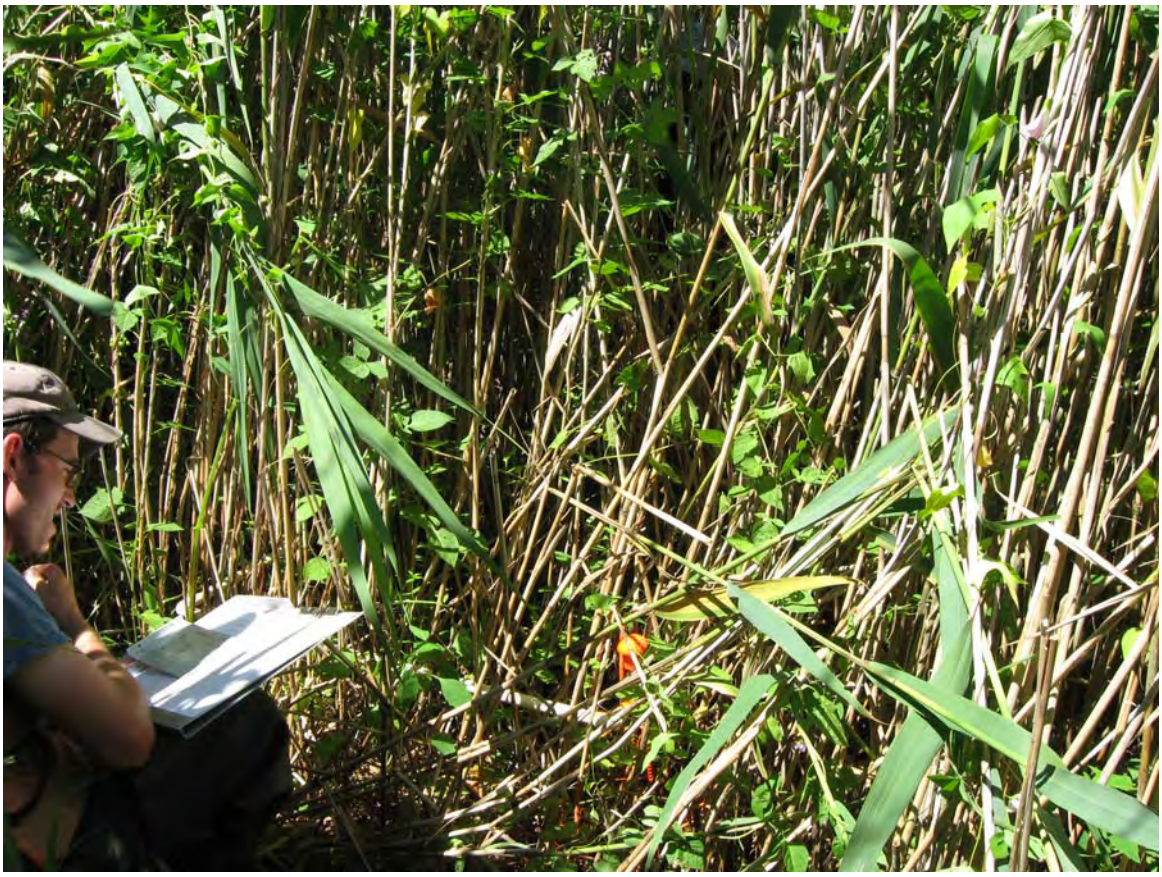

Photo: Plot B-7

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

General Plot Information

Observers : SEK, AEH, JDG, GE Date: 7-15-08

Plot ID: B-8

Northing: 1115449.8 Easting: 103916.0

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	63.0	16
Broad leaf cattail	*Typha latifolia*	38.0	
Canada thistle	*Cirsium arvense*	3.0	
Jewelweed	*Impatiens capensis*	3.0	
Garlic mustard	*Alliaria officinalis*	3.0	12
Hedge bindweed	*Convolvulus sepium*	3.0	
Poa sp.	*Poa sp.*	TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Side-cast/Spoil

Photo: Plot B-8

GENERAL BUCKHORN PHOTOS

Photo: Interior of large sedge meadow located along northern edge of the study area east of I-190.

Photo: Area dominated by Cattail and River bulrush along the far western boundary of the study area.

Photo: Representative vegetation found in excavated channels within Buckhorn (this channel is just east of the large sedge meadow).

Photo: Common reed dominated stand, view from interior.

Photo: View of a mixed stand, note single stems of Common reed within existing vegetation.

Photo: Large stand of Swamp rose mallow (*Hibiscus palustris*) observed near Invasive Group 1

APPENDIX E: PRIORITY RANKING MATRIX

APPENDIX E, TABLE 1. INDIVIDUAL STAND RANKING BASED ON DECISION FRAMEWORK OUTLINED IN SECTION 6

Stand ID	Site Number	Cover Type	Invasive Cover %	Acres	Evaluation Criteria					
					Size	Access	Cover	Expansion	Sens. Hab	Priority Score*
bh Ditch	1	MIXED SPECIES COMMON REED PRESENT	45	0.09	1	0	1	3	2	7
bh Ditch	2	MIXED SPECIES COMMON REED PRESENT	45	0.08	1	0	1	3	2	7
bh knot 52	3	JAPANESE KNOTWEED	95	0.03	0	0	0	0	0	0
bh mix 05	4	MIXED SPECIES COMMON REED PRESENT	50	0.16	1	1	1	3	2	8
bh mix 09	5	MIXED SPECIES COMMON REED PRESENT	45	0.01	0	1	1	3	0	5
bh mix 12	6	MIXED SPECIES COMMON REED PRESENT	45	0.06	0	1	1	3	2	7
bh mix 17	7	MIXED SPECIES COMMON REED PRESENT	45	0.06	0	1	1	3	2	7
bh mix 19	8	MIXED SPECIES COMMON REED PRESENT	45	0.03	0	1	1	3	2	7
bh mix 23	9	MIXED SPECIES COMMON REED PRESENT	50	0.13	1	1	1	1	2	6
bh mix 24	10	MIXED SPECIES COMMON REED PRESENT	50	0.06	0	1	1	2	2	6
bh mix 37	11	MIXED SPECIES COMMON REED PRESENT	45	0.05	0	0	1	2	2	5
bh mix 39	12	MIXED SPECIES COMMON REED PRESENT	60	0.01	0	0	1	2	2	5
bh mix 40	13	MIXED SPECIES COMMON REED PRESENT	55	0	0	0	1	2	2	5
bh mix 42	14	MIXED SPECIES COMMON REED PRESENT	15	0.01	0	0	0	1	2	3
Bh mix 43	15	COMMON REED DOMINATED MARSH	90	0.04	0	0	2	1	2	5
bh mix 43	16	MIXED SPECIES COMMON REED PRESENT	20	0.01	0	0	0	1	2	3
bh mix 44	17	MIXED SPECIES COMMON REED PRESENT	20	0.1	0	2	1	3	2	8
bh mix 47	18	MIXED SPECIES COMMON REED PRESENT	35	0.04	0	2	1	3	2	8
bh mix 49	19	MIXED SPECIES COMMON REED PRESENT	55	0.01	0	0	1	2	2	5

Stand ID	Site Number	Cover Type	Invasive Cover %	Acres	Evaluation Criteria					
					Size	Access	Cover	Expansion	Sens. Hab	Priority Score*
bh mix 50	20	MIXED SPECIES COMMON REED PRESENT	25	0.03	0	0	0	3	2	5
bh mix 54	21	COMMON REED DOMINATED MARSH	75	0.08	1	0	2	3	2	8
bh mix 57	22	MIXED SPECIES COMMON REED PRESENT	45	0.02	0	1	1	2	2	6
bh mix 59	23	MIXED SPECIES COMMON REED PRESENT	60	0	0	1	1	2	2	6
bh mix 61	24	MIXED SPECIES COMMON REED PRESENT	50	0.02	0	0	1	1	1	3
bh mix 63	25	MIXED SPECIES COMMON REED PRESENT	0	0.14	1	0	0	3	2	6
bh mix 64	26	MIXED SPECIES COMMON REED PRESENT	0	0.05	0	1	0	3	0	4
bh mix 65	27	MIXED SPECIES COMMON REED PRESENT	15	0.01	0	0	0	3	2	5
bh mix 66	28	MIXED SPECIES COMMON REED PRESENT	30	0.02	0	1	0	2	1	4
bh mix 67	29	MIXED SPECIES COMMON REED PRESENT	20	0.07	0	1	0	1	2	4
bh mix 68	30	MIXED SPECIES COMMON REED PRESENT	20	0.02	0	1	0	2	3	6
bh phrag 01	31	COMMON REED DOMINATED MARSH	100	0.03	0	1	2	3	2	8
bh phrag 02	32	COMMON REED DOMINATED MARSH	100	0.12	1	1	2	3	2	9
bh phrag 03	33	COMMON REED DOMINATED MARSH	95	0.41	1	1	2	3	0	7
bh phrag 04	34	COMMON REED DOMINATED MARSH	100	0.05	0	1	2	3	2	8
bh phrag 06	35	COMMON REED DOMINATED MARSH	100	0.29	1	1	2	2	1	7
bh phrag 07	36	COMMON REED DOMINATED MARSH	85	0.08	1	1	2	2	1	7
bh phrag 08	37	COMMON REED DOMINATED MARSH	90	0.05	0	1	2	3	0	6
bh phrag 11	38	COMMON REED DOMINATED MARSH	90	0.01	0	1	2	2	0	5
bh phrag 13	39	COMMON REED DOMINATED MARSH	95	0.1	1	1	2	3	0	7
bh phrag 14	40	COMMON REED DOMINATED MARSH	95	0.1	1	1	2	2	2	8
bh phrag 15	41	COMMON REED DOMINATED MARSH	95	0.08	0	1	2	1	2	6

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

Stand ID	Site Number	Cover Type	Invasive Cover %	Acres	Evaluation Criteria					
					Size	Access	Cover	Expansion	Sens. Hab	Priority Score*
bh phrag 16	42	COMMON REED DOMINATED MARSH	90	0.31	1	1	2	2	2	8
bh phrag 18	43	COMMON REED DOMINATED MARSH	95	0.1	1	1	2	3	2	9
bh phrag 20	44	COMMON REED DOMINATED MARSH	75	0.07	0	1	2	3	1	7
bh phrag 21	45	COMMON REED DOMINATED MARSH	95	0.03	0	1	2	3	2	8
bh phrag 22	46	COMMON REED DOMINATED MARSH	95	0.07	0	1	2	0	0	3
bh phrag 25	47	COMMON REED DOMINATED MARSH	95	0.06	0	1	2	2	0	5
bh phrag 26	48	COMMON REED DOMINATED MARSH	90	0.08	0	1	2	0	0	3
bh phrag 27	49	COMMON REED DOMINATED MARSH	98	0.29	1	1	2	0	0	4
bh phrag 28	50	COMMON REED DOMINATED MARSH	100	1.64	2	0	2	3	2	9
bh phrag 29	51	COMMON REED DOMINATED MARSH	75	0.002	0	0	0	1	2	3
bh phrag 30	52	COMMON REED DOMINATED MARSH	0	0.002	0	1	0	1	2	4
bh phrag 31	53	COMMON REED DOMINATED MARSH	0	0.002	0	0	0	3	2	5
bh phrag 32	54	COMMON REED DOMINATED MARSH	0	0.002	0	0	0	3	2	5
bh phrag 33	55	COMMON REED DOMINATED MARSH	0	0.002	0	0	0	3	2	5
bh phrag 35	56	COMMON REED DOMINATED MARSH	0	0.002	0	0	0	3	2	5
bh phrag 35	57	COMMON REED DOMINATED MARSH	0	0.002	0	0	0	3	2	5
bh phrag 36	58	COMMON REED DOMINATED MARSH	95	0.25	1	1	2	3	2	9
bh phrag 38	59	COMMON REED DOMINATED MARSH	98	0.01	0	0	2	2	1	5
bh phrag 41	60	COMMON REED DOMINATED MARSH	85	0.01	0	0	2	2	2	6
bh phrag 45	61	COMMON REED DOMINATED MARSH	85	0.09	0	2	2	3	2	9
bh phrag 48	62	MIXED SPECIES COMMON REED PRESENT	70	0.14	1	0	1	3	2	7
bh phrag 51	63	COMMON REED DOMINATED MARSH	95	1.49	2	1	2	2	2	9

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

Stand ID	Site Number	Cover Type	Invasive Cover %	Acres	Evaluation Criteria					
					Size	Access	Cover	Expansion	Sens. Hab	Priority Score*
bh phrag 55	64	COMMON REED DOMINATED MARSH	98	0.46	1	0	2	3	3	9
bh phrag 60	65	COMMON REED DOMINATED MARSH	75	0.28	1	1	2	0	0	4
bh phrag 62	66	COMMON REED DOMINATED MARSH	80	0.03	0	1	2	2	0	5
bh phrag 69	67	COMMON REED DOMINATED MARSH	75	0.09	0	1	2	2	1	6

* Priority Score = (Size+Access+Cover+Expansion+Sens. Hab.)

APPENDIX E, TABLE 2. GROUP RANKING OF INVASIVE SPECIES POLYGONS

Stand ID	Site Number	Group	Group Rank	Priority	Acres
High Priority Sites (Phase I)					
bh knot 52	3	2	2.5	High	0.03
bh mix 61	24	1	3.5	High	0.02
bh mix 64	26	7	3.67	High	0.05
bh mix 67	29	15	4	High	0.07
bh phrag 22	46	16	3	High	0.07
bh phrag 26	48	7	3.67	High	0.08
bh phrag 27	49	7	3.67	High	0.29
bh phrag 29	51	8	4.57	High	0.002
bh phrag 30	52	8	4.57	High	0.002
bh phrag 31	53	8	4.57	High	0.002
bh phrag 32	54	8	4.57	High	0.002
bh phrag 33	55	8	4.57	High	0.002
bh phrag 35	56	8	4.57	High	0.002
bh phrag 35	57	8	4.57	High	0.002
bh phrag 60	65	1	3.5	High	0.28
bh phrag 62	66	2	2.5	High	0.03
			High Priority Sub-Total		**0.934**
Moderate Priority Sites					
bh mix 05	4	12	6.8	Moderate	0.16
bh mix 09	5	11	6.75	Moderate	0.01
bh mix 12	6	14	6.83	Moderate	0.06
bh mix 23	9	10	6.6	Moderate	0.13
bh mix 24	10	10	6.6	Moderate	0.06
bh mix 37	11	9	6.33	Moderate	0.05
bh mix 39	12	5	5.55	Moderate	0.01
bh mix 40	13	5	5.55	Moderate	0
bh mix 42	14	5	5.55	Moderate	0.01
Bh mix 43	15	5	5.55	Moderate	0.04
bh mix 43	16	5	5.55	Moderate	0.01
bh mix 54	21	5	5.55	Moderate	0.08
bh mix 57	22	5	5.55	Moderate	0.02
bh mix 59	23	5	5.55	Moderate	0
bh mix 65	27	5	5.55	Moderate	0.01
bh mix 66	28	12	6.8	Moderate	0.02
bh phrag 01	31	10	6.6	Moderate	0.03
bh phrag 02	32	11	6.75	Moderate	0.12
bh phrag 03	33	11	6.75	Moderate	0.41
bh phrag 04	34	12	6.8	Moderate	0.05

NEW YORK POWER AUTHORITY
NIAGARA POWER PROJECT (FERC NO. 2216)
BUCKHORN MARSH INVASIVE SPECIES ACTION PLAN

Stand ID	Site Number	Group	Group Rank	Priority	Acres
bh phrag 06	35	12	6.8	Moderate	0.29
bh phrag 07	36	12	6.8	Moderate	0.08
bh phrag 08	37	11	6.75	Moderate	0.05
bh phrag 11	38	14	6.83	Moderate	0.01
bh phrag 13	39	14	6.83	Moderate	0.1
bh phrag 14	40	14	6.83	Moderate	0.1
bh phrag 15	41	14	6.83	Moderate	0.08
bh phrag 16	42	14	6.83	Moderate	0.31
bh phrag 21	45	10	6.6	Moderate	0.03
bh phrag 25	47	10	6.6	Moderate	0.06
bh phrag 36	58	9	6.33	Moderate	0.25
bh phrag 38	59	9	6.33	Moderate	0.01
bh phrag 41	60	5	5.55	Moderate	0.01
bh phrag 55	64	5	5.55	Moderate	0.46
				Moderate Priority Sub-Total	**3.12**
Low Priority Site					
bh Ditch	1	6	7.25	Low	0.09
bh Ditch	2	6	7.25	Low	0.08
bh mix 17	7	13	7	Low	0.06
bh mix 19	8	13	7	Low	0.03
bh mix 44	17	4	7	Low	0.1
bh mix 47	18	4	7	Low	0.04
bh mix 49	19	4	7	Low	0.01
bh mix 50	20	4	7	Low	0.03
bh mix 63	25	6	7.25	Low	0.14
bh mix 68	30	13	7	Low	0.02
bh phrag 18	43	13	7	Low	0.1
bh phrag 20	44	13	7	Low	0.07
bh phrag 28	**50***	6	7.25	Low	1.64
bh phrag 45	61	4	7	Low	0.09
bh phrag 48	62	4	7	Low	0.14
bh phrag 51	63	3	9	Low	1.49
bh phrag 69	67	13	7	Low	0.09
				Low Priority Sub-Total	**4.22**
				Grand total	**8.274**

* This stand will be included in the High Priority Sites and treated during Phase 1.
This stand has easy access and obstructs views of the marsh from the trail.
It is also considered to be the original stand of Common reed in the marsh.