Smokes Creek Habitat Connectivity and Improvement Opportunity Assessment

New York State Office of General Services and the New York State Department of Environmental Conservation

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→ The Power of Commitment

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List of Terms and Acronyms

ACOE (USACE)	U.S. Army Corps of Engineers
Agricultural BMPs	practices that relate to conservation tillage, crop nutrient management, weed and pest management, and conservation buffers
ARA	Active River Area
BMP	Best Management Practice
channelization	straightening, narrowing, and deepening of a stream channel; often includes removal of debris and channel obstructions that may impede flow
creation	construction of a new habitat or ecosystem where it did not historically exist
enhancement	improving the quality of a habitat through direct manipulation
establishment	construction of a new habitat or ecosystem where it did not historically exist
floodplain	a flat depositional feature of a river valley adjoining the channel, the floodplain is formed by climate and hydrological conditions and is subject to periodic flooding
fluvial processes	associated with rivers and streams and the deposits and landforms created by sediments
forb	an herbaceous flowering plant other than a grass
headwaters	the source of a stream or river; located at the furthest point from where the water body empties or merges with another
HEC-RAS model	simulation software used in computational fluid dynamics – specifically, to model the hydraulics of water flow through natural rivers
hydric soil	soils that, in an undrained condition, are saturated, flooded, or ponded long enough during a growing season to develop an anaerobic condition that supports the growth and regeneration of wetland vegetation
incised channel	where the stream bed is deepened to a point where flow is no longer connected the surrounding floodplain but cuts through the stream bed, resulting in further erosion and instability
invasive	tending to spread especially in a quick or aggressive manner and is likely to cause economic or environmental harm
lateral connectivity	the periodic inundation of the floodplain and the resulting exchange of water, sediment, organic matter, nutrients, and organisms
level spreader	a level, graded area designed to slow and spread concentrated runoff and release it as sheet flow to a stabilized area

ACOE (USACE)	U.S. Army Corps of Engineers
longitudinal connectivity	the pathways along the entire length of a stream (upstream-downstream)
mesic forest	type of habitat with a well-balanced or moderate supply of moisture throughout the growing season
mesophytic forest	an ecoregion of the temperate broadleaf and mixed forests biome
NRU	Natural Resource Unit
NWI	National Wetland Inventory
NYNHP	New York Natural Heritage Program
NYRAM	New York Rapid Assessment Method for Wetlands
NYSDEC	New York State Department of Environmental Conservation
NYSOGS	New York State Office of General Services
ORV	Off-road vehicle
QHEI	Qualitative Habitat Evaluation Index
restoration	returning an ecosystem to its pre-disturbed condition
riparian	the banks of a river or the terrestrial aquatic interface that exerts a direct influence on stream channels or lake margins, and the water or aquatic ecosystems
SB	South Branch of Smokes Creek
SC	Main Branch of Smokes Creek
Stormwater Management	the process of controlling the storm runoff that comes primarily from impervious surfaces like parking lots, driveways, and rooftops
Stormwater Management BMPs	devices, practices, or methods that are used to manage stormwater runoff by controlling peak runoff rate, improving water quality, and managing runoff volume
streambank (bank) stabilization	practices that protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries to reduce erosion
succession	changes in species composition of plants and animals in an ecosystem with time, often in a predictable order
tributary	a stream or river that flows into another stream or river
watershed	entire land–drainage area of a river

1. Introduction

GHD Services, Inc. (GHD) was retained by the New York State Office of General Services (OGS) and the New York State Department of Environmental Conservation (DEC) to assist in the development of a comprehensive Smokes Creek Habitat Connectivity and Improvement Opportunity Assessment (Assessment). The goal of the Assessment was to identify and evaluate habitat restoration opportunities and flood mitigation alternatives to improve natural stream hydrology and habitat connectivity along the entire Smokes Creek corridor and an adjacent stretch of Lake Erie shoreline. The targeted project area included areas adjacent to and within the Smokes Creek mouth and mainstem, including the main and south branches of the Creek to their headwaters and the Lake Erie shoreline between Woodlawn Beach State Park and the Buffalo Outer Harbor.

The Assessment consisted of three phases of work: Phase 1 – Resource Inventory and Review, Phase 2 - Identification and Assessment of Potential Habitat Connectivity and Improvement Alternatives, and Phase 3 - Potential Habitat Opportunities Strategy. This report contains the comprehensive results of all three Phases of the Assessment along with associated maps, photos, figures, tables, and appendices.

2. Phase 1 – Resource Inventory & Review

GHD conducted a desktop review of existing data that was previously collected within the Smokes Creek watershed. After reviewing the available information, GHD biologists participated in a field visit with members from OGS and DEC on May 17th and 18th, 2022. The field visit was comprised of various stops along Smokes Creek from public and private locations to observe the condition of the waterway and associated riparian areas. Following the field visit, GHD coordinated virtual meetings with four (4) local municipality leaders within the Smokes Creek watershed (City of Lackawanna, Town of Hamburg, Town of West Seneca, and Town of Orchard Park) to notify leaders of this Assessment, and to request any municipality-specific data or input on any areas concern for incorporation into GHD's Assessment. Moving into Phase 2, GHD identified data gaps needing to be filled to identify stressors on the watershed and to develop habitat connectivity strategies.

2.1 Smokes Creek Assessment Framework

The Assessment incorporated a watershed-scale framework that integrates multiple habitat and stressor assessment methods. GHD divided the project area into land management units (Natural Resource Units; NRUs), which generally correspond to the sub-watershed boundaries of Smokes Creek (SC) and South Branch Smokes Creek (SB), that were used as the geographic framework for this Assessment. Overlapping with the NRUs is the Active River Area (ARA), which is a spatially driven approach to identify the functional riparian corridor of SC and SB. The following describes how the NRUs and the ARA were developed and used for this Assessment.

2.2 Natural Resource Units

NRUs are geographically based land units that combine watershed, land use and other physical features, such as roads. NRU boundaries were developed from the National Hydrography Dataset (NHD), Great Lakes Stream Basins (GLSB), DEC stream layer, Light Detection and Ranging (Lidar) elevation data and aerial imagery. The NRU boundaries correspond to watershed catchment areas of approximately 500 acres. Lidar contour data, aerial imagery and stream layers were used to refine NRU boundaries to better match topographic divides and NHD boundaries and then were further adjusted to reflect current land use. Each NRU contains a unique stream reach and corresponding ARA. The NRUs provide a geographic framework for evaluating aquatic and terrestrial resources on a sub-watershed scale and for identifying and prioritizing strategies to address watershed stressors.

2.3 Active River Area

The ARA, originally developed by The Nature Conservancy (Smith et. al., 2008), encompasses floodplains, river terraces, riparian wetlands, meander belts and critical contribution zones of the stream corridor. The modeled ARA for the Erie Basin was used for this assessment to identify the riparian corridor for SC, SB, and their respective tributaries. In some cases, the modeled ARA boundary bisects floodplain forests and other features that are contiguous with SC or SB. To fully encompass significant natural resources that are contiguous with SC, SB, and their respective tributaries, an ARA Priority Buffer was created. The ARA Priority Buffer extends 300 feet around the outside boundary of the ARA and surrounding wetlands and natural communities that abut the ARA. The rationale for expanding the ARA in this way is that management of wetlands and forested areas can best be accomplished based on the actual boundaries of wetlands and/or natural communities. This may also serve as a geographic framework for identifying protection strategies that are correlated to the ARA or the ARA Priority Buffer. The location of the SC/SB watershed, NRU boundaries, and ARA is shown on Figures 1 through 3.

3. Phase 2 – Identification and Assessment of Potential Habitat Connectivity and Improvement Alternatives

The Phase 2 assessment was completed to fill identified data gaps and to lay the groundwork for identification of habitat connectivity and improvement alternatives. Phase 2 field work was completed July 31 through August 3, 2023, and included three key data components: instream habitat, wetland condition, and natural community type and quality. Prior to conducting the Phase 2 field work, a desktop review of spatial data was completed for each NRU. This review identified SC/SB stream reaches, wetlands and terrestrial/aquatic natural communities. For the lower-most reach of Smokes Creek, a geomorphic assessment was completed. The following describes the methodologies for each of these components.

3.1 Qualitative Habitat Evaluation Index (QHEI) Stream Assessment

GHD used available spatial data and aerial imagery to pre-select representative stream reaches for in-field data collection. At least one (1) location was selected in each NRU that was representative of that NRU. In NRUs with major differences in stream type or condition (e.g., area of channelization or significant changes in adjacent land use), two representative stream reaches were identified. GHD biologists used the Qualitative Habitat Evaluation Index (QHEI) methodology (Ohio EPA, 2001) to conduct the in-stream habitat assessment.

The QHEI assessment metrics include:

– substrate
– in-stream cover
– channel morphology
– riparian zone and bank erosion
– pool/glide and riffle/run quality
– watershed size vs. gradient

Collectively and individually, these metrics characterize habitat quality and are summed for a comprehensive QHEI score. The QHEI score can then be used to assign a narrative stream habitat qualitative rating (very poor, poor, moderate, good, excellent). QHEI Stream Reaches are shown in Figures 4.1 through 4.12.

3.2 NY Rapid Assessment Method (NYRAM) for Wetlands

GHD reviewed National Wetland Inventory (NWI) maps, hydric soils maps, elevation contours, and aerial imagery to delineate wetland areas within each NRU. Wetlands less than two (2) acres, artificial ponds, and impoundments were excluded from the assessment. The two-acre minimum size threshold focused available project resources on larger, generally higher quality wetland features. Although artificial ponds and impoundments may include small areas of incidental wetland, these features were not mapped as wetland and were excluded from the assessment. GHD used the New York Rapid Assessment Method (NYRAM; Shappell et. al. 2016) to evaluate wetland condition and identify stressors. The NYRAM assigns a condition rating calculated by summing points assigned to observed stressors within the wetland as well as a 540-meter field buffer. The NYRAM also includes a wetland condition rating that considers the level of disturbance within the wetland. The combined condition rating and stressor scores are summed to generate the NYRAM score.

It is important to note that NYRAM scores measure stressors on the wetland, and although the ecological condition of the wetland is considered as part of the condition rating, the stressor scores can lower the overall NYRAM score. For example, high quality wetlands that have significant development in the 540-meter field buffer may have a lower condition rating, while low quality wetlands with an undeveloped field buffer may have a higher condition rating than might be expected, if only the quality of the wetland alone is considered. The Natural Community Assessment, which includes wetland communities, provides a better measure of wetland quality.

The NYRAM assessment was completed on all wetlands within or adjacent to the ARA, unless limited by access, in which case a desktop review NYRAM was performed. The Natural Community Assessment described below provides additional detail on wetland community type and condition and was used to supplement the NYRAM assessment. Wetlands that were evaluated with the NYRAM are shown in Figures 5.1 through 5.12.

3.3 Natural Community Assessment

GHD used aerial imagery to delineate terrestrial and wetland communities/habitat. Areas with residential, commercial, or agricultural land uses or areas with recent disturbance were excluded from this assessment. GHD biologists classified the natural communities in accordance with the methods described in *Ecological Communities of New York State* (Edinger, et al., 2014). The natural community assessment included identifying dominant plant species in each stratum (canopy, shrub, herbaceous), structural elements (e.g., age, size class of trees), physiographic features, human disturbance, and invasive species. This assessment data was used to assign an element occurrence ranking that reflects the condition quality of the natural community. The natural community assessment was completed on terrestrial and wetland communities within or contiguous with the ARA unless limited by access, in which case a desk review to identify natural community type and quality was performed.

3.4 Geomorphic Assessment of SC Estuary and Shoals

GHD completed a pedestrian survey of lower SC including the channelized lower-most reach, the mouth at Lake Erie and the nearshore areas of Lake Erie adjacent to the mouth. GHD completed a desk review of lower SC and SC estuary including records of dredging, historic water level data and geotechnical information. The review also included the extent of past flooding events and the frequency and magnitude of dredging activities. As part of this assessment, the SC HEC-RAS model was reviewed to gain an understanding of flood issues, instream velocities, and suitability of model for evaluating or developing improvement opportunities.

4. Phase 2 Results

The results of the QHEI, NYRAM and Natural Community Assessment are summarized on NRU Summary Sheets provided in Appendix A. The Summary Sheets include the following: narrative description of key NRU elements; percent breakdown of NRU land use; QHEI, NYRAM and Natural Community maps and ratings; stressor identification

matrix; and potential opportunities for habitat connectivity and watershed improvement. The results that follow provide a high-level summary of each assessment parameter. For more detailed and site-specific information, refer to the applicable NRU Summary Sheet.

4.1 QHEI Stream Habitat Assessment

GHD completed QHEI assessments on 33 stream reaches (see Figures 4.1 through 4.12). Total QHEI scores ranged from 72.25 to 27.5, with an average score of 56.9. The count of reaches and their respective QHEI scores and narrative ratings is presented in Table 1. The reach count by QHEI score and narrative rating indicates that 70% of SC and SB, above their confluence, have a narrative rating of good or excellent.

With few exceptions, the highest quality reaches are in non-headwater portions of the upper reaches and tributaries of SC and SB. Instream habitat in the headwater reaches ranges from good to poor with habitat in the upper-most headwaters of SC and SB limited by intermittent streamflow. The remaining upper reaches of SC and SB (generally north of Powers Road) receive significant groundwater inputs from seeps and groundwater-dependent wetlands, contain a good diversity of substrates, and have forested riparian corridors. Groundwater inputs to SC and SB occur where the stream valley has down cut through till or beach deposits to Angola Shale, Cashaqua Shale and West River Shale bedrock. These bedrock deposits consist of shale, limestone, siltstone, and mudstone and are the dominant substrates in many SC and SB reaches above Highway 20 and Milestrip Road. The lower reaches of SC and SB are generally lower quality due to channelized or partly channelized reaches, entrenched channels with embedded substrate, eroded streambanks, and discontinuous and/or low-quality riparian corridors. As noted, there are exceptions. Several reaches in lower SC and SB flow through undeveloped floodplain and have excellent in-stream habitat. As noted in the discussion on groundwater inputs, some upper reaches flow continuously over bedrock and are referred to in this report as silt-stone limited. Siltstone-stone limited reaches often lack quality pool and riffle habitat since substrate is limited to scoured siltstone. Additional exceptions apply to the many road crossings where debris jams form on the upstream side of crossings creating large areas of scour and bank erosion. Refer to NRU summaries for a more detailed description of QHEI ratings and stream habitat condition.

Table 1 Breakdown of QHEI narrative scores and number of reaches in each rating group.

Narrative Rating		QHEI Range	Reach Count
Excellent		≥ 70	2
Good		55 – 69	21
Fair		43 – 54	5
Poor		30 – 42	4
Very Poor		< 30	1

4.2 NYRAM Wetland Assessment

GHD completed NYRAM assessments on 67 wetlands within the ARA and ARA Priority Buffer (see Figures 5.1 through 5.12). The count of wetlands and their respective NYRAM scores and stressor ratings is presented in Table 2. Total NYRAM scores ranged from 19 to 89, with an average score of 66. None of the assessed wetlands received a stressor rating of excellent and almost half of the wetlands received a stressor rating of very poor. Wetlands with the best stressor rating were generally located within or adjacent to large contiguous blocks of forest with limited urban development in the field buffer. These wetland communities generally consisted of diverse hardwood swamp communities in upper SC or SB. Wetlands with lower stressor ratings are impacted by invasive species, stormwater inputs, encroachment from adjacent land uses, and habitat fragmentation within the wetland buffer and the field buffer.

Table 2 Breakdown of NYRAM narrative scores and number of wetland areas in each rating group

NYRAM Stressor Rating	NYRAM Range	Wetland Count
Excellent	< 14	0
Good	< 38	7
Fair	38 – 53	12
Poor	> 53	15
Very Poor	> 70	33

4.3 Natural Community Assessment

GHD assessed 173 areas of natural communities within the ARA and ARA Priority Buffer (see Figures 6.1 through 6.12). Each natural community was assigned a condition rank based on observed ecological integrity, as defined in *The Ecological Communities of New York State* (Edinger et al., 2014). The condition ranks are coded symbolically in Table 3.

Natural communities that were identified include beech-maple forest, rich mesophytic forest, successional southern hardwoods, floodplain forest, red maple hardwood swamp, silver maple-ash swamp, shallow emergent marsh, shrub swamp and rich fen. Rich fen communities occur as small inclusions along valley slopes at edges of hardwood swamps and floodplain forests and were not mapped due to their small size. The natural community rating in upper SC and SB ranged from fair to good with three areas ranked as excellent. The natural communities in lower SC and SB are dominated by floodplain forest scrub-shrub, old field and successional southern hardwood communities and generally have a poor to fair rating. Observed natural community stressors include historic logging, fragmentation, invasive plant species, dumping, and misuse of natural areas.

Table 3 Breakdown of natural community narrative scores and number of areas in each ranking group

Narrative Rating	Condition Rank	Area Count
Excellent	A – Little to no human disturbance	3
Good	B – Lightly disturbed	28
Fair	C – Strong disturbance	78
Poor	D – Severely disturbed	64

Invasive species prevalence is strongly correlated with poor NYRAM and natural community ratings. In upper SC and SB, larger areas of contiguous natural communities generally had the lowest number and density of invasive species. While in the lower SC and SB, where natural communities are smaller in size and often fragmented, invasive species often dominated the shrub and herbaceous strata. The lower-most channelized reaches of SB and SC have the highest prevalence of invasive species, with Japanese Knotweed approaching 100% coverage in some areas.

Table 4 lists invasive species identified in SC and SB, including primary habitat type and whether the species is classified as prohibited in New York State (NYS). Note that other invasive species, not listed in Table 4, are likely present in adjacent urban and agricultural areas.

Table 4 Invasive Species Documented in SC and SB

Common Name	Scientific Name	Habitat*	NYS Part 575 Status
Tree and Shrub Species			
Autumn Olive	*Elaeagnus umbellata*	U	Prohibited
Common Buckthorn**	*Rhamnus cathartica*	U	Prohibited
English Ivy	*Hedera helix*	U	-
Privet	*Ligustrum obtusifolium*	U	Prohibited
Glossy Buckthorn**	*Frangula alnus*	W	Prohibited
Honeysuckle Shrub**	*(L. morrowii, L. maackii, L. tatarica)*	U	Prohibited
Honeysuckle Vine	*Lonicera japonica*	U	Prohibited
Japanese Barberry	*Berberis thunbergii*	U	Prohibited
Multiflora Rose**	*Rosa multiflora*	U	Prohibited
White Mulberry	*Morus alba*	U	-
**Primary habitat type: U=upland; W=wetland* ***Widespread occurrence*			
Herbaceous Species			
Birdsfoot trefoil	*Lotus corniculatus*	U	-
Canada Thistle**	*Cirsium arvense*	U	Prohibited
Creeping Jenny**	*Lysimachia nummularia*	W	-
Crown Vetch	*Securigera varia*	U	-
Garlic Mustard	*Alliaria petiolata*	U	Prohibited
Hybrid Cattail**	*Typha x glauca*	W	-
Japanese Knotweed**	*Reynoutria japonica*	U	Prohibited
Japanese Stiltgrass**	*Microstegium vimineum*	W	Prohibited
Mugwort**	*Artemisia vulgaris*	U	Prohibited
Phragmites**	*Phragmites australis*	W	Prohibited
Purple Loosestrife	*Lythrum salicaria*	W	Prohibited
Spotted Knapweed	*Centaurea steobe*	U	Prohibited
Yellow Iris	*Iris pseudacorus*	W	Prohibited
**Primary habitat type: U=upland; W=wetland* ***Widespread occurrence*			

4.4 Lower SC Estuary and Shoals

GHD completed a review of Lower SC from the Hamburg Turnpike (Highway 5) to Lake Erie to explore potential opportunities for improvement to channelized reaches, estuary and near shore areas adjacent to the estuary of SC. The purpose of the review was to explore potential opportunities for improvement to the fluvial system. The evaluation included the following:

– Review of available models
– Review of existing fluvial geomorphic processes
– Improvement recommendations

GHD's detailed report is included in Appendix B.

5. Phase 2 – Data Evaluation and Stressor Identification

GHD reviewed the data compiled for each NRU and identified stressor categories that may impact the ecological integrity of instream and riparian habitat. Within each category, key stressors that were directly or indirectly observed are listed. GHD notes that best management practices, such as stormwater treatment, may be effectively implemented at the local level, yet unmanaged stormwater is still listed as a stressor due to the cumulative impacts of upstream sources. GHD also explored the potential to create or enhance recreational opportunities throughout the watershed. While the Implementation Plans conceived during Phase 3 include some elements for public education (e.g. increasing educational signage or hosting volunteer days to implement projects), GHD did not discover any obvious locations to create new recreational opportunities nor were any locations brought up during Phase 1 municipality meetings. GHD recommends requesting public input during the stakeholder engagement portion of Phase 3.

A summary of stressor categories and associated key stressors is presented in Table 5. A listing of stressors, specific to each NRU, is provided on the NRU Summary Sheets (Appendix A).

Table 5 Stressor Identification

Stressor Category	Stressors	
Hydrology	IFM	Baseflow
	HSF	High/Stormflows
	USW	Unmanaged Stormwater
	S/GWI	Impacts to Surface/Groundwater Interaction
Structures	SO	Stormwater Outfall
	BCC	Bridge/Culvert Crossing
Water Quality	USD	Untreated Stormwater Discharge
	TU	Visual Turbidity
	TH	Lack of Thermal Protection
Geomorphic	SE	Streambank Erosion
	ENT	Entrenchment
	CH	Channelization
	DF	Disconnected Floodplain
Instream Habitat	S/E	Siltation/Embeddedness
	RD/Q	Poor Riffle Development/Quality
	PD/Q	Poor Pool Development/Quality
	W/VC	Lack of Woody/Vegetative Cover
	SSL	Siltstone Limited
Riparian Habitat	BW/Q	Poor Buffer Width/Quality
	IN	Invasive Species
	LUE	Land Use Encroachment
	CON	Lack of Corridor Connectivity

5.1 NRU Summaries

One-page, easy reference summaries for each NRU have been developed to summarize current conditions, results of stream, wetland and natural community assessments, stressor assessment, and potential opportunities (Appendix A).

6. Phase 3 – Potential Habitat Opportunities Strategy

6.1 Opportunities Assessment

A broad range of measures were assessed to address stressors identified in Phase 2, improve fish and wildlife habitat, enhance public access and environmental awareness, and foster an understanding of the unique ecological features in the Smokes Creek Watershed. Should an entity choose to move forward with implementing a recommended opportunity, the projects will need to comply with applicable local, state, and federal floodplain and land use zoning ordinances and for lower SC and SB, restrictions for work within the ACOE flood control project area.

Opportunities considered as part of Phase 3 included:

- Restore drained wetlands, re-meander channelized reaches and create riparian corridors in headwater areas of watershed.
- Address barriers (bridge crossings, culverts, etc.) that hinder geomorphic processes and fish and wildlife movement between high-quality resource areas.
- With a focus on gaps between high value resource areas, establish and/or improve width and quality of riparian corridors.
- Protect critical groundwater recharge/discharge areas and groundwater-dependent natural communities.
- Create model riparian buffer detail for residential and commercial properties that includes guidance on minimum width, species selection, invasive species control and strategies to limit human impact.
- Landowner education and outreach that includes explanation and examples of best management practices (urban, stormwater, and agricultural).
- In lower watershed, identify and implement comprehensive ecosystem restoration projects that restore instream geomorphic processes, reconnect floodplains, and restore native plant communities.
- Where adjacent land uses limit options for more comprehensive stream and riparian corridor restoration, implement instream habitat improvements that partially restore geomorphic processes and that mitigate poor habitat and thermal impacts though enhancement of riparian corridor.
- Restore Smokes Creek estuary through channel modifications, coastal wetland restoration and re-establishment of natural communities.
- Brownfield reclamation and redevelopment of Mainstem SC may provide opportunities to restore coastal natural communities and enhance connections between ecosystem restoration efforts in SBL3 and the shoreline of Lake Erie.
- The status of existing brownfields and land along the rail corridor should be evaluated to identify areas that can serve as ecological and community links between other natural areas and neighborhoods.

Based on the results of Phase 1 and Phase 2, opportunities to improve the riparian corridor along the Creek were identified and evaluated based on habitat and species benefits, flood mitigation potential and other co-benefits such as public engagement, recreational access, and water quality improvement. GHD established six main goals for restoration, each with associated strategies to achieve the goal. The restoration goals and strategies are presented in Table 6.

Table 6 Restoration goals and strategies

Goal	Key Strategies
Maintain or Restore Hydrologic Functions (reduce peak flow rates and provide for consistent baseflow)	Urban stormwater volume and rate control
	Wetland restoration/creation
	Protect/restore groundwater-dependent resources
	Replace direct stormwater discharges with infiltration or retention basins that regulate rate and volume of discharge to pre-development levels
	Re-establish floodplain connectivity
	Increase culvert sizes where feasible
Maintain or Restore Water Quality (nutrients, sediment, chloride, thermal, etc.)	Urban (residential/commercial/industrial) stormwater treatment
	Replace direct stormwater discharges with infiltration or retention basins that regulate rate and volume of discharge to pre-development levels
	Agricultural best management practices
	Wetland restoration/creation
	Riparian buffers (increase width and quality)
	Restore/enhance riparian canopy
Restore Longitudinal and Lateral Connectivity of SC and SB	Re-establish floodplain connectivity on aggraded/entrenched reaches
	Remove fill, structures, and constrictions (such as undersized culverts and bridge crossings) within floodplain
	Where feasible, remove dams, artificial levees, trails, and roads that block lateral movement of water; alternatively, mitigate impacts of these features through increased hydraulic capacity of culverts through these barriers
	Expand riparian buffers to limits of floodplain where possible
	Improve quality of riparian buffers through management of invasive species and restoration of natural communities
	Bank stabilization
	Instream habitat improvements
Protect and enhance wetland communities within the ARA	Wetland buffer standards/ordinances
	Apply land conservation tools to protect high quality examples of floodplain forest, red-maple hardwood swamp, silver maple-ash swamp, rich fen, and shrub swamp wetland communities
	Invasive species control (within wetlands and wetland buffers)
	Maintain/restore wetland hydroperiod (urban stormwater rate and volume control).
	Restore hydrology to ditched/tiled headwater wetlands
	Restore lateral, overbank flow to floodplain of SC/SB
	Control incompatible uses (e.g., dumping, ATV/bike trails, etc.
Protect and enhance upland natural communities within the ARA	Apply land conservation tools to protect high quality examples of beech-maple, maple-basswood, rich mesophytic forest communities
	Invasive species control
	Control incompatible uses (e.g., dumping, ATV/bike trails, etc.)
Expand public access opportunities and environmental awareness	Where compatible with resource protection, integrate public engagement and access into habitat improvement and connectivity projects

Goal	Key Strategies
	Develop locally based neighborhood stewardship plans that engage residents and provide focal point to communicate actions that residents can take to protect/improve habitat
	Develop resource protection templates that include techniques to mitigate stormwater and invasive species; planting/seeding species and practices, and guidance on co-existing with ARA

6.2 Implementation Plan

Utilizing the collected data and existing resources, GHD created an Implementation Plan for the Smokes Creek watershed (Figures 7 and 7.0-7.24. The Implementation Plan includes three key components:

– **Focus Areas:** Key areas of public land-private land with multiple project components, that when implemented, benefit not only the focus area itself, but other areas of the watershed.
– **Riparian Buffer Areas:** Stream reaches that lack viable riparian buffer. The Riparian Buffer Areas identify where landowners and local units of government can concentrate efforts towards implementing the three-zone buffer framework, which provides a flexible, yet effective approach to establishing, protecting and maintaining riparian buffers.
– **Conservation Areas:** Ecologically significant areas that may be targeted for protection. Conservation Areas can be protected with a broad range of land protection tools guided by site specific stewardship plans.

The following sections describe the implementation framework for Focus Areas, Riparian Buffer Areas, and Conservation Areas. These sections are followed by an overview of stakeholder outreach and regulatory considerations that will need to be addressed for focus area and riparian buffer establishment projects.

6.2.1 Focus Areas

GHD identified thirteen (13) Focus Areas, totaling 780-acres, which are geographically dispersed between the headwaters and mouth of SC. The potential for habitat enhancement exists throughout the watershed, however, GHD selected these specific locations due to their combination of addressing restoration goals and overall feasibility for implementation. The following criteria were applied in selecting focus areas:

– Proximity to ARA and ARA Buffer (focus areas are generally located within ARA/ARA Buffer)
– Proximity to high quality natural communities
– Large tracts of public/private land (land ownership determined with GIS data “NYS_Tax_Parcels_Public” from the NYS GIS Clearinghouse)
– Public land including parks, school property, dedicated land along creek, etc.
– Drained hydric soils, wetlands and channelized reaches of SC/SB and tributaries
– Within mapped floodplain
– Redevelopment projects (such as Bills Stadium, Tecumseh, etc.)
– Potential of project to establish connectivity to other natural resources

Focus areas that include wetland restoration were selected based on the presence of hydric soils and hydrologic alterations that could include ditching, topographic alterations, and potential presence of subsurface drainage systems. Wetland restoration sites that have the potential to provide instream flow and water quality benefits such as baseflow attenuation, peak flow reduction and nutrient/sediment load reduction were given additional consideration.

As-built constructed drawings of the *Local Flood Protection Smokes Creek at Lackawanna, New York* (ACOE 1965) and the *Operation and Maintenance Manual for Local Flood Protection Project on Smokes Creek at Lackawanna, New York* (ACOE 1972) were reviewed to identify Focus Areas that are within or adjacent to the U.S. Army Corps of Engineers Flood Control Project. Conceptual projects within the limits of the Smokes Creek Flood Protection Project

will require Article 16 Flood Control Land Use Permits from the New York State Department of Environment Conservation and Section 408 Permissions from the U.S. Army Corps of Engineers. Project Integrity and Unimpeded Access for project Operation & Maintenance are requirements for issuing an Article 16 Flood Control Land Use Permit and may also require hydraulic analyses. Smokes Creek Flood Protection Project "As-Built" Drawings (ACOE 1965), Real Estate Key Maps (Erdman & Anthony Consulting Engineers 1966), and the project's O&M Manual (ACOE 1972) should be utilized during project planning.

GHD completed a desktop site assessment of each Focus Area with respect to soils, hydrology, geomorphology, vegetation, and land use to develop conceptual implementation plans. The implementation plans describe ecological restoration and enhancement measures, instream improvements, streambank stabilization and other actions specific to each Focus Area. Estimated planning, design and construction costs are provided for each Focus Area with costs broken out by subarea or project type within the focus area. The Focus Area Implementation Plans can be found in Appendix C. There are several additional resources that are referenced in the Focus Area Implementation Plans and the Sections that follow:

– Instream Treatment Alternatives (Appendix D): This appendix provides standard construction details and specifications on practices recommended in the Focus Areas.
– NY Natural Heritage Program – Natural Community Guides (Appendix E): This appendix includes natural community fact sheets that describe ecological characteristics including species composition, physiographic features, management guidelines.
– Riparian Buffer Guidance (Appendix F) – This guidance document describes the three-zone buffer framework as adapted for the Smokes Creek Watershed.

6.2.2 Riparian Buffer Areas

GHD identified reaches of SC and SB where the riparian corridor is not of sufficient width, is discontinuous, or is impacted by various stressors that may include invasive species, stormwater discharges or human activity. Forty-two (42) reaches, totaling over eleven miles, were identified, and are shown in Figure 7 and the associated NRU Implementation Plans in Figures 7.0-7.24. The three-zone buffer guidance identified in the DEC's Stormwater Design Manual (NYSDEC, 2022), with some modifications, is recommended as a flexible framework to guide creation and enhancement of riparian buffers and is described in Appendix F. The three-zone buffer guidance can be implemented by individual landowners, homeowner's associations or on land owned by, or controlled by local units of government. This guidance can also be implemented on new and existing development through local zoning ordinances and stormwater management standards.

6.2.3 Conservation Areas

Conservation Areas are broadly defined in this document as ecologically significant blocks of land that contain one or more high quality natural communities; support unfragmented "interior" forest habitat; and/or, include high quality riparian habitat. Conservation Areas identified in Smokes Creek are:

– Unfragmented natural communities that are 40-acres or more in size;
– Located within ARA or ARA Priority Buffer; and
– A significant component of the area includes a natural community with a qualitative rating of good or excellent.

Using these criteria, GHD identified 2,060-acres of mostly forest land on fourteen (14) separate tracts. These areas are intended as a starting point for identifying Conservation Areas. Additional areas that may be designated as Conservation Areas include groundwater-dependent wetland communities, areas with unique habitat or rare features, and focus areas after ecological restoration is implemented. A broad range of land protection tools is available to protect Conservation Areas and could include purchase of fee title, conservation easements, low impact development design, and zoning ordinances. A number of these areas are already afforded some level of protection since they may include wetlands that are protected under New York's Freshwater Wetlands Act. Starting in 2028 the Freshwater Wetlands Act may protect wetlands 7.4 acres in size and greater (current threshold is 12.4-acres). Class I wetlands, or

wetlands of “unusual importance” may be regulated regardless of size. The location of Conservation Areas is shown Figure 7 and the associated NRU Implementation Plans in Figures 7.0-7.24.

6.2.4 Consistency with Local, State and Federal Requirements

The recommendations provided in the Implementation Plan are conceptual and subject to public and private landowner approval. Engagement with affected landowners and community representatives will be a first step towards implementing any of the recommendations provided herein. Focus Area and Riparian Buffer Area projects will generally require further feasibility analysis and design that may include boundary and topographic surveys, ecological assessments, hydrologic and hydraulic analyses, and engineering/landscape design. Local, state, and federal permits may be required and any project within the limits of the Smokes Creek Flood Protection Project will require Article 16 Flood Control Land Use Permits from NYSDEC and Section 408 Permissions from the U.S. Army Corps of Engineers. Project Integrity and Unimpeded Access for project Operation & Maintenance are requirements for issuing an Article 16 Flood Control Land Use Permit. In addition, projects located within a mapped floodway and/or floodplain may require local floodplain permits. As noted in Section 6.2.3, protection and enhancement of conservation areas will require engagement with affected landowners and the local community.

7. Summary

A fundamental tenant of ecological restoration, stated in the Active River Area Conservation Framework (Smith, et al., 2008), is “*the ultimate source of failure of many restoration projects is likely the result of the continued absence of natural processes and associated disturbance regimes after project implementation. The projects have tried to fix a symptom of the problem, rather than the cause of the problem.”* Keeping this in mind, our review of focus areas, riparian buffer areas and conservation areas prioritizes projects that address root causes, are sustainable, and address key stressors on terrestrial and aquatic resources within the Smokes Creek ARA. Project screening also includes other feasibility factors such as land ownership and estimated implementation costs. The criteria identified for project screening are summarized in Table 7. It is acknowledged that some of these criteria can be difficult to measure and/or are subjective.

Table 7 Project Screening & Prioritization

Criteria	Evaluation
Land Ownership	Sites under existing public ownership are prioritized. Private land may be considered with preference for single landowner where possible. Projects with multiple landowners may be difficult to implement.
Address Root Cause	Does project remove or mitigate key stressors (e.g., stormwater rate/volume, riparian corridor encroachment, invasive species, etc.)?
Proximity to Conservation Areas	Is project within or adjacent to identified high quality terrestrial or aquatic resource that is identified as a conservation area?
Mitigation of Corridor Gaps	Does the project create new connectivity or enhance existing connections between otherwise fragmented natural resource features?
Public Access and Uses	Does project provide new access, improve existing access, or provide new opportunities for community engagement?
Sustainability	Assuming long term monitoring and maintenance can be provided, is the project expected to deliver long term ecosystem services?
Cost	What is the relative cost of the project when weighed against the benefits provided?

Following DEC and OGS review of this document, GHD will present findings to the PAC and other key stakeholders via virtual meetings, to be coordinated by DEC. GHD will work with the project team to incorporate all PAC and public comments and produce a public-friendly Final Assessment Report.

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Appendices

Appendix A

NRU Summaries and Opportunities Strategies

SMOKES CREEK

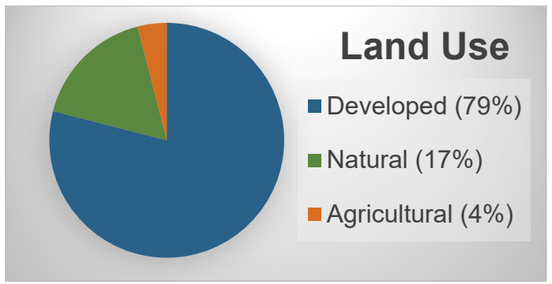
Natural Resource Unit
Smokes Creek Lower 5 (NRU SCL5)

City of Lackawanna
Size: 211.06 acres
Stream length: 1.3 miles

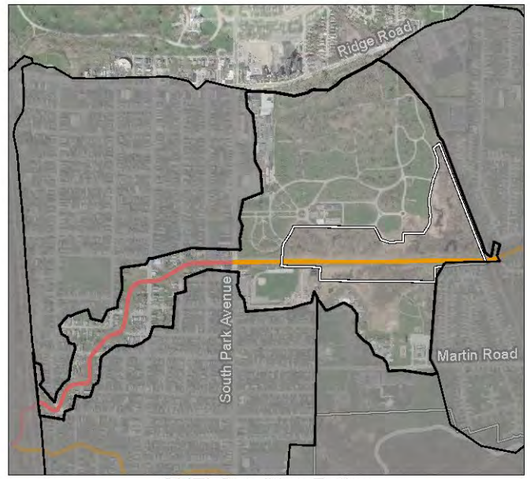
Key Elements

Smokes Creek flows within a constructed channel measuring approximately 150 feet x 10 feet. The riparian corridor ranges from only the vegetated channel slopes to adjacent areas that are a mixture of open space, forested/emergent wetland and successional forest.

Adjacent natural communities are poor to fair quality floodplain forest that is no longer hydraulically connected to stream. Instream habitat is poor to very poor due to channelized condition.



Assessment Overview



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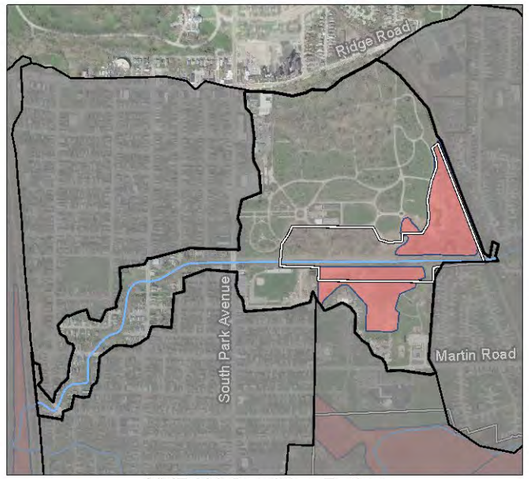

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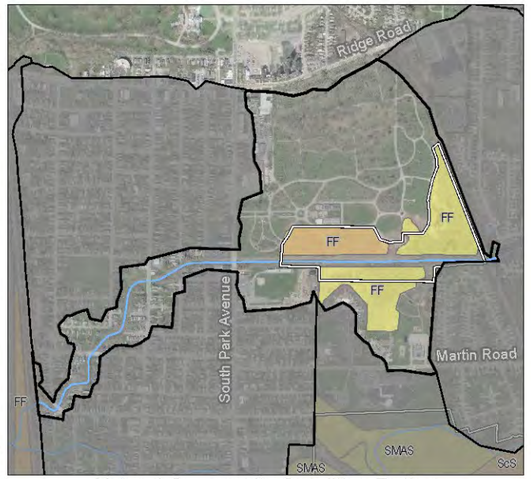


Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of Thermal Protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality, Aquatic Barrier
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Land owned by the City of Lackawanna along either side of channel should be focus of management efforts that include alternatives to partially restore channel and floodplain connectivity where adjacent land ownership and site conditions meet project feasibility requirements;
- Evaluate alternatives that partially restore bankfull geomorphic processes and instream habitat;
- Establish native vegetation within constructed channel and manage for invasive species on adjacent forest, wetland and early successional communities;
- A portion of the NRU is located within Galanti Park which may allow for a potential project (stormwater control, wildlife corridor, invasive species control, public education, etc.).

SMOKES CREEK

Natural Resource Unit
South Branch Lower 3 (NRU SBL3)

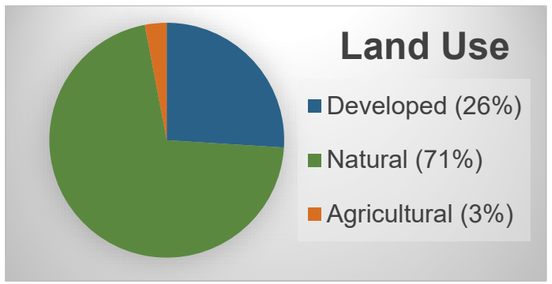
City of Lackawanna
Size: 265.45 acres
Stream length: 0.8 mile

Key Elements

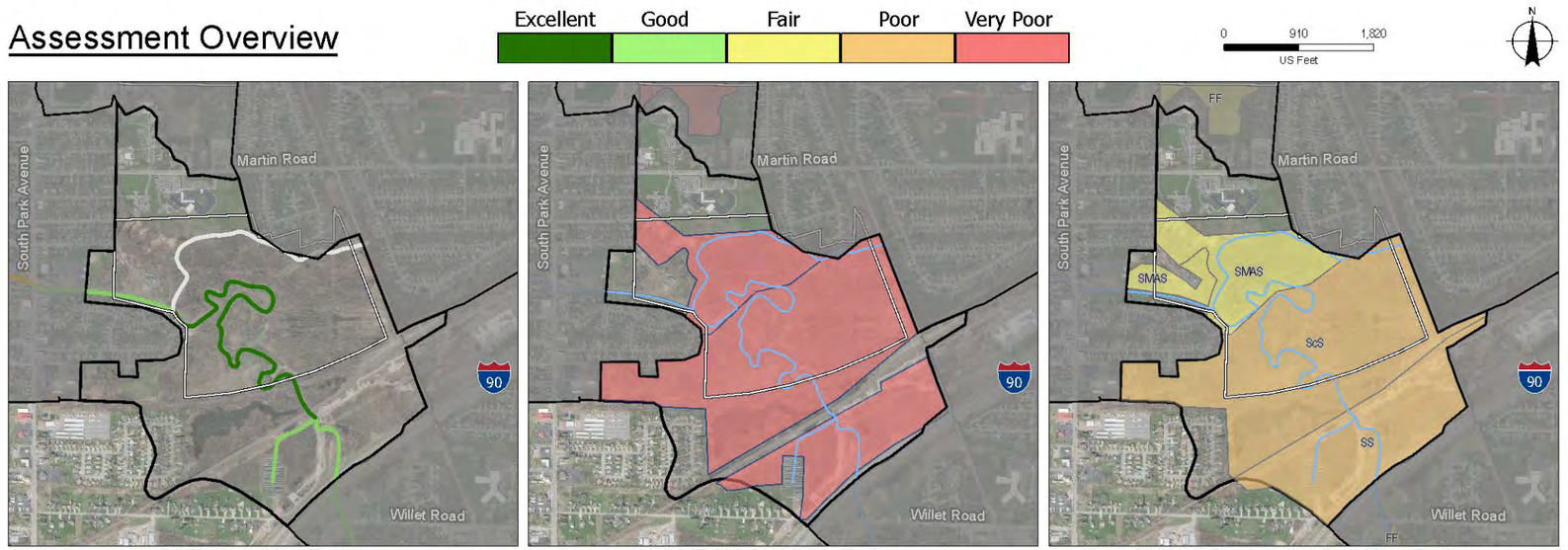
The quality of wetlands ranges from very poor to fair due to the high prevalence of invasive species and urban land use that borders these wetlands.

Overall, instream habitat is rated as excellent due to good quality substrate, pool/riffle development and a generally wide riparian buffer.

Sections of this reach; however, do include streambank erosion, sedimentation, dumping/trash, and ATV trail crossings.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfalls
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of thermal protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness
Riparian Habitat	Invasive Species, Land use encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- A significant portion of this NRU is owned by the City of Lackawanna and may provide opportunities to reconnect floodplain, restore natural communities, manage local stormwater, and address specific areas where streambank erosion is occurring;
- Several sections of stream channel near residential areas, particularly where the un-channelized reach joins the downstream channelized reach, may need to be re-routed to address on-going encroachment into residential areas;
- Several ditches extend though this NRU that outfall to the south branch; these ditches should be routed into floodplain wetlands with restored stream channels to attenuate and treat storm flows;
- Landowner education to encourage stormwater best management practices should be implemented.

SMOKES CREEK

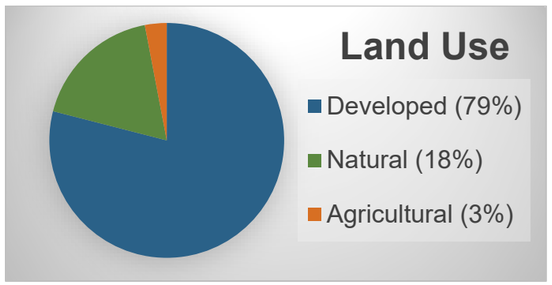
Natural Resource Unit
Smokes Creek Lower 4 (NRU SCL4)

Town of Orchard Park, Town of West Seneca,
City of Lackawanna
Size: 1001.45 acres
Stream length: 1.3 miles

Key Elements

Discontinuous riparian corridor dominated by poor to fair quality floodplain forest with emergent marsh openings and old field.

Instream habitat is poor due to bank erosion, sedimentation and entrenchment and lack of quality pool, riffle, run habitat. Stream channel is entrenched and lacks connectivity to floodplain.



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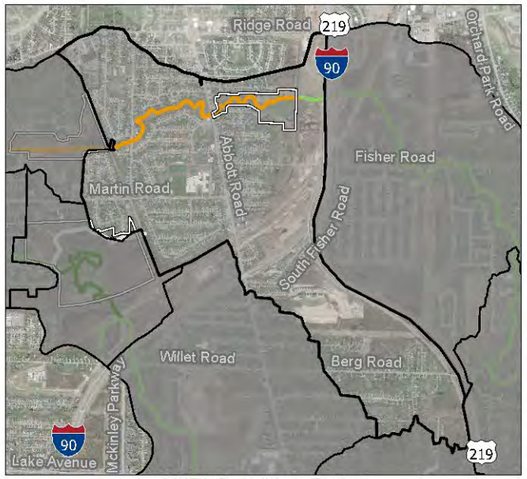

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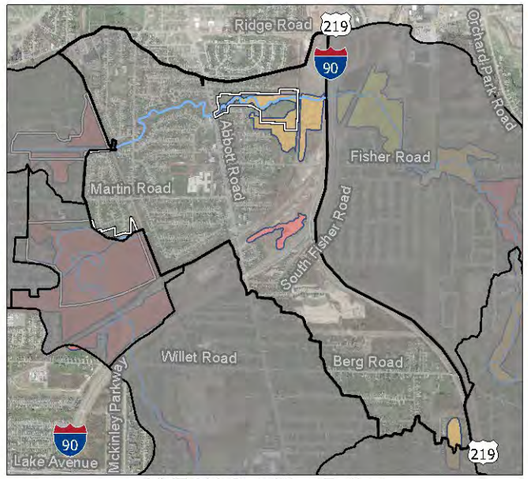

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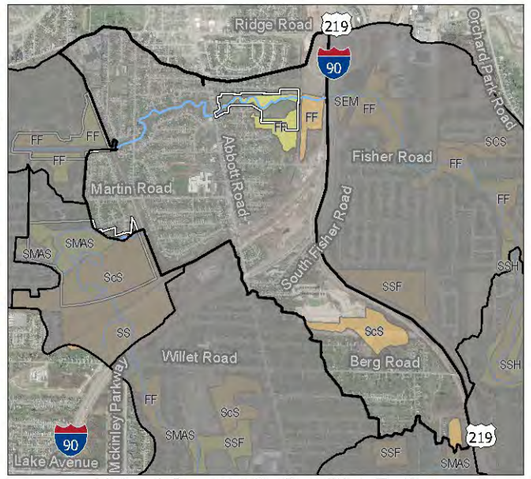


Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of Thermal Protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Re-establish connectivity to floodplain where possible;
- Identify opportunities for water quality treatment and stormwater retention where direct stormwater discharge is occurring;
- Improve existing riparian corridor with stream bank/floodplain channel stabilization and invasive species control.

SMOKES CREEK

Natural Resource Unit
South Branch Lower 2 (NRU SBL2)

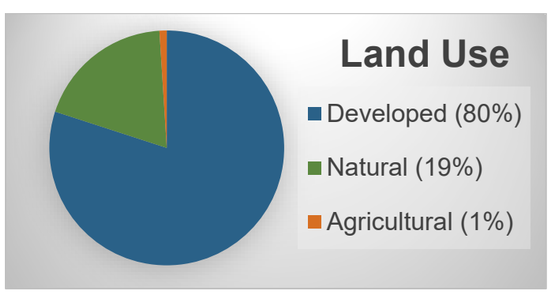
Town of Orchard Park, Town of Hamburg,
City of Lackawanna
Size: 847.59 acres
Stream length: 1.3 miles

Key Elements

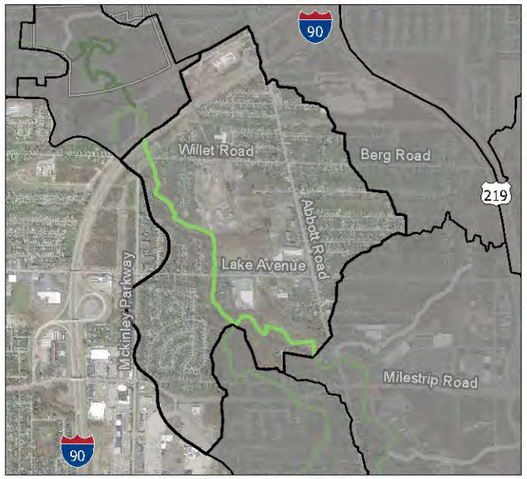
Riparian corridor is of variable width and quality with several gaps.

This NRU contains hardwood swamp, floodplain forest and old field/disturbed land that is succeeding to scrub-shrub and successional forest.

Wetlands are rated as very poor due to residential/commercial development, limited buffering, numerous ATV trails, and high prevalence of invasive species.



Assessment Overview



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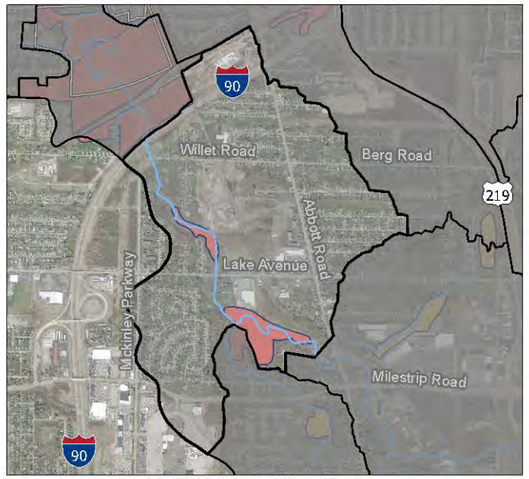

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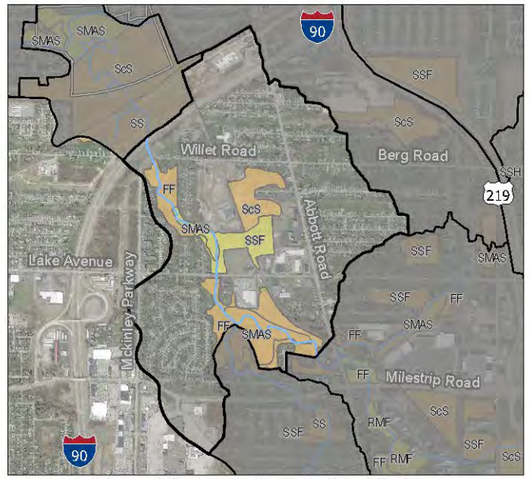

Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfalls, Bridge/Culvert Crossings
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of thermal protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Identify gaps in riparian corridor connectivity and/or quality for opportunities to improve overall corridor function;
- Limit trail/ATV use along stream banks and within stream channel;
- Instream habitat improvements and stabilization of streambanks focused on channelized reaches and at bridge crossings;
- Educate landowners on the benefits of riparian buffers and how to properly install them.

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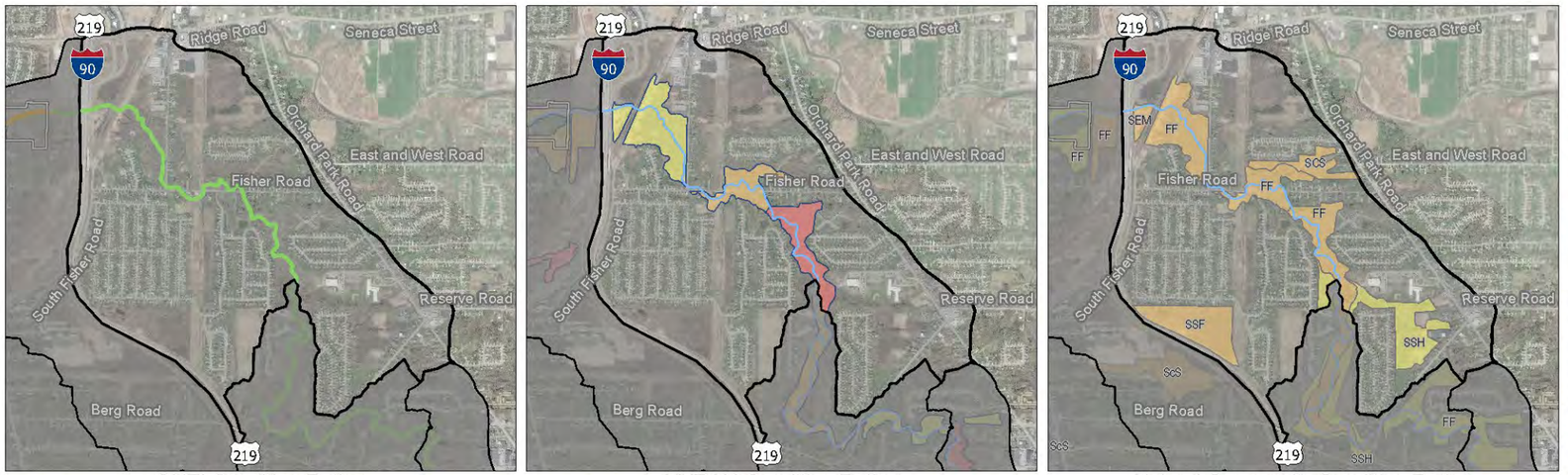
SMOKES CREEK

Natural Resource Unit
Smokes Creek Lower 3 (NRU SCL3)

Town of West Seneca
Size: 1042.92 acres
Stream length: 1.6 miles

Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

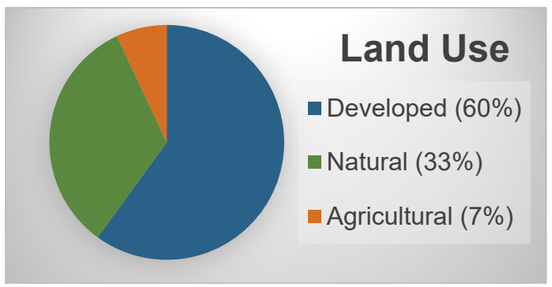
Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load
Geomorphic	Streambank Erosion, Entrenchment, Channelization
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment

Key Elements

Discontinuous riparian corridor is dominated by poor to fair quality floodplain forest, emergent marsh, successional forest and old field/scrub-shrub.

Encroachment into wetland and terrestrial communities from adjacent residential areas, hillslope erosion and invasive species are key management issues.

Instream habitat is good; however, impacted by streambank erosion and sedimentation.



Opportunities for Habitat Connectivity and Watershed Improvement

- Areas of public/private land in floodplain that may be suitable for floodplain/wetland restoration;
- Landowner outreach to create/expand riparian buffers and reduce encroachment into riparian corridor;
- Control invasive species with priority given to higher quality natural communities.

SMOKES CREEK

Natural Resource Unit
South Branch Lower 4 (NRU SBL4)

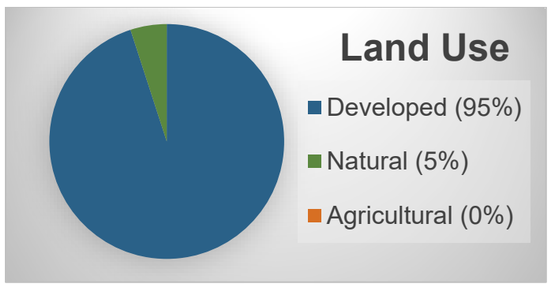
City of Lackawanna
Size: 262.72 acres
Stream length: 0.6 mile

Key Elements

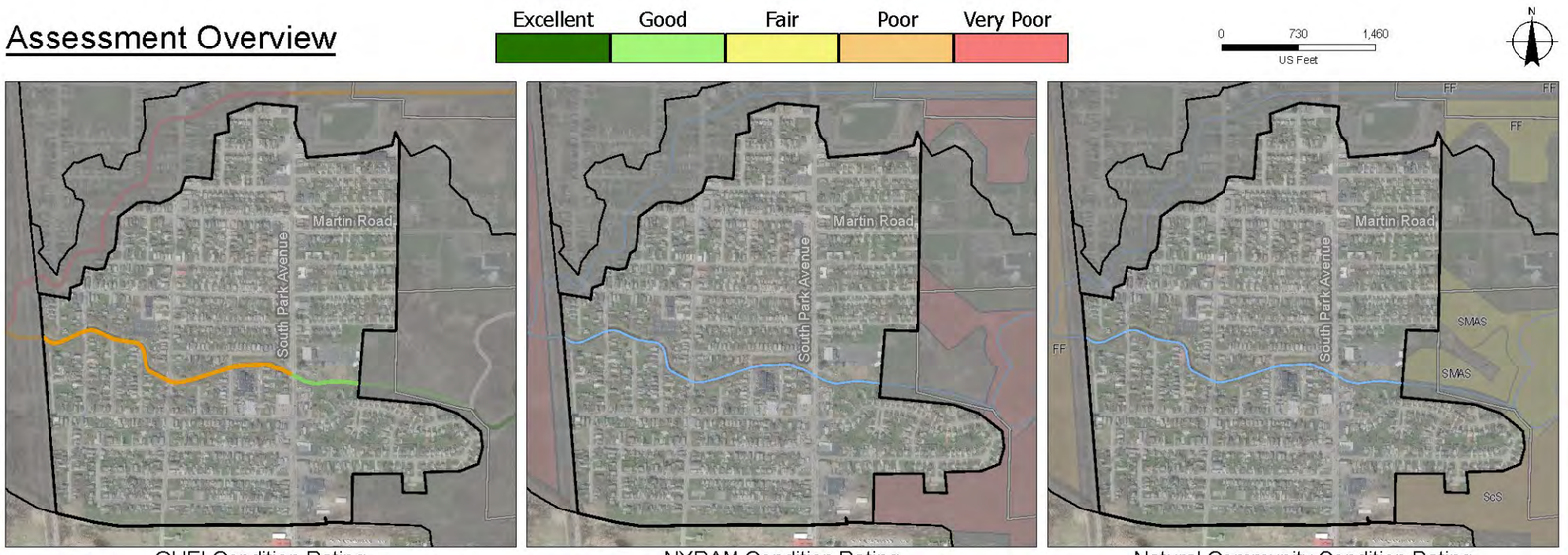
The riparian corridor is limited to a narrow band of vegetation along the top of bank on both sides.

Vegetation is successional forest with shrub and herbaceous cover dominated by invasive species.

Instream habitat is rated as poor due to poor substrate, siltation and limited pool and riffle development.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfalls, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of thermal protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- The primary opportunities in NRU SBL4 are creation or enhancement of instream and riparian cover, creation of riffle and pool habitat and stormwater management. These efforts should be focused on areas with active streambank erosion and where physical space along the riparian corridor is sufficient to support these improvements;
- Landowner education to encourage stormwater best management practices should be implemented.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Lower 2 (NRU SCL2)

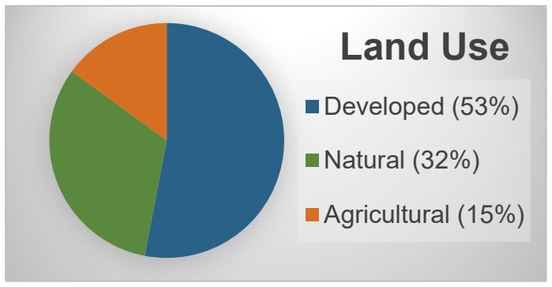
Town of Orchard Park, Town of West Seneca
Size: 505.86 acres
Stream length: 1.5 miles

Key Elements

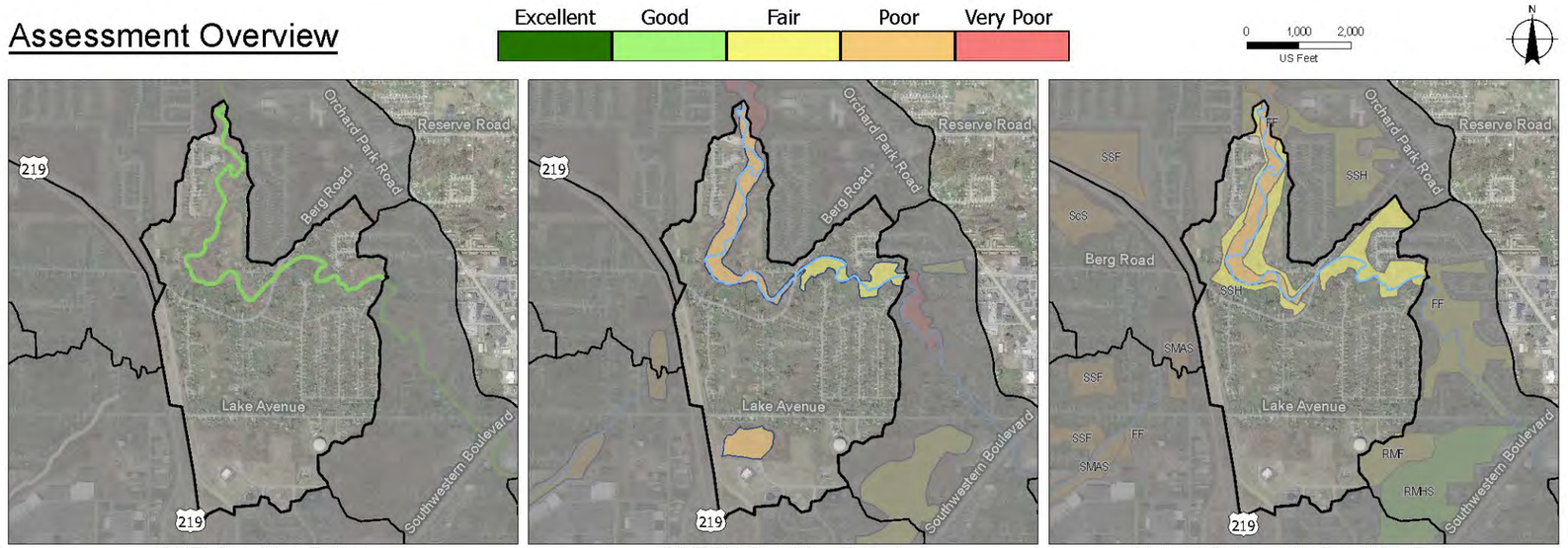
Continuous riparian corridor of variable width and quality.

Floodplain forest and successional forest characterize ARA plant communities.

Instream habitat is good; however, hillslope erosion and bank erosion is common. Deer browsing and invasive species impacting forest habitat.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load
Geomorphic	Streambank Erosion
Instream Habitat	Siltation/Embeddedness
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Landowner outreach to create/expand riparian buffers and reduce encroachment into riparian corridor;
- Control invasive species with priority given to higher quality natural communities.
- The upper reach of SCL2 includes a block of land owned by Township of Orchard Park that would be an excellent location to implement invasive species management and instream habitat improvements in conjunction with similar projects in SCL1.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Lower 1 (NRU SCL1)

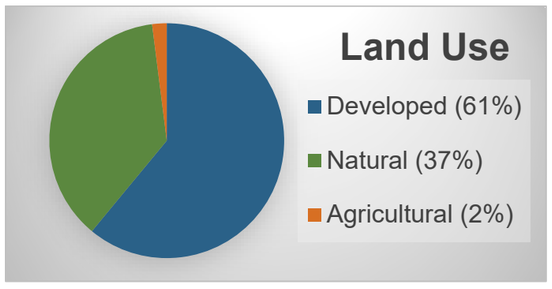
Town of Orchard Park, Town of West Seneca
Size: 690.14 acres
Stream length: 1.3 miles

Key Elements

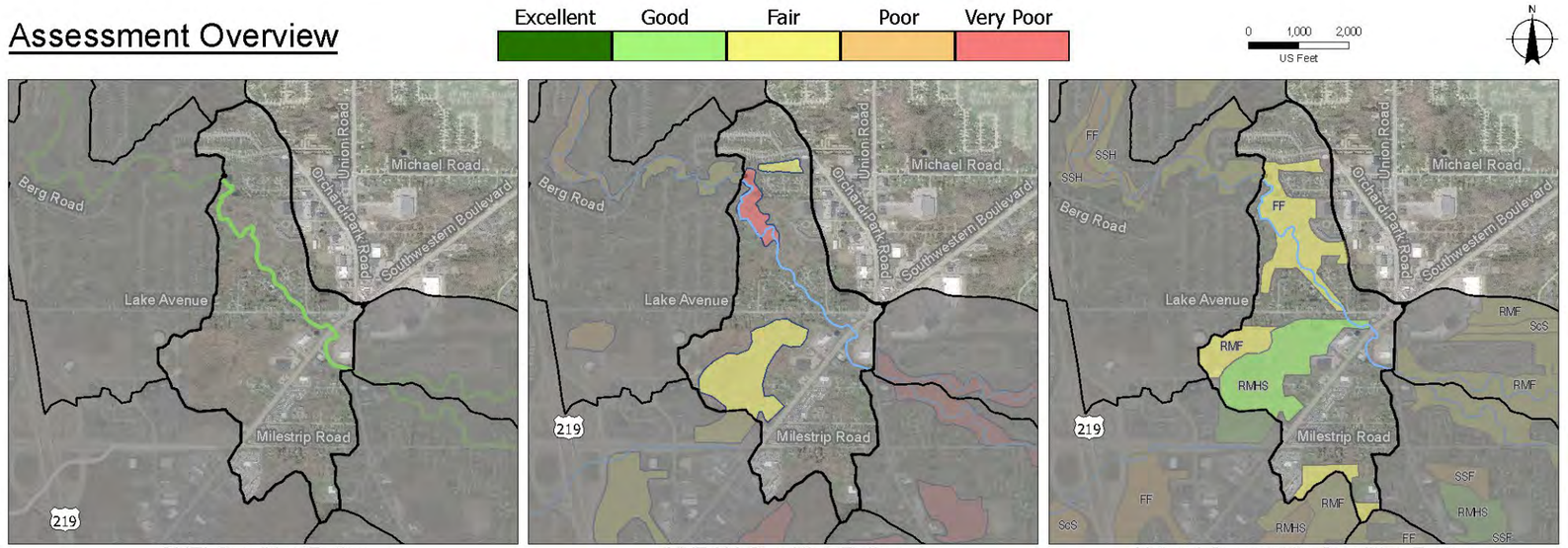
Discontinuous riparian corridor dominated by fair to good quality floodplain, hardwood swamp, mesic hardwood, and successional forest.

Instream habitat is good, but siltstone limited.

Small areas of excellent quality groundwater-dependent rich fen and hardwood swamp communities are present.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load
Geomorphic	Streambank Erosion
Instream Habitat	Siltation/Embeddedness
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Landowner outreach to create/expand riparian buffers and reduce encroachment into riparian corridor;
- Control invasive species with priority given to higher quality natural communities;
- The lower reach of SCL1 includes a block of land owned by the Town of Orchard Park that would be an excellent location to implement invasive species management and instream habitat improvements in conjunction with similar projects in SCL2.

SMOKES CREEK

Natural Resource Unit
South Branch Lower 21 (NRU SBL21)

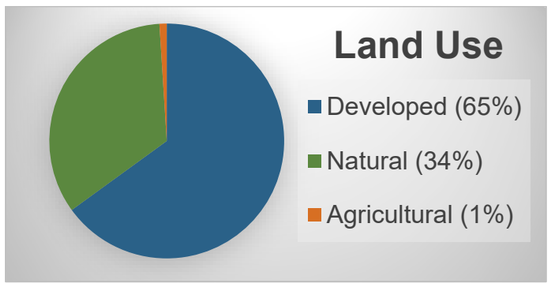
Town of Orchard Park, Town of Hamburg
Size: 645.14 acres
Stream length: 1.1 miles

Key Elements

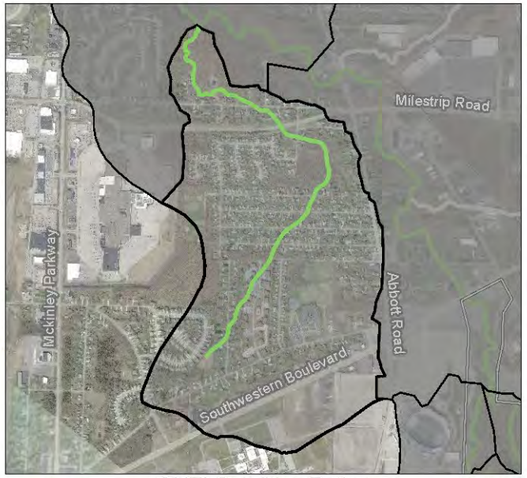
Much of the tributary crosses though residential neighborhoods with numerous road crossings with no riparian buffer.

Natural communities identified include poor to fair quality shrub swamp, hardwood swamp and successional forest.

Wetlands are rated as very poor to poor due to residential development, limited buffering, numerous ATV trails, and a high prevalence of invasive species.



Assessment Overview



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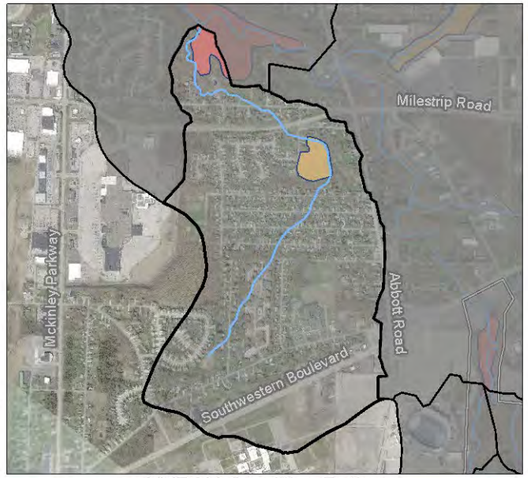
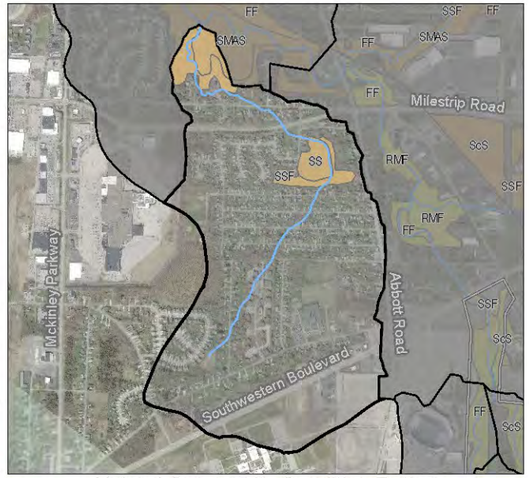


NYRAM Condition Rating



Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfalls, Bridge/Culvert Crossings
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of thermal protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Instream channel restoration just above the confluence that would include re-meandering the channel and reconnecting / expanding the floodplain;
- Implement targeted stormwater best management practices education to the residential neighborhood that borders this stream reach.

SMOKES CREEK

Natural Resource Unit
South Branch Lower 1 (NRU SBL1)

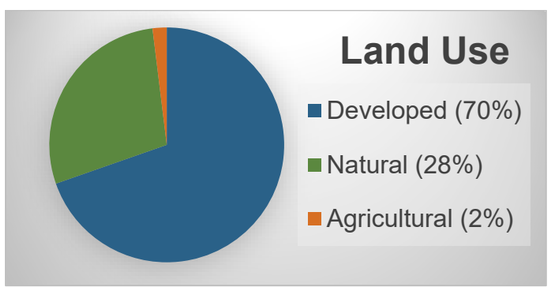
Town of Orchard Park
Size: 1,289.22 acres
Stream length: 3.5 miles

Key Elements

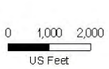
South Branch and two major tributaries that drain commercial and residential areas that are fragmented by several major four-lane roads and freeways.

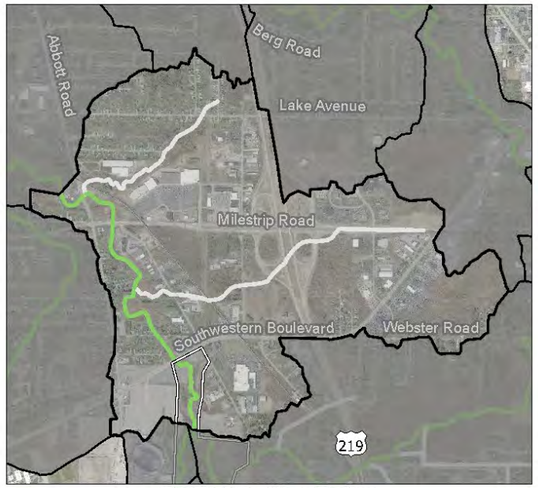
This NRU contains several large blocks of floodplain forest, hardwood swamp and old field succeeding to shrub-scrub and successional forest.

Although instream habitat is rated as good, there are significant areas of stream bank erosion, entrenchment, and sedimentation.



Assessment Overview





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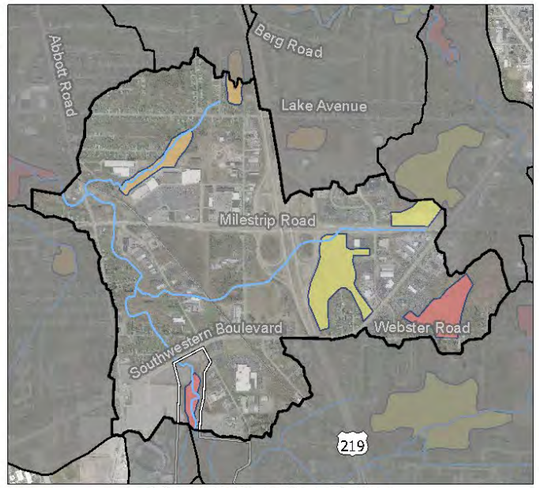

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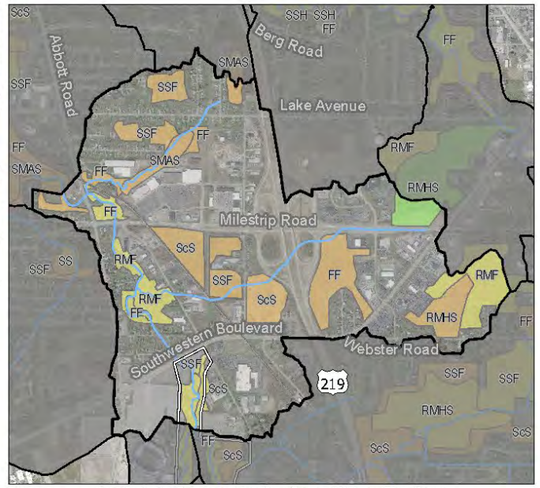


Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfalls, Bridge/Culvert Crossings
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of thermal protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Large tracts of floodplain forest, wetland, and riparian corridor (both SB and tributaries) that that may be good candidates for protection and/or restoration;
- Opportunities for stormwater management. Gaps or narrow portions of the SB riparian corridor in the vicinity of the Highmark Stadium should be evaluated as possible floodplain restoration areas that include improved stormwater management.

SMOKES CREEK

Natural Resource Unit
South Branch Upper Tributary 1
(NRU SBUT1)

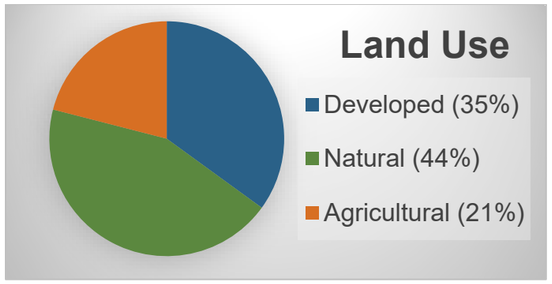
Town of Orchard Park
Size: 1795.25 acres; Stream length: 6.1 miles

Key Elements

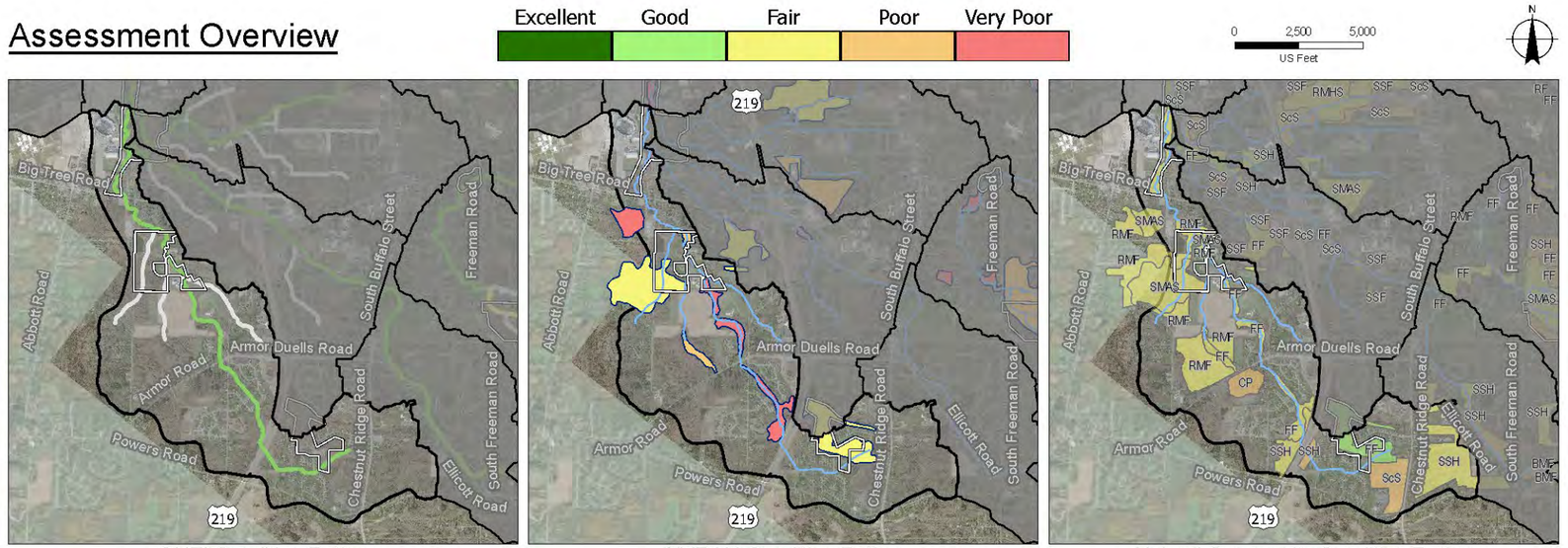
Discontinuous, fragmented riparian corridor on main stem and three tributaries.

Natural communities include mostly fair quality floodplain, successional and rich mesic forest, conifer plantation and scrub-shrub. Several good quality wetlands around headwaters.

Instream habitat within reaches is rated as good; however, quality of substrate and instream habitat is limited by siltstone bottom in many areas. Beaver activity was noted along the stream in Brush Mountain Park.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of Thermal Protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- The main reach in SBUT1 crosses several areas that either lack a riparian buffer or have narrow, poor quality buffers with landowner encroachment. These areas should be targeted for landowner outreach/education and or as riparian habitat improvement projects;
- The town-owned land (Brush Mountain Park) near the confluence of mainstem of SBUT1 and the three tributaries includes several channelized reaches that could be targeted for instream and riparian corridor restoration;
- Evaluate beaver dams and possibly remove;
- The downstream reach in the vicinity of Highmark Stadium should be evaluated as a potential location for floodplain restoration and stormwater management.

SMOKES CREEK

Natural Resource Unit
South Branch Upper 3 (NRU SBU3)

Town of Orchard Park
Size: 1143.79 acres
Stream length: 4.7 miles

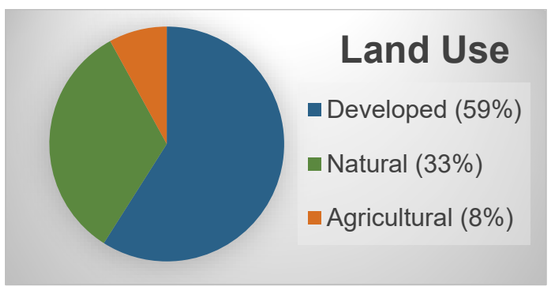
Key Elements

Highly fragmented riparian corridor with impoundments and channelized reaches.

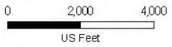
Poor to fair quality natural communities include floodplain and successional hardwood forest, shrub swamp and old field/scrub-shrub.

General lack of wetlands along tributaries except for one higher quality wetland at headwaters.

Three tributaries join reach within this NRU. Instream habitat is good, but limited by areas of siltstone, embedded substrate, and siltation.



Assessment Overview



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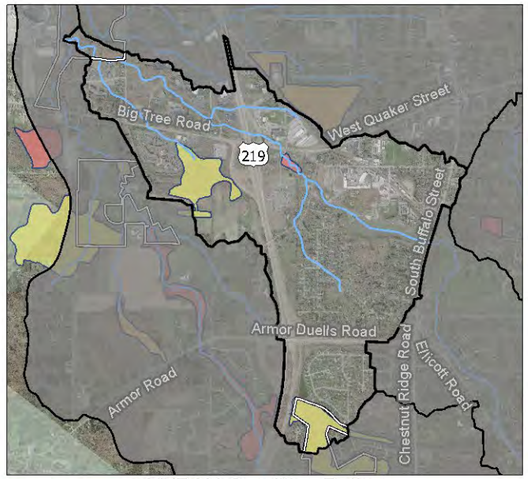
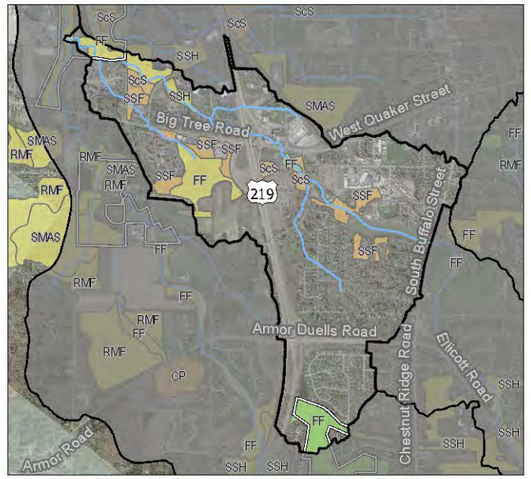


NYRAM Condition Rating



Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of Thermal Protection
Geomorphic	Stream Bank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Channelized reaches may be suitable for instream habitat restoration;
- Instream restoration, corridor gaps and reduction of land use encroachment should be addressed through landowner education and targeted improvement projects;
- Town-owned property or undeveloped private land could be targeted for habitat restoration;
- Opportunities to provide site specific stormwater treatment or alternatively regional stormwater treatment, particularly downstream of high impervious commercial development and/or along the freeway that bisects this NRU.

SMOKES CREEK

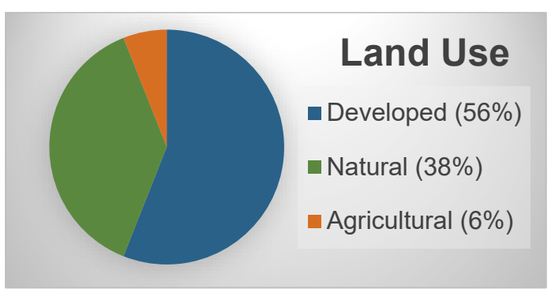
Natural Resource Unit
South Branch Upper Tributary 2
(NRU SBUT2)

Town of Orchard Park
Size: 1386.20 acres; Stream length: 6.1 miles

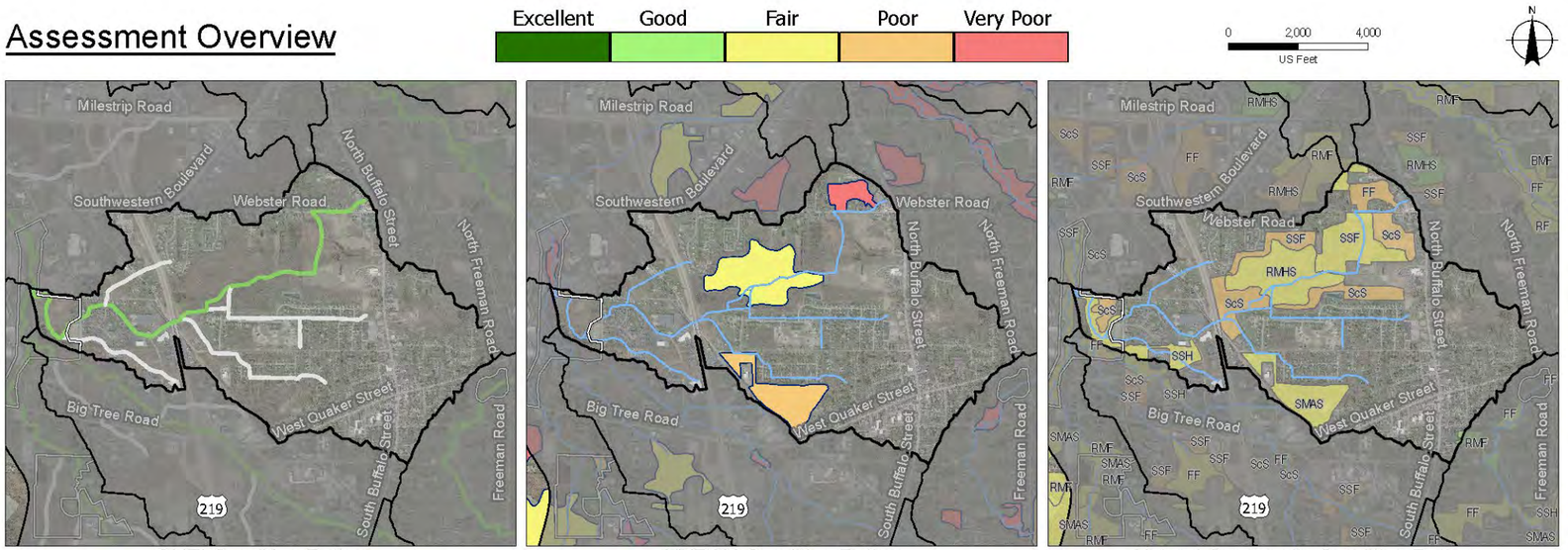
Key Elements

A discontinuous, fragmented riparian corridor with main reach of SBUT2 draining a large complex of good quality hardwood swamp bordered by old field succeeding to scrub-shrub and forest.

The lower corridor of SBUT2 flows through low quality flood plain forest. Although instream habitat is rated as good for SBUT2, the tributaries are generally channelized or otherwise flow through stormwater pipes through residential or commercial development.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load, Visual Turbidity, Lack of Thermal Protection
Geomorphic	Streambank Erosion, Entrenchment, Channelization, Disconnected Floodplain
Instream Habitat	Siltation/Embeddedness, Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- SBUT2 headwater wetlands include channelized reaches that may be good candidates for instream restoration;
- Headwater wetlands and adjacent upland areas should be targeted for protection and restoration that includes invasive species management;
- Channelized middle and lower reaches of SBUT2 and tributaries often lack buffers and where buffers are present, adjacent landowner encroachment occurs. These areas should be targeted for landowner outreach and where possible riparian buffers should be established;
- The lower-most reach, near the confluence with SBUT1, should be protected and restored in conjunction with the recommendations noted for SBL1 and SBUT1.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper 4 (NRU SCU4)

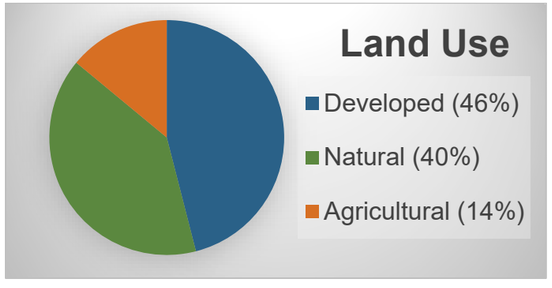
Town of Orchard Park
Size: 1155.86 acres
Stream length: 3.5 miles

Key Elements

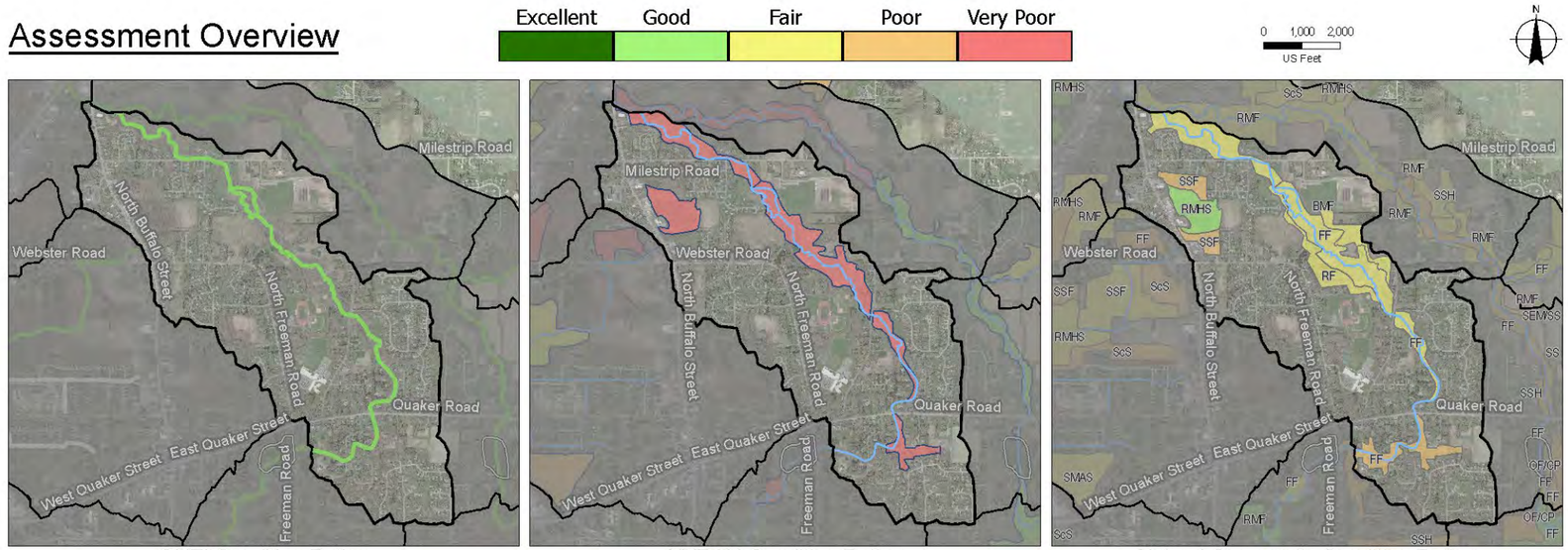
Continuous riparian corridor of varying width and quality dominated by floodplain forest with groundwater-dependent wetlands along floodplain valley slopes.

Upland areas dominated by moderate quality beech-maple forest.

Wetlands rated as very poor due to invasive species and urban stressors.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows, Impacts to Surface/Groundwater Interaction
Structures	Stormwater Outfall, Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Loading
Geomorphic	Streambank Erosion
Instream Habitat	Poor Riffle Development/Quality, Poor Pool Development/Quality, Siltstone Limited
Riparian Habitat	Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Inventory rich fens, hardwood swamps and groundwater seeps and prioritize for protection;
- Identify opportunities to expand riparian buffer width and encourage stormwater and stormwater best management practices;
- Improve quality of riparian and wetland buffers through invasive species control.

SMOKES CREEK

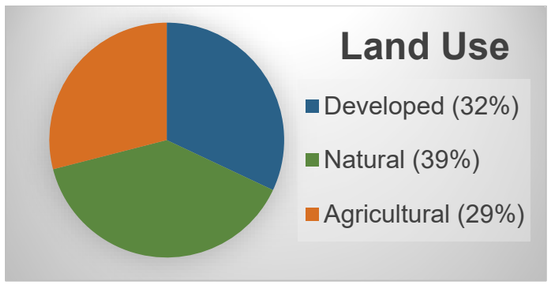
Natural Resource Unit
Smokes Creek Upper Tributary 1D
(NRU SCUT1D)

Town of Orchard Park
Size: 356.6 acres; Stream length: 2.8 miles

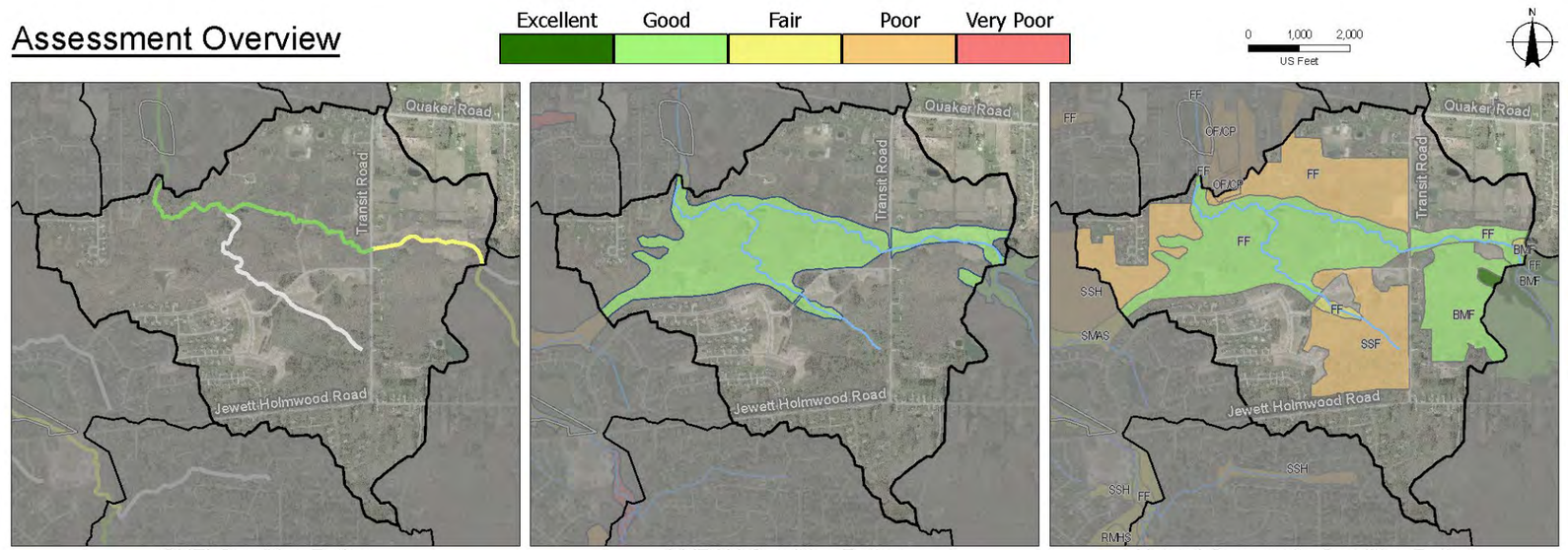
Key Elements

Continuous riparian corridor of poor to good quality floodplain forest, rich mesic forest and successional forest.

Good quality instream habitat.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Loading
Geomorphic	Streambank Erosion
Instream Habitat	Not observed
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Implement landowner education to encourage stormwater best management practices.
- Invasive species management within riparian buffer.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper Tributary 1C
(NRU SCUT1C)

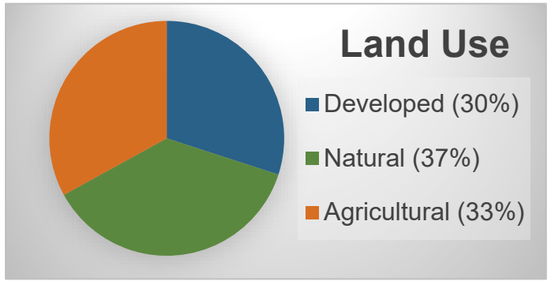
Town of Orchard Park
Size: 356.6 acres; Stream length: 1.3 miles

Key Elements

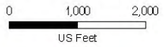
Discontinuous, sometimes narrow, riparian corridor dominated by poor quality floodplain, successional hardwoods and old field.

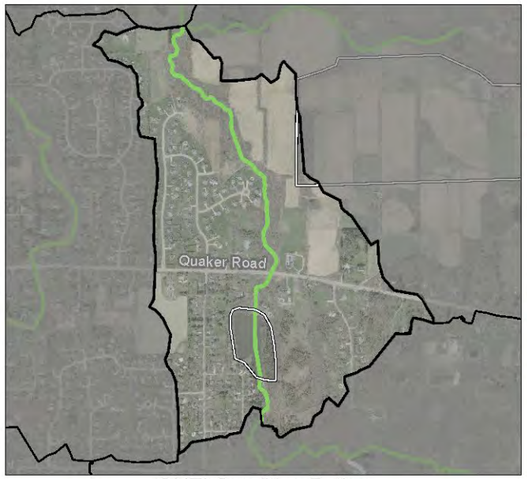
Several stream reaches are channelized or impounded.

A portion of this corridor is under National Wildlife Federation (NWF) Certification.



Assessment Overview





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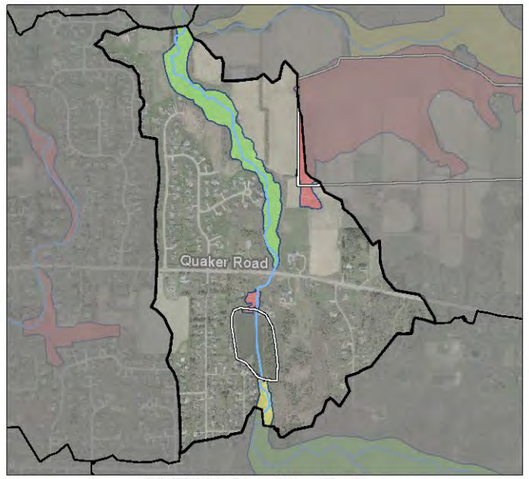
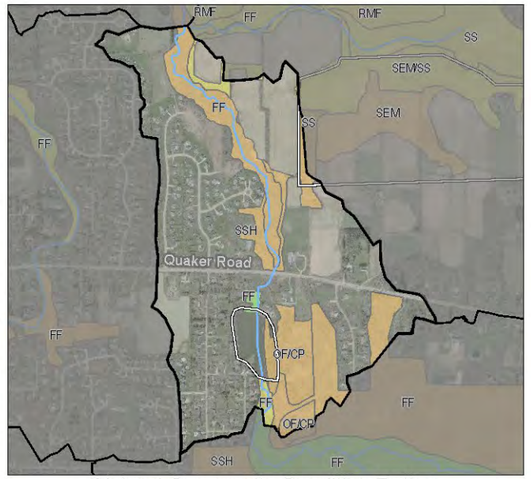


NYRAM Condition Rating



Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Loading, Lack of Thermal Protection
Geomorphic	Streambank Erosion, Channelization
Instream Habitat	Aquatic Barrier
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Identify opportunities to expand/create riparian buffers on new residential development;
- Several channelized stream reaches may be good candidates for stream restoration;
- Evaluate alternatives to enhance impounded reach.

SMOKES CREEK

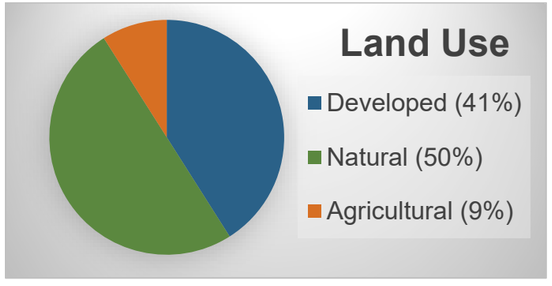
Natural Resource Unit
Smokes Creek Upper 3 (NRU SCU3)

Town of Orchard Park
Size: 1,223.53 acres
Stream length: 4.6 miles

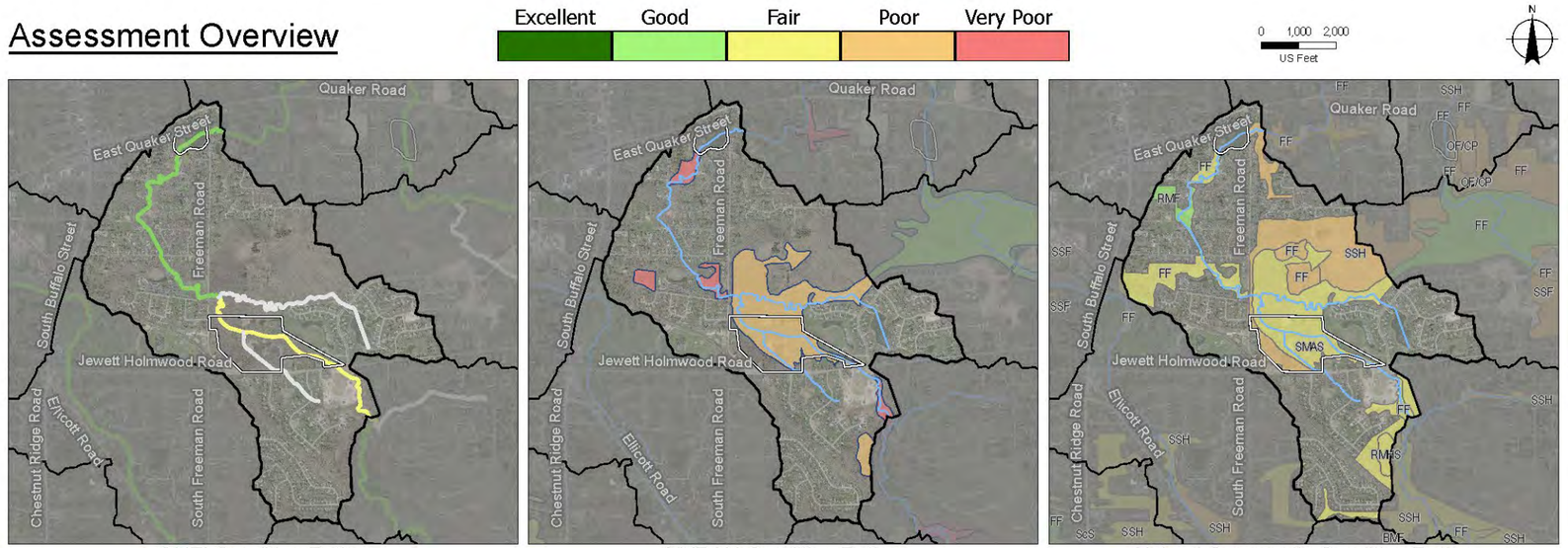
Key Elements

Discontinuous riparian corridor with two large blocks of good to moderate quality floodplain forest, hardwood swamp and successional hardwood forest.

A large block of forest in Birdsong Park includes restored sections of formally channelized stream channel with fair instream habitat.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	High/Stormflows
Structures	Stormwater Outfalls, Bridge/Culvert Crossings
Water Quality	Nutrient Sediment Load
Geomorphic	Streambank Erosion, Channelization
Instream Habitat	Siltation/Embeddedness, Siltstone Limited
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Expand stream restoration to channelized reaches;
- Implement stormwater treatment for new and existing public/private development;
- Create riparian buffers through middle section of NRU;
- Invasive species management.

SMOKES CREEK

Natural Resource Unit
South Branch Upper 2 (NRU SBU2)

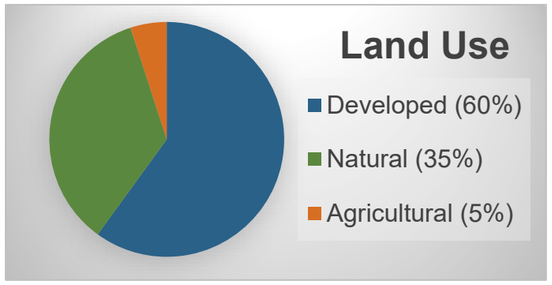
City of Orchard Park
Size: 853.15 acres
Stream length: 1.9 miles

Key Elements

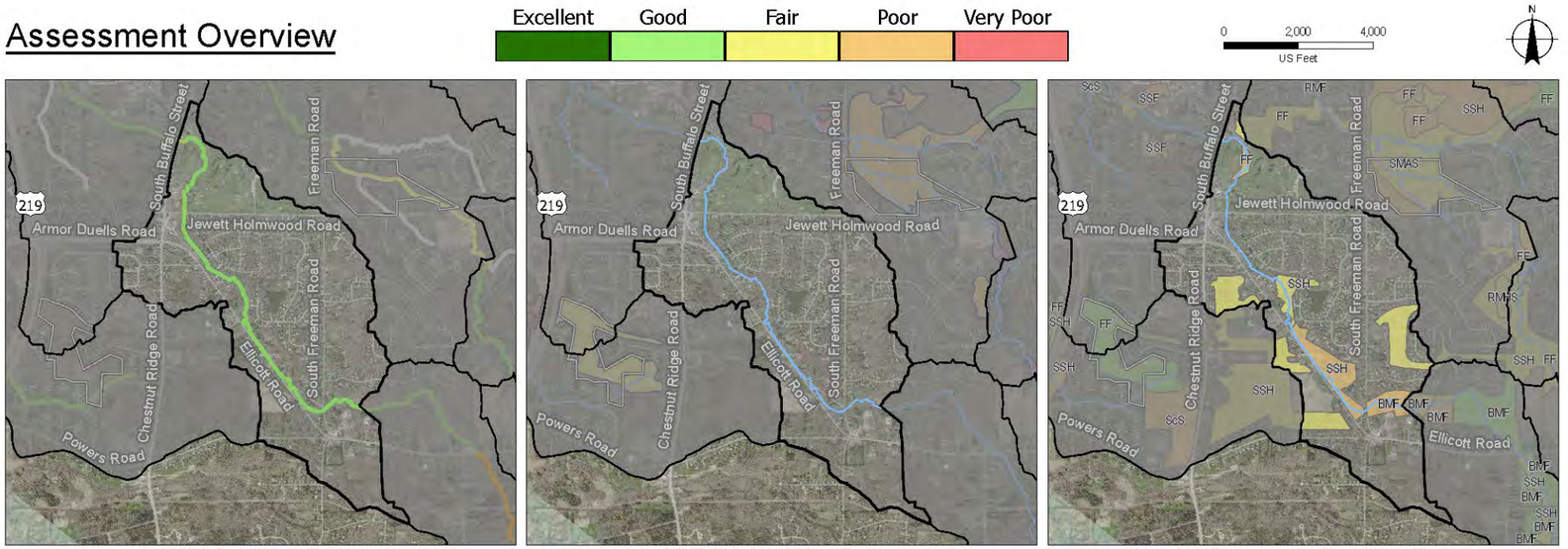
Discontinuous riparian corridor with upper and middle reaches extending along Ellicott Road and lower reach crossing residential area and Orchard Park Country Club Golf Course.

The riparian corridor is dominated by poor to good quality successional hardwood, beech-maple, and floodplain forest.

The channelized reaches are recovering with instream habitat rated as good.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Baseflow, Impacts to surface/Groundwater Interaction
Structures	Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load
Geomorphic	Stream Bank Erosion, Channelization
Instream Habitat	Poor Riffle Development/Quality, Poor Pool Development/Quality
Riparian Habitat	Poor Buffer Width/Quality, Land Use Encroachment, Lack of Corridor Connectivity

Opportunities for Habitat Connectivity and Watershed Improvement

- Where property ownership and existing infrastructure is not a constraint, evaluate opportunities to restore instream habitat;
- Gaps in the riparian corridor should be identified and addressed through expansion or creation of riparian buffers;
- Assess the feasibility of installing a native, vegetative buffer using native perennial grasses and forbs along reach within golf course.

SMOKES CREEK

Natural Resource Unit
South Branch Upper 1 (NRU SBU1)

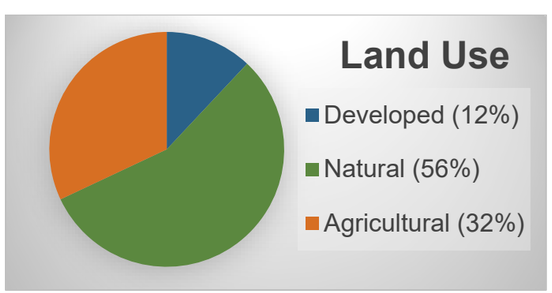
Town of Orchard Park
Size: 741.20 acres
Stream length: 2.2 miles

Key Elements

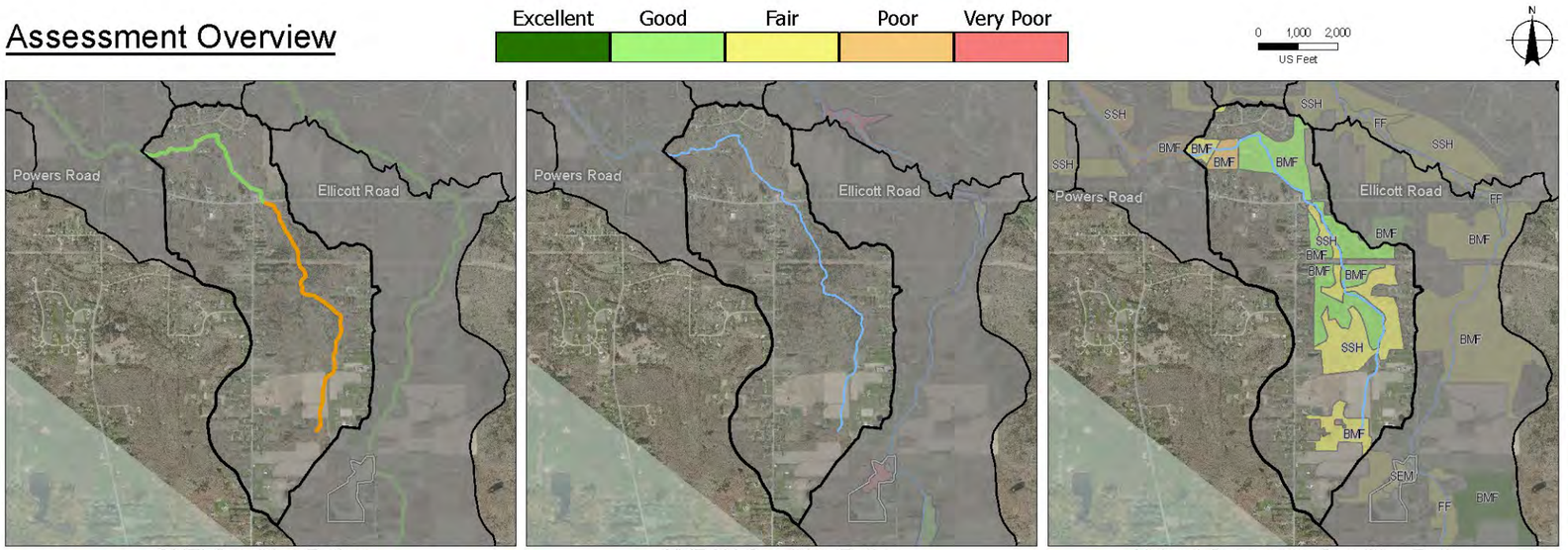
Discontinuous riparian corridor that includes fair to good quality beech-maple, successional forest, and agricultural row crops where stream is channelized.

This NRU does not contain any mapped wetlands or areas of potential wetland that meet the minimum size threshold, although small hillslope seeps and small wetlands are present along the stream channel and in wooded areas.

Instream habitat ranges from poor to good and is limited by small flows and lack of pools and riffles.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Baseflow, Impacts to surface/Groundwater Interaction
Structures	Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Load
Geomorphic	Channelization
Instream Habitat	Not observed
Riparian Habitat	Not observed

Opportunities for Habitat Connectivity and Watershed Improvement

- Target channelized reaches that lack riparian buffers for possible channel restoration and riparian corridor establishment;
- Conservation easements and reforestation can be used to fill corridor gaps and improve stream function;
- Conduct outreach to local farmers and other rural landowners to assess interest in riparian corridor restoration.

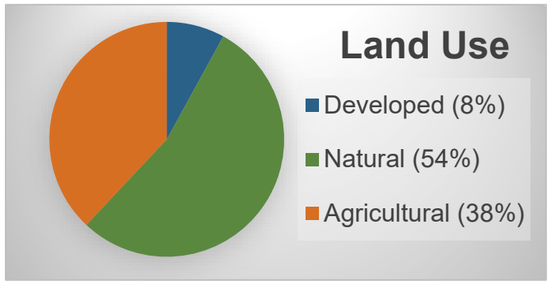
SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper 1 (NRU SCU1)

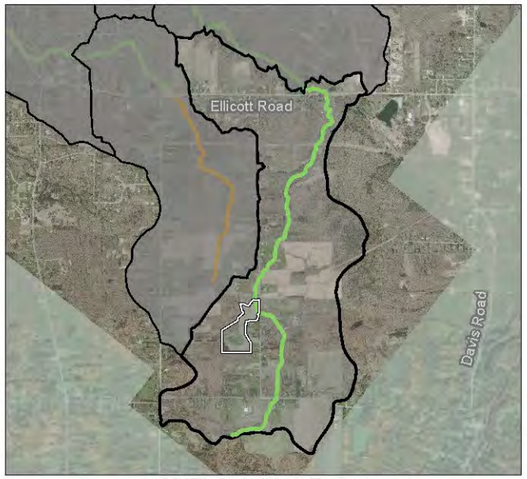
Town of Orchard Park
Size: 1069.21 acres
Stream length: 2.6 miles

Key Elements

Upper headwaters with moderate to high quality maple-beech forest and good instream habitat



Assessment Overview



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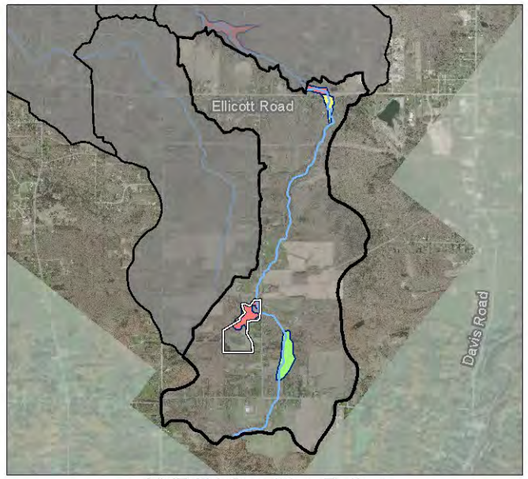

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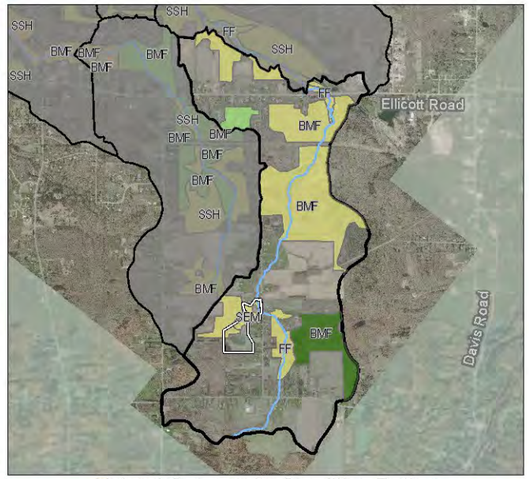


Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Not Observed
Structures	Not Observed
Water Quality	Not Observed
Geomorphic	Not Observed
Instream Habitat	Not Observed
Riparian Habitat	Poor Buffer Width/Quality

Opportunities for Habitat Connectivity and Watershed Improvement

- Landowner outreach to create/expand riparian buffers, particularly within agricultural fields.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper 2 (NRU SCU2)

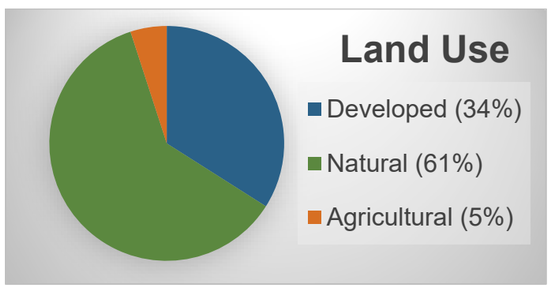
Town of Orchard Park
Size: 810.61 acres
Stream length: 2.2 miles

Key Elements

Continuous riparian corridor of moderate quality floodplain forest, red maple swamp, rich mesic forest, and successional forest.

Cross Country trail runs along entire corridor.

Good quality instream and riparian habitat.



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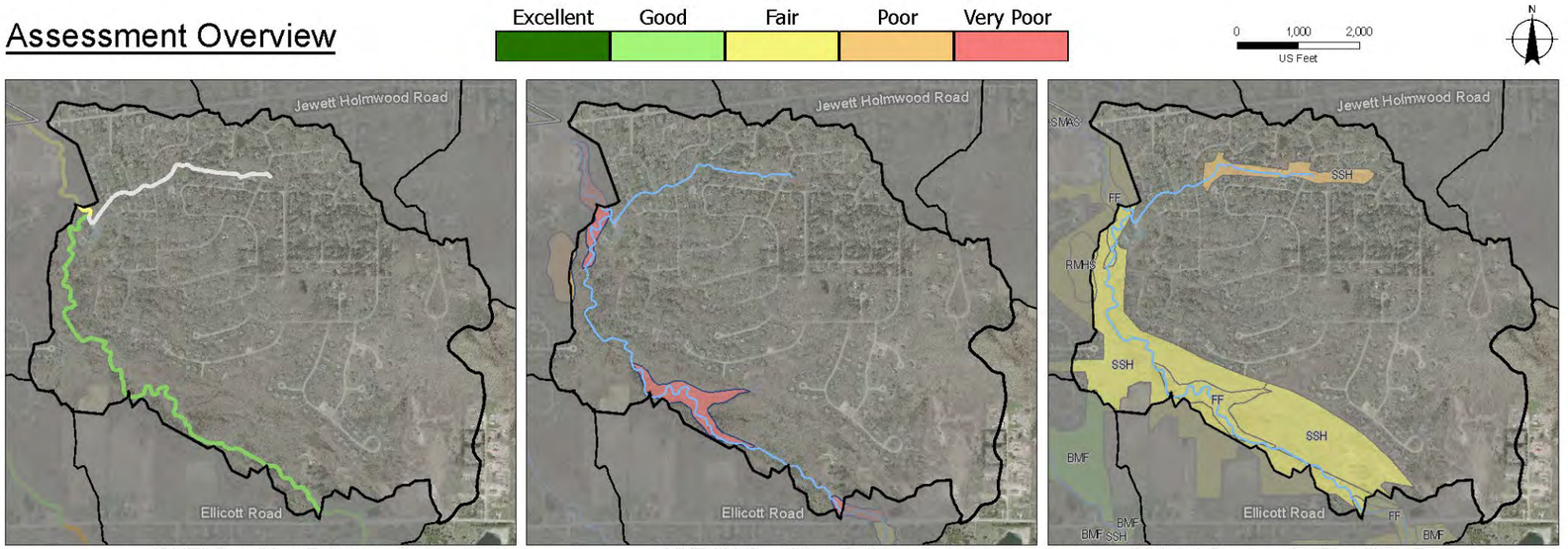


QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Impacts to Surface/Groundwater Interaction
Structures	Not Observed
Water Quality	Not Observed
Geomorphic	Not Observed
Instream Habitat	Siltstone Limited
Riparian Habitat	Invasive Species, Land Use Encroachment

Opportunities for Habitat Connectivity and Watershed Improvement

- Landowner education to encourage stormwater best management practices should be implemented.
- Invasive species management within riparian buffer.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper Tributary 1E
(NRU SCUT1E)

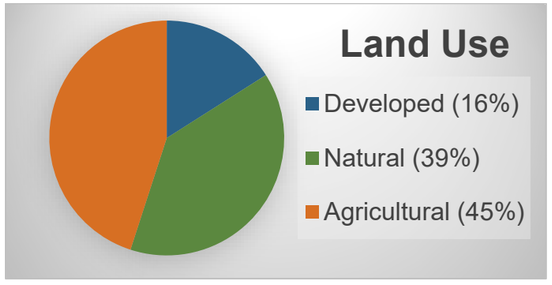
Town of Orchard Park. Village of Aurora
Size: 673.2 acres
Stream length: 0.9 mile

Key Elements

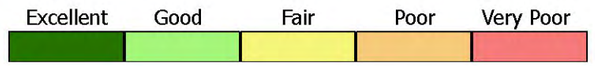
NRU is drained by secondary tributary bordered by large block of floodplain forest, shrub swamp and rich mesic forest.

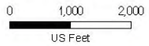
Agricultural fields and shrub swamp at headwaters of tributary may be suitable for wetland restoration.

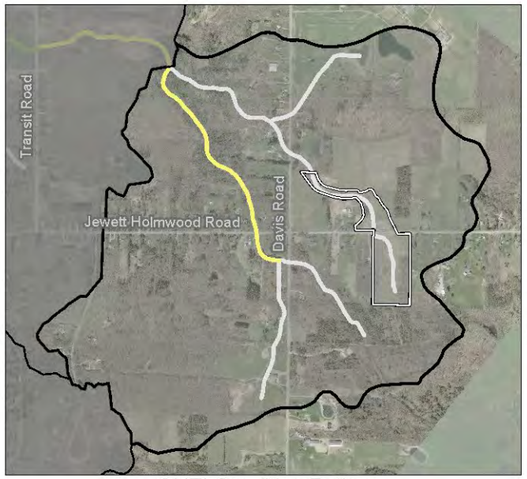
Although stream habitat is good, it may be limited by instream flow.



Assessment Overview







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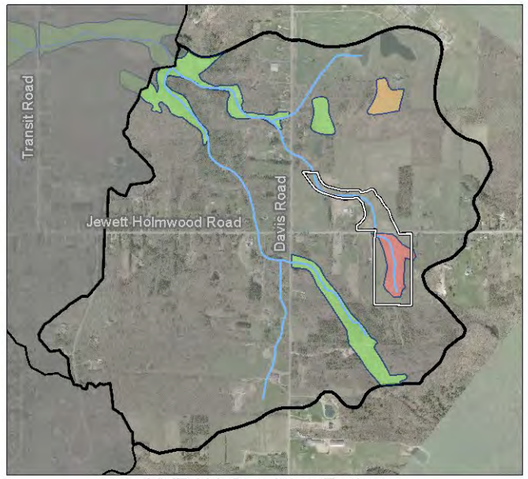
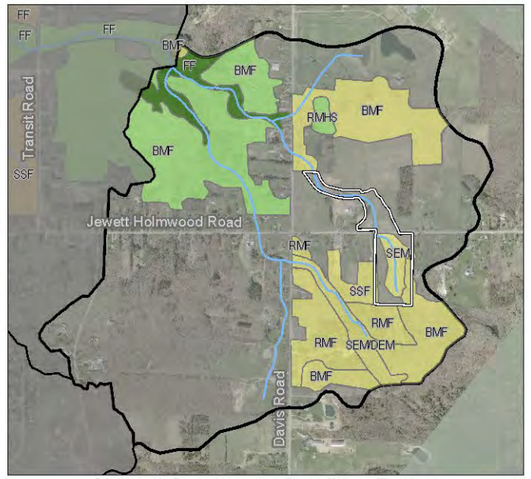


NYRAM Condition Rating



Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Baseflow
Structures	Stormwater Outfalls
Water Quality	Not observed
Geomorphic	Streambank Erosion, Channelization
Instream Habitat	Not observed
Riparian Habitat	Poor Buffer Width/Quality, Invasive Species

Opportunities for Habitat Connectivity and Watershed Improvement

- May be suitable for large-scale wetland restoration;
- Identify opportunities to expand wetland buffers and control invasives.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper Tributary 1B
(NRU SCUT1B)

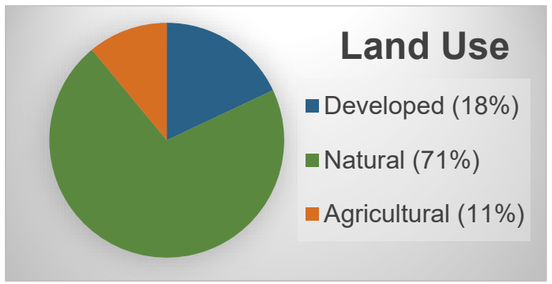
Town of Orchard Park, Village of Aurora
Size: 898.46 acres; Stream length: 2.5 miles

Key Elements

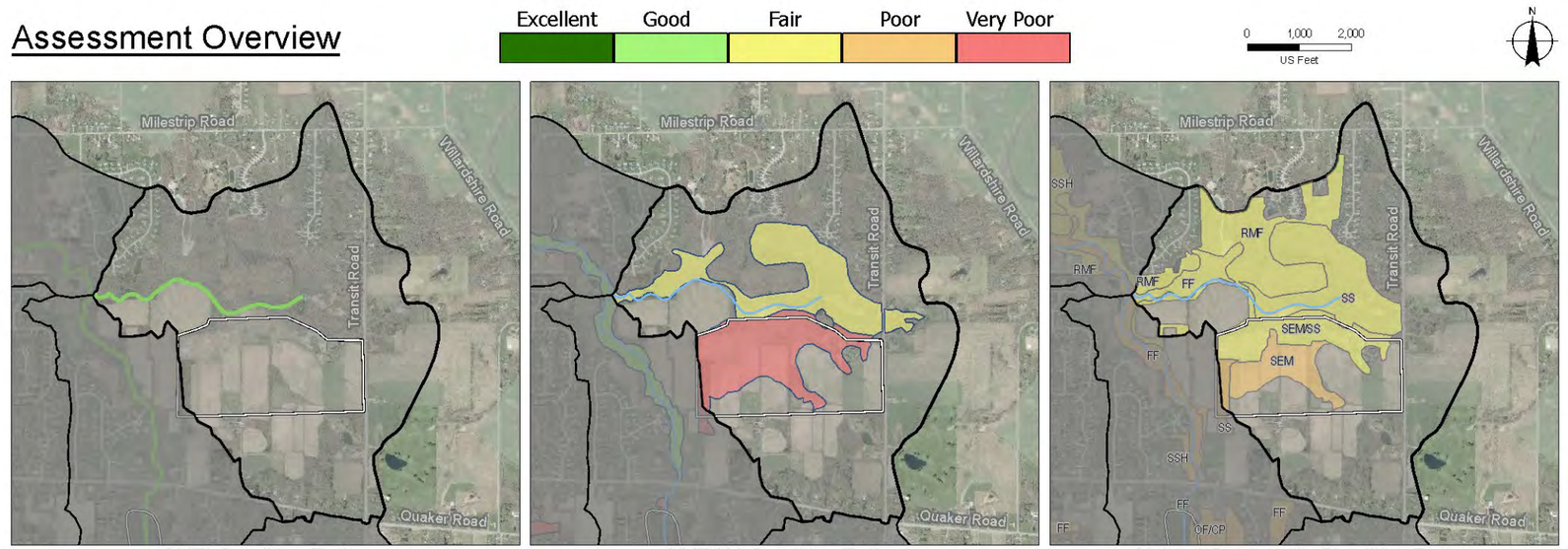
Discontinuous riparian corridor dominated by fair to excellent quality floodplain, beech-maple and successional forest. Small areas of groundwater-dependent hardwood swamp and rich fen communities are present along valley slopes.

Stream habitat ranges from fair to good and is likely limited by minimal instream flow in smaller tributaries.

A portion of this corridor is under National Wildlife Federation (NWF) Certification.



Assessment Overview



QHEI Condition Rating | NYRAM Condition Rating | Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Baseflow, Impacts to Surface/Groundwater Interaction
Structures	Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Loading
Geomorphic	Streambank Erosion
Instream Habitat	Not Observed
Riparian Habitat	Poor Buffer Width/Quality

Opportunities for Habitat Connectivity and Watershed Improvement

- Identify opportunities to expand or create riparian buffers on new residential development.

SMOKES CREEK

Natural Resource Unit
Smokes Creek Upper Tributary 1A
(NRU SCUT1A)

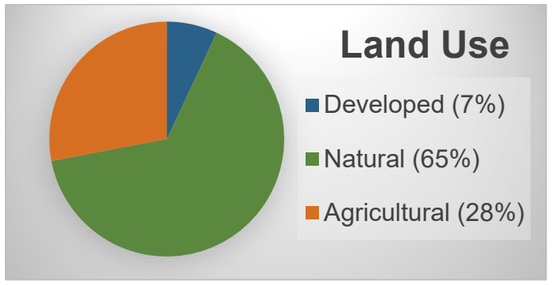
Village of Aurora
Size: 797.94 acres; Stream length: 3.2 miles

Key Elements

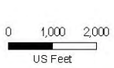
Upper headwaters of tributary to Smokes Creek with two main branches. Discontinuous riparian corridors extend through mixture of agricultural, residential and forest. Contains three large blocks of fair to excellent quality beech-maple, rich mesic and floodplain forest.

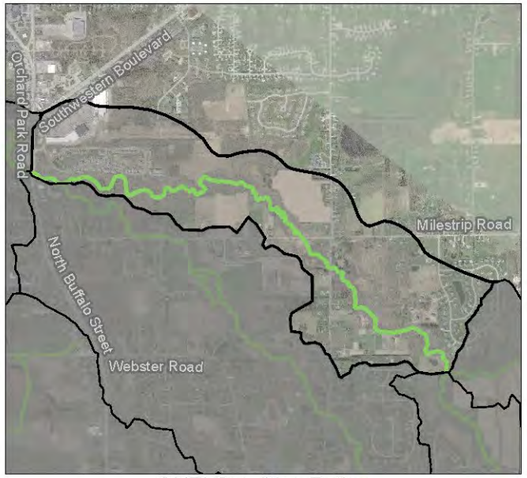
Small areas of excellent quality groundwater-dependent rich fen and hardwood swamp communities are present.

Stream habitat is fair due to limited instream flow in upper reaches of tributaries.



Assessment Overview





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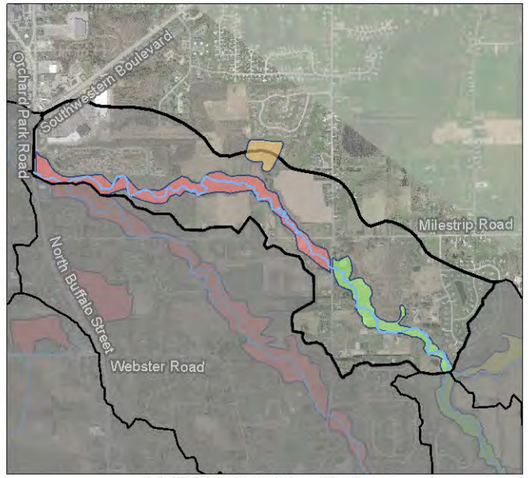
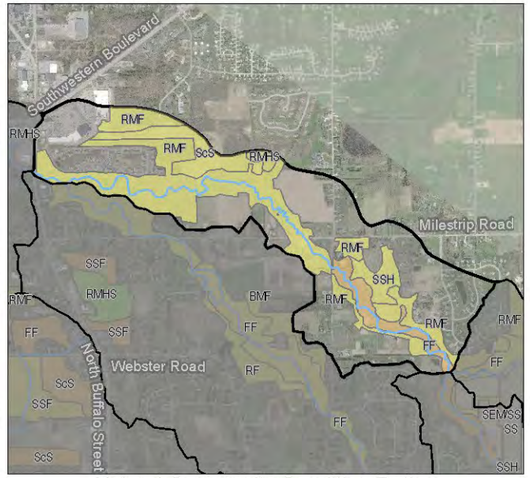


NYRAM Condition Rating



Natural Community Condition Rating

Natural Resources Stressor Identification

Stressor Category	Stressors
Hydrology	Baseflow, Impacts to surface/Groundwater Interaction
Structures	Bridge/Culvert Crossing
Water Quality	Nutrient Sediment Loading
Geomorphic	Streambank Erosion
Instream Habitat	Not Observed
Riparian Habitat	Poor Buffer Width/Quality

Opportunities for Habitat Connectivity and Watershed Improvement

- Inventory rich fens, hardwood swamps and groundwater seeps and prioritize for protection;
- Identify opportunities to expand riparian buffer width and encourage agricultural and stormwater best management practices;
- Potential wetland restoration on east branch of tributary.

Appendix B

Lower Smokes Creek Improvement Opportunities (GHD Report)

Report

27 March 2024

To	Carolyn Dunderdale - OGS	**Contact No.**	
Copy to	Stephany Tatarevich – DEC (**Stephany.Tatarevich@dec.ny.gov**) Mark Filipski – DEC (**Mark.Filipski@dec.ny.gov**) Chistine Miller - GHD	**Email**	**Carolyn.Dunderdale@ogs.ny.gov**
From	Chris Muirhead and Jeff Doucette - GHD	**Project No.**	12572245
Project Name	OGS - Smokes Creek Lake Erie Habitat Connectivity & Improvement		
Subject	Lower Smokes Creek Improvement Opportunities		

1. Introduction

GHD completed a review of Lower Smokes Creek as part of the Smokes Creek Habitat Connectivity and Improvement Opportunity Assessment. This review focused on Lower Smokes Creek from the Hamburg Turnpike (Highway 5) to Lake Erie. The purpose of the review was to explore potential opportunities for improvement to the fluvial system. The review included the follow tasks:

– Review of the available HEC-RAS model to gain an understanding of the flood issues, local velocities in the creek and suitability of the model for use in evaluating or developing improvement opportunities;
– Review of the existing fluvial geomorphic processes;
– Provide Improvement recommendations; and
– Note modelling requirements for further developing improvements.

2. Limitations

This report: has been prepared by GHD for OGS and may only be used and relied on by OGS for the purpose agreed between GHD and OGS as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than OGS arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

3. Model Review

3.1 HEC-RAS

The existing coupled 1D-2D HCE-RAS model for Smoke Creek was developed in 2017 by STARRII. Smoke Creek is modelled in the 1D model in three segments. These segments include upstream, downstream and the south branch. The upstream branch and south branch converge into the downstream branch. Smoke Creek then discharges in Lake Eerie. The 1D model component consists of 370 cross sections that extends approximately 5.6km upstream of where Smoke Creek discharges into Lake Eerie. The cross sections that lie within the immediate study area are cross sections 6531 to 170 from the Hamburg Turnpike (Highway 5) downstream to Lake Erie. Within all reaches of Smoke Creek, the main channel was assigned Manning's n value of 0.04 for a channel that is clean, winding with some pools and shoals. The right and left banks were assigned Manning's n values of 0.045 which is representative of the vegetated floodplains. The channel bed had an average slope of approximately 0.0016 (0.16%). This low slope facilitates the sedimentation happening at the mouth of the creek. The maximum flows and velocities associated with the cross sections in the Lower Smoke Creek are summarized below in **Table 1.**

Table 1 Maximum flows, water depth and channel velocities within Lower Smoke Creek

River Sta	Q Total (cfs)	Water Depth (ft)	Channel Velocity (ft/s)
2740	5300	18.99	5.02
2664	5300	17.27	4.9
2574	5300	17.29	4.8
2476	5300	17.34	4.76
2371	5300	17.43	4.81
2274	5300	17.48	4.7
2167	5300	17.44	4.67
2083	5300	17.55	4.67
1971	5300	17.6	4.62
1849	5300	17.69	4.69
1730	5300	17.74	4.59
1620	5300	17.91	4.51
1524	5300	17.96	4.52
1432	5300	18.02	4.53
1330	5300	18.07	4.41
1240	5300	18.17	4.43
1116	5300	18.4	4.35
996	5300	18.67	4.74
880	5300	18.89	4.85
771	5300	18.98	5.26
662	5300	19.12	5.77

River Sta	Q Total (cfs)	Water Depth (ft)	Channel Velocity (ft/s)
539	5300	19.43	6.06
407	4303.93	19.6	5.36
313	4294.33	19.74	5.13
170	5300	19.8	5.39

The 2D component of the HEC-RAS model consists of three flow areas, the North Overbank, South Overbank and East Overbank areas. A normal depth boundary conditions was set for the North and South Overbank areas. There are 197 break lines present, which model the roadways, bridges. In the 2D overland model, blocked obstructions were used to model buildings that laid within the floodplain. An overland Manning's n of 0.06 was used for the three flow areas for medium intensity developed land cover. The flow data was inputted into the model as initial boundary conditions for each river reach. A summary of the flows is shown in **Table 2**.

Table 2 Initial Flow Data

Reach	River Station	Initial Flow (cfs)
Smoke Creek Upstream	22517	2900
Smoke Creek Downstream	9838	5300
South Branch	12151	2900

Results of the 2D model show the flood inundation boundary for the 50-, 100- and 500-year storm events. **Figure 1, Figure 2 and Figure 3** show these inundation maps.

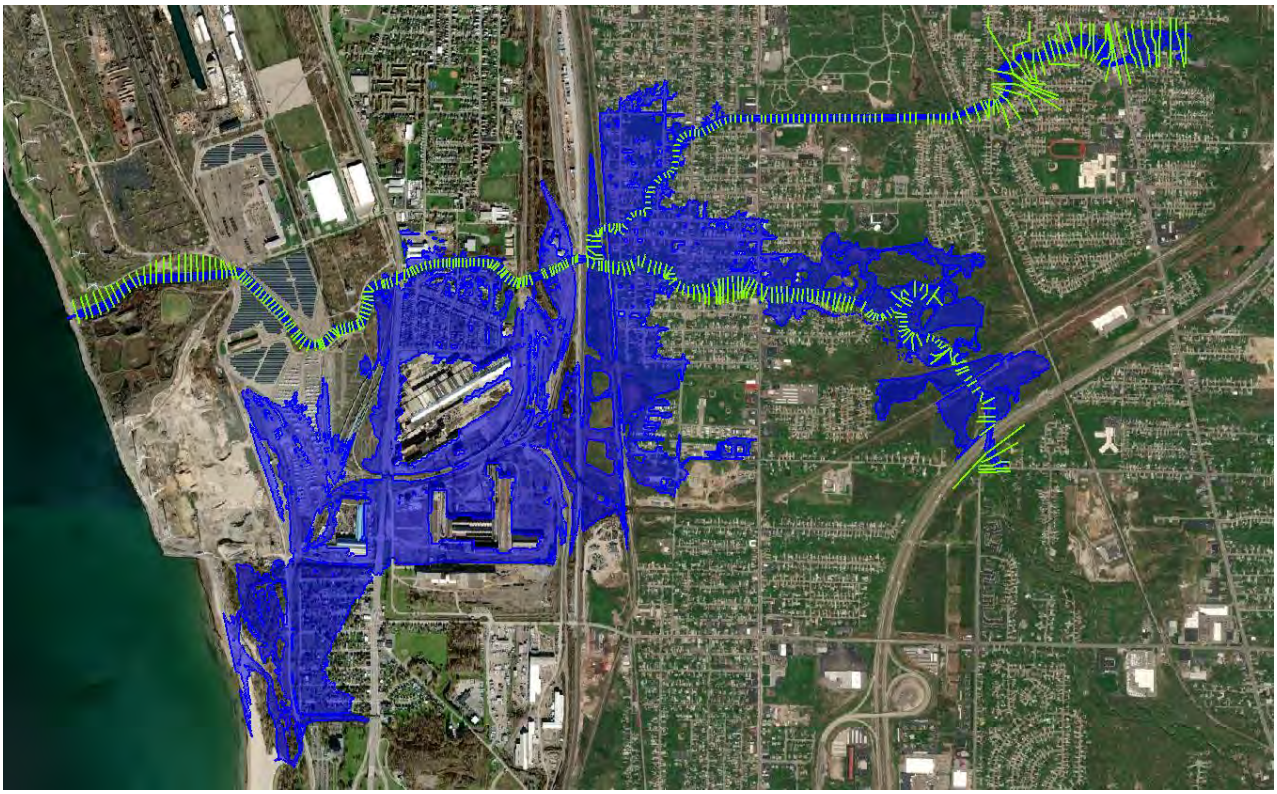


Figure 1 Inundation boundary for the 50-year event

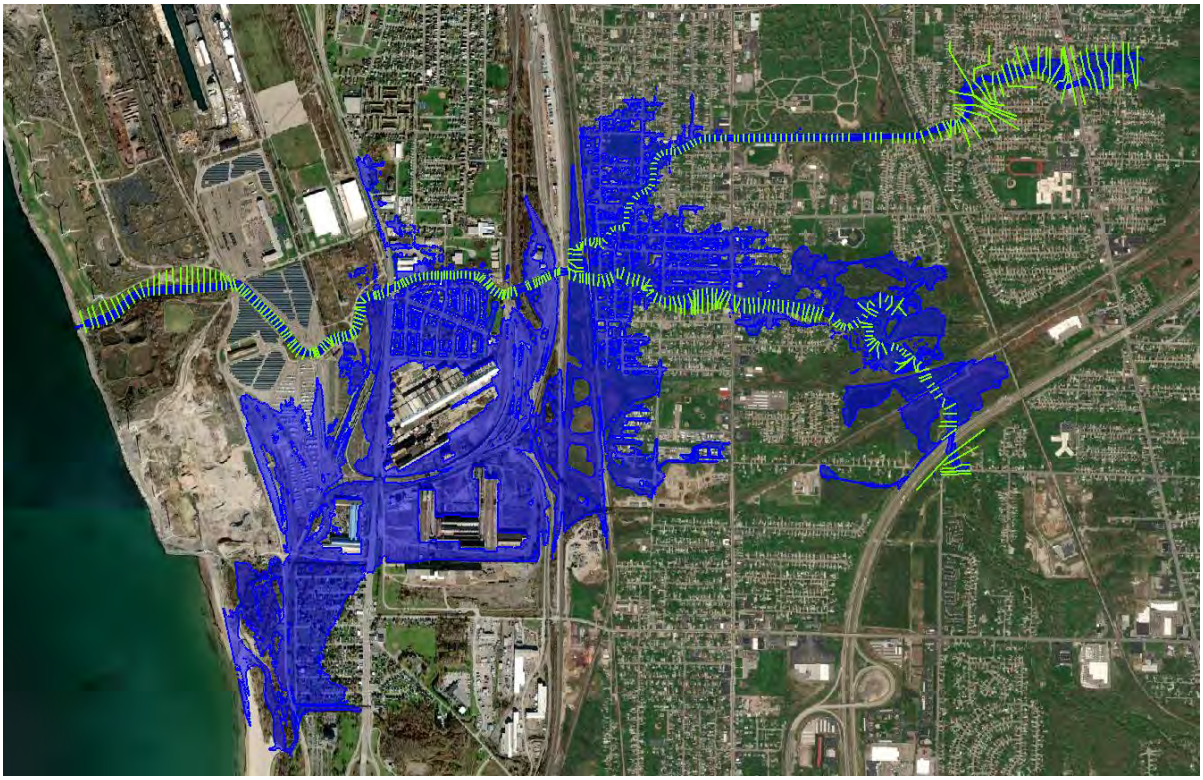


Figure 2 *Inundation boundary for the 100-year event*

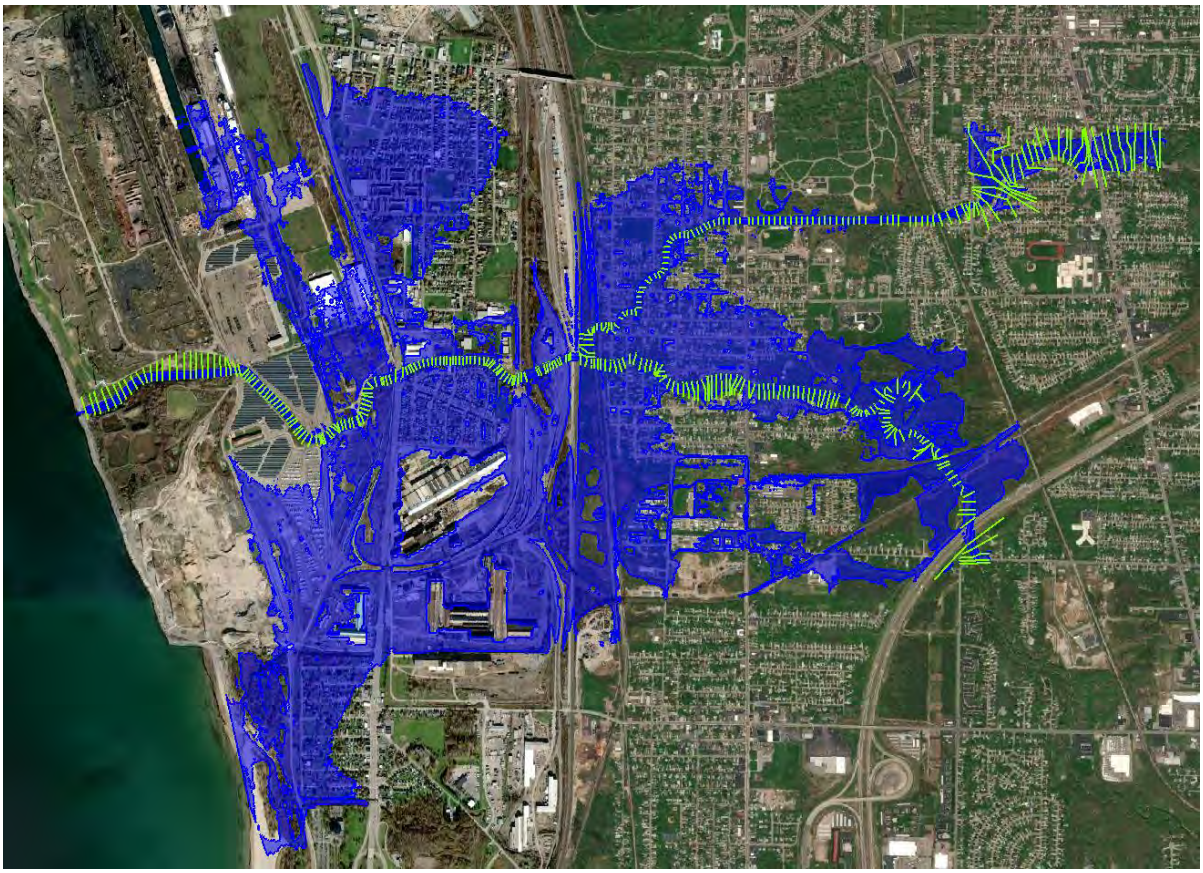


Figure 3 *Inundation boundary for the 500-year event*

Figure 4 and Figure 5 show the water surface elevation at cross sections 880 and 5742 within the channel for the 10-, 50-, 100- and 500-year storm events. Cross section 880 is located near the mouth of the creek and cross section 5742 is located closer to the upstream end of the project area, below the Hamburg Turnpike. The location of these cross sections is shown in **Figure 6**.

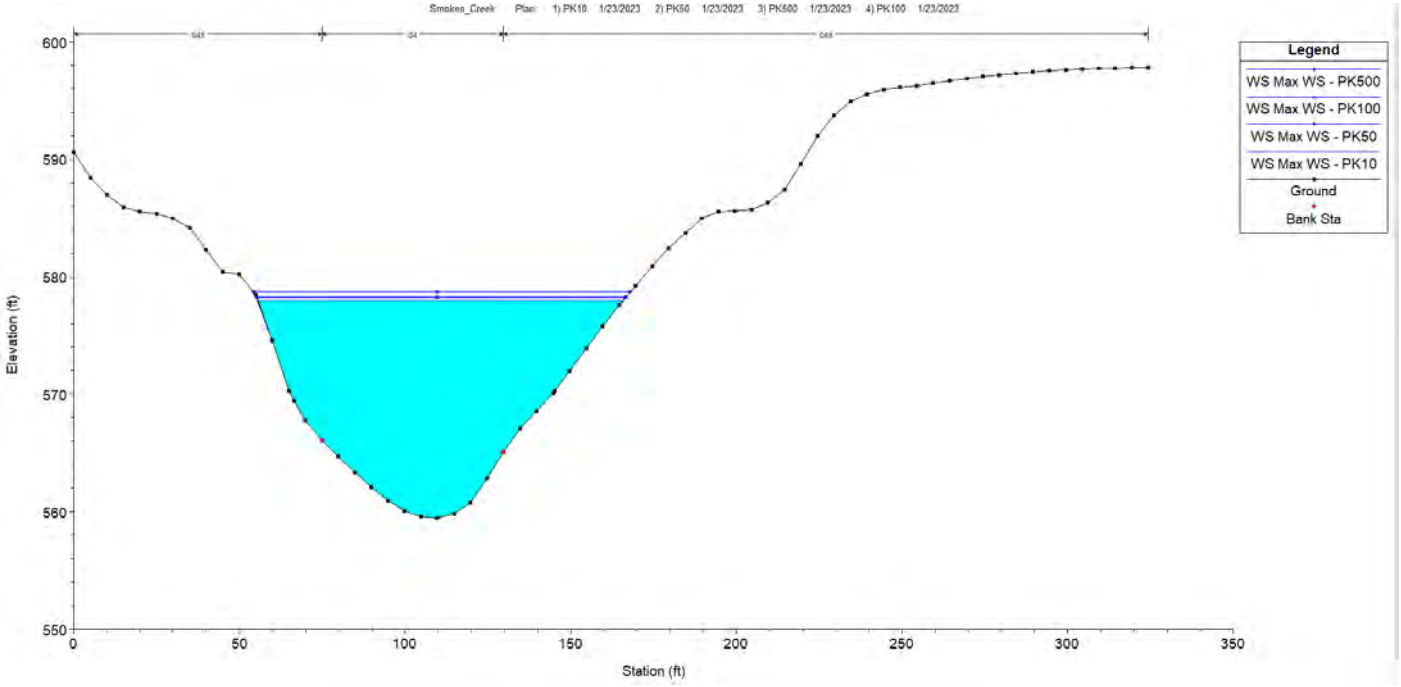


Figure 4 *Water Surface elevations for Cross Section 880*

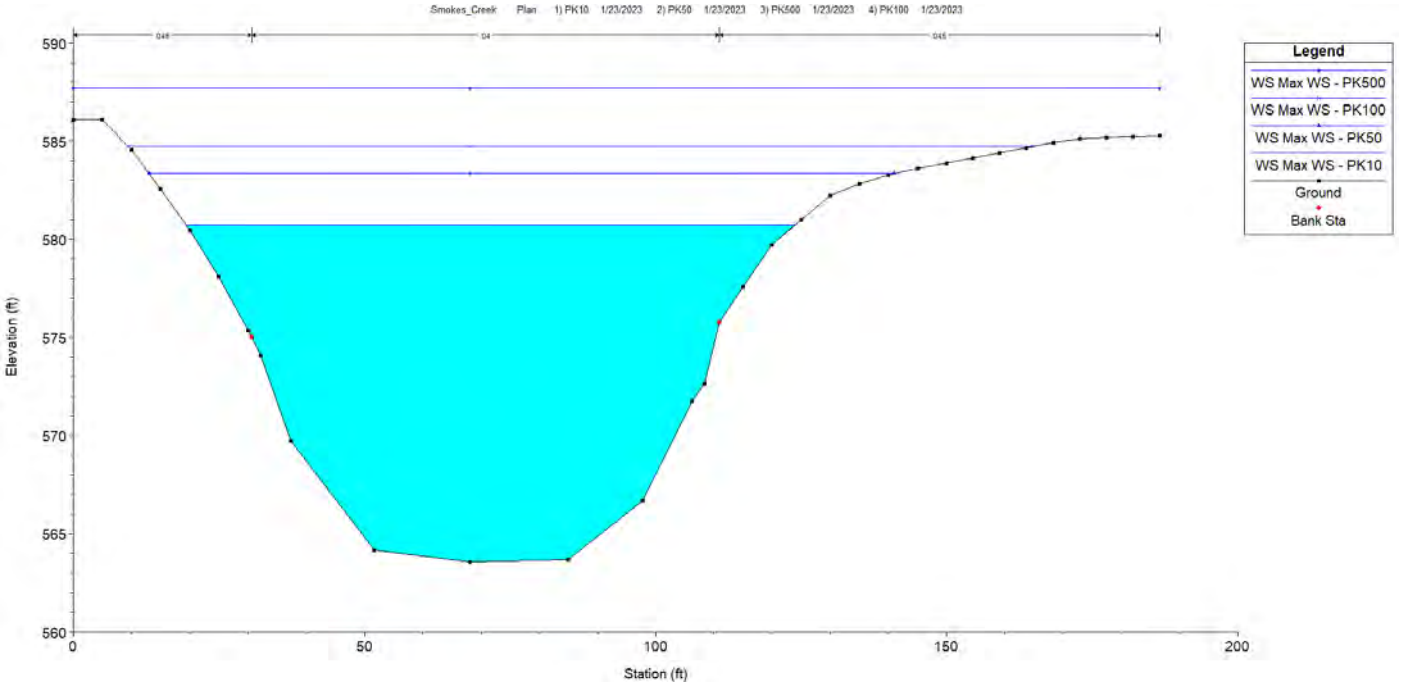


Figure 5 *Water Surface Elevation for Cross Section 5742*

Figure 6 Cross Section Locations

4. Fluvial Geomorphic Processes Overview

The mouth of Smokes Creek drains into Lake Erie at the former Bethlehem Steel Corporation Lackawanna Facility property, south of Buffalo Harbor. From the late 1800s and throughout the 20th century the property was used primarily for iron and steel production. Initially, facilities were built along Lake Erie's shoreline; however, iron-making and steel-making slag deposits advanced the shoreline into the Lake. The historical filled land was formed between circa 1900 and 1968 (TurnKey Environmental Restoration LLC, 2019). Plate 4-1A in TurnKey Environmental Restoration LLC's Corrective Measures Study Report for Tecumseh Redevelopment Inc. (2019) shows historic Lake Erie shorelines for the Tecumseh Redevelopment Site, including the mouth of Smokes Creek. The oldest available shoreline is from 1912 and suggests Smokes Creek discharged directly into the Lake near the present railroad crossing, approximately 0.5 miles from the present outlet. It is possible the outlet was even further east under pre-development conditions, but detailed shorelines circa 1900 were not available.

In addition to the slag filled areas, there were two federal dumping grounds near the mouth of Smokes Creek that extended offshore (also depicted in Plate 4-1A). The dumping grounds were used for USACE dredged material and other waste material from Buffalo Harbor, Buffalo River, and Black Rock Canal (TurnKey Environmental Restoration LLC, 2019).

Today, Smokes Creek flows through the Slag Fill Areas as a confined trapezoidal channel with a very low gradient. The low gradient results in low velocities, which would only entrain sediment up to approximately 3 in in diameter according to the HEC RAS model output.

GHD staff observed that the lower reach of Smokes Creek, west of Hamburg Turnpike (highway 5), had almost no natural floodplain and was entrenched into the reclaimed land during a site visit on July 26, 2023. Photographs from the site visit are included in the **Attachment 1**. The banks at the mouth of the creek are large steel caissons confining the flows. Further upstream the banks are either vertical sheet pile, concrete vertical walls, or hardened vegetated banks. Where vegetation exists along the banks it is primarily shrubs with few trees. The bank material appears to be composed of hard artificial materials like asphalt and packed slag material, however vegetation covers most of the bank and immediate riparian area. The steep hard banks throughout the lower reach of Smokes Creek provide little to no sediment for transport downstream. Therefore, typical fluvial processes do not dominate the Smokes Creek mouth morphology.

The bar that regularly builds at the mouth of Smokes Creek must be formed by offshore processes given the limited sediment supply from the Creek. The Creek discharges into Lake Erie at the Smokes Creek Shoals, one of few primarily gravel shoals that are shallow enough to support spawning of warm water fish species (City of Lackawanna, 2018). The Shoals are likely made up of, at least in part, slag deposits from the industrial and federal waste previously mentioned, providing a nearly infinite sediment supply. Offshore waves move the shoal material onshore, forming a barrier at the Smokes Creek outlet. Without high velocities coming from Smokes Creek to break through the barrier, it builds up until it reaches the height of the wave runup. The Creek likely backs up until flows overtop and erode the bar. We understand that dredging of the mouth is required every year which suggests that flood events are not able to sufficiently flush out the bar material built-up at the mouth. We understand that this leads to backwater flooding. The barrier was partially obstructing the mouth of Smokes Creek during the site walk on July 26, 2023. The bar material ranged from sand to cobbles (up to approximately 10 in diameter). This suggests that the material is likely coming from offshore and transported by waves since the modelled velocities within the Creek are too low to transport cobbles that large. Waves driven by South-Westerly winds over the full lake fetch are able to entrain and transport the larger stone material observed in the bar and on the beach given The Smokes Creek Shoal provides a large source of sediment which in conjunction with the low Creek gradient and consequently low flow velocities, creates ideal conditions for deposition within the mouth of the creek.

5. Improvement Opportunities and Constraints

This section outlines proposed improvement opportunities for Lower Smokes Creek, including constraints. GHD reviewed the *Operation and Maintenance Manual for Local Flood Protection Project on Smokes Creek at Lackawanna, New York* (USACE, 1972) to ensure the proposed opportunities do not interfere with flood control activities. Additionally, GHD reviewed the USACE (2013) *Modifications for the Improvement of the Environment, Scoping Information* Report. The *South Branch Stream Channel Reconnection* and *South Branch Wetland Enhancement* described in USACE (2013) are outside the Lower Smoke Creek study area. The *Main Stem Riparian Enhancement* and *Rubblemound Jetties* proposed in USACE (2013) are discussed as they pertain to GHD's proposed improvement opportunities.

5.1 Increase Floodplain Access

Given the hydraulic and sedimentary processes dominating the mouth of Smokes Creek, a suitable flood mitigation restoration solution may include reconnecting Smokes Creek to the floodplain and/or creating coastal wetlands. The large offshore sediment source and the low velocities through Smokes Creek make it challenging to develop solutions without the presence of a barrier at the mouth. As such, creating suitable areas to direct the floodwater is recommended.

Reconnecting Smokes Creek to the floodplain involves creating a second stage for floodwaters near the mouth of the creek, increasing the capacity of the channel. While there are terraces above the creek banks, which were likely used for vehicle access, they are too high to be inundated during frequent flood events. Therefore, the terraces would be lowered by excavating the existing bank material and potentially also widening the terraces.

Coastal wetlands occur naturally around the Great Lakes, including Lake Erie (Herdendorf, 1992). The mouth of Smokes Creek likely consisted of estuarine wetlands prior to development. Creating wetland habitats to add flood storage and reduce backwater flooding of the Creek would require excavating areas behind the Creek banks near the mouth. In addition to managing flooding, coastal wetlands can provide ecosystem functions like nutrient retention and habitat enhancement.

There are several constraints pertinent to restoring to the proposed restoration designs for Smokes Creek. First, whether lowering the terrace along the Creek's lower reach or creating wetlands behind the Creek banks, considerable excavation would be required given the height of the banks. Second, increasing the flood limits may act to reduce the overall flow velocities as the water depth for any given flow will be reduced. This would likely not be compatible with the *Operation and Maintenance Manual for Local Flood Protection Project on Smokes Creek at Lackawanna, New York* (USACE, 1972). Further, the Creek banks and adjacent lands are primarily slag deposits and potentially contain contaminated material, creating a risk for remobilizing contaminants and considerable costs for disposal. The contaminated sediments may also pose challenges for establishing floodplain and/or wetland flora and fauna, which may be important for providing secondary ecosystem functions. Finally, the water quality of Smokes Creek will influence the potential for biota to establish. During the site walk, hydrocarbons appeared to be upwelling from Smokes Creek at several locations.

5.2 Modifications to the Creek Mouth

The USACE (2013) report presents a potential improvement for the creek mouth consisting of rubblemound jetties extending offshore. These jetties are intended to better maintain an open creek mouth. However, the report notes that deposition will still occur at the new mouth and longshore sediment transport would be deposited on the south side of the mouth. Specifically, of the estimated 2,550 cubic yards (CY) per year currently shoaling at the inlet (25% of the total littoral transport, which USACE (2013) estimated is 10,200 CY per year), the report states that 1,020 CY would deposit at the mouth of the inlet with the jetties installed. While the deposition at the mouth would need to be dredged less often (every 2-3 years), it would be more difficult to access to dredge. The report explains that "marine based equipment and a hydraulic dredge" would be needed to clear the new inlet.

Further, it is likely that as material builds up along the southern shoreline, the amount of material bypassing the jetties and depositing at the mouth will increase. Eventually, the dredging frequency would approach that which was required prior to the rubblemound placement. USACE (2013) estimates this equilibrium will likely be reached after approximately 9 years. Deposition on the south side of the jetties may require regular maintenance to artificially bypass sediment to the north. USACE (2013) suggests that a hydraulic dredge will need to move material from the south fillet to the shoreline north of the creek mouth every 3-5 years. This additional dredge, transport and placement of material is not currently required.

An alternative to construction of jetties at the mouth of the creek could be widening of the creek mouth. The creek mouth at present is constrained by high steel caissons on either side of the creek. Wave deposited sediment forms a bar between the caissons which can restrict flows through the mouth. The height of the bar or beach at the mouth is limited by the wave runup height. A wider mouth could allow for a greater cross-sectional area for flow across the top of any bar or beach deposits. Although a wider creek mouth may reduce velocities in the channel, the velocities are already too low to breach the bar at the mouth. Additionally, the material forming the bar is predominately from the offshore shoals, not sediment transport through the channel. As such, it is unlikely that further reducing channel velocities at the creek mouth will increase deposits. This alternative, however, would need to be further investigated with a combined flow, wave and sediment transport 2-dimensional numerical model to see if it would reduce flooding upstream. The USACE (2013) report does not document the methods used to evaluate the proposed jetty alternative. It is recommended that additional numerical modelling be completed to evaluate the alternatives for the creek mouth.

5.3 Bank and Riparian Enhancement

Lower Smokes Creek between the Hamburg Turnpike and Lake Erie lacks a treed riparian zone to provide shading to reduce water temperatures within the creek. The aquatic and riparian habitat could be enhanced by significant tree planting along the banks of the creek where feasible. This aligns with the proposed *Main Stem Riparian Enhancement*

described in USACE (2013). Additionally, potions of Lower Smoke Creek contain tall vertical sheet pile banks. These vertical banks constrict the flood plain and do not provide any habitat benefit. These banks could be improved by removal of the sheet pile and replacement with low terraced banks or even a sloped embankment that could be planted with native material. If it is impractical to remove sheet pile banks due to constraints such as the presence of contaminated material, infrastructure close to the creek or high embankments next to the creek, then an alternative could be the addition of a vegetated rock buttress at the toe of the sheet pile wall. This would add vegetation cover and additional microhabitat and refugia. Any increase in roughness or impact to flood capacity would need to be reviewed within the context of the *Operation and Maintenance Manual for Local Flood Protection Project on Smokes Creek at Lackawanna, New York* (USACE, 1972).

5.4 Aquatic Habitat Enhancement

Lower Smokes Creek water level is generally controlled by lake levels due to the low creek gradient, except when there is a significant bar at the mouth. This reach of the creek acts as a freshwater estuary where creek and lake waters mix making it a unique aquatic habitat.

It appears that the bed of the creek is likely devoid of morphological variability that would be found in more natural systems. The aquatic habitat could be enhanced by the addition of features such as shoals, pools, boulder clusters, root wads, and woody debris. Lower Smokes Creek is, however, a flood control project, so “no fills, structures, or construction of any type shall be placed within the channel limits” (USACE, 1972). Therefore, aquatic habitat enhancement within the channel is not a feasible design alternative within this framework.

6. Model Requirements for Design

For the purpose of evaluating the floodplain, the existing HEC-RAS model has sufficient detail and would not require modifications. If bank modifications are necessary, the existing cross sections may need to be extended. Also, in order to evaluate any changes proposed at the mouth of the creek, the development of a numerical model is needed. This alternative would require further investigation using a combined flow, wave and sediment transport 2-dimensional numerical model to determine if work at the creek mouth would reduce upstream flooding.

7. References

TurnKey Environmental Restoration LLC. 2019. Corrective measures study report.

City of Lackawanna. 2018. Local waterfront revitalization program.

Herdendorf, C. E. 1992. Lake Erie coastal wetlands: an overview. Journal of Great Lakes Research.

US Army Corps of Engineers. 2013. Sections 1135: modifications for improvement of the environment.

US Army Corps of Engineers. 1972. Operation and Maintenance Manual for Local Flood Protection Project on Smokes Creek at Lackawanna, New York.

Project name		OGS - Smokes Creek Lake Erie Habitat Connectivity & Improvement					
Document title		Report | OGS – Smokes Creek Lake Erie Habitat Connectivity & Improvement					
Project number		12572245					
File name		12572245-MEM-01-Lower Smokes					
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
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Attachments

Attachment 1

Photographic Inventory

Lower Smokes Creek

Photo 1 Mouth of Smokes Creek. Note steel caissons and gravel/cobble bar.

Photo 2 View facing south across the mouth of Smokes Creek. Note the wide beach.

Photo 3 Beach gravel and cobble.

Photo 4 Terraced banks with herbaceous vegetation cover and limited shrubs and trees.

Photo 5 Exposed asphalt type material in the vertical portions of the terraced banks.

Photo 6 Flat terrace area for access.

Photo 7 Exposed asphalt type material on the steeper parts of the terrace.

Photo 8 The toe of the creek bank was generally stable.

Photo 9 Vertical steep pile wall and old railway crossing.

Photo 10 Outlet, rail abutments and vertical sheet pile.

Photo 11 Outlet between 2 old railway crossings.

Photo 12 View upstream towards Hamburg Turnpike. Banks were uniform and stable.

Appendix C

Focus Area Implementation Plans

Focus Area: Tecumseh – Lower (TL)

Location: City of Lackawanna, the mouth of Smokes Creek at Lake Erie (42.811638, -78.863012)

Size: ~100 acres

Ownership: 100% Private – Tecumseh Redevelopment Inc.

Existing/historic conditions/land use: Historically the location of the Bethlehem Steel Corporation's Lackawanna facility. Iron and steel making ended in 1983, coke production ended in 2001, and steel rolling and galvanizing ended in 2009. Approximately 440 acres along two miles of Lake Erie waterfront are primarily manmade land where iron and steel slag and waste were disposed. Aerial photos from 1912 indicate that Smokes Creek discharged into the Lake near the railroad crossing which is located approximately one-half mile inland from the present-day mouth of mouth of Smokes Creek. The site is now managed under NYSDEC Resource Conservation and Recovery Act (RCRA) program.

Site Description: The mouth of Smokes Creek drains into Lake Erie at the former Bethlehem Steel Corporation's Lackawanna facility property, south of Buffalo Harbor. The creek flows through slag and waste deposits as a confined trapezoidal channel with a very low gradient, resulting in low velocities. The lower reach of the creek has almost no natural floodplain and is entrenched into the reclaimed land. The banks at the mouth of the creek are large steel caissons confining the flows. Further upstream the banks are either vertical sheet pile, concrete vertical walls, or hardened vegetated banks. Where vegetation exists along the banks it is primarily shrubs with few trees. The bank material appears to be composed of hard artificial materials like asphalt and packed slag material, however vegetation covers most of the bank and immediate riparian area. A bar regularly builds at the mouth of the creek, composed primarily of sands, gravel, and cobbles. The lower reach of Smokes Creek is part of the ACOE flood control project. The shoreline of Lake Erie has been expanded due to buildup of slag and waste materials. To the south of the creek and above the bluffs of the shoreline, the site is made up of several containment mounds from the remediation stage of cleanup. A plan is proposed to convert this area to a greenspace for the community that will include trails, sculptures, an event area, a play area, and meadows.

Goals: Maintain/Restore water quality (thermal focus), Protect and enhance natural communities, Expand/support public access opportunities and environmental awareness

Recommended Opportunities (Refer to Tecumseh-Lower Implementation Plan Map):

<u>TL1 – Riparian enhancement and invasives management (within flood control channel)</u>
This action proposes removing invasive plant species on the banks of the ACOE flood control channel and replacing them with native grass, forb and shrub species that will not reduce hydraulic capacity of the channel. A site assessment should be completed to characterize existing vegetative cover, soil (texture, organic content, nutrients) and hydrologic conditions with respect to expected frequency of inundation. The vegetation establishment will include establishment of vegetation on the lower banks of the channel that is adapted to periodic inundation while the middle and upper banks of the channel will be targeted to species that are

suitable for dryer conditions. The native plants provide quality habitat for wildlife that uses the riparian zone but will also increase shade cover to the channel thereby reducing water temperatures and improving conditions for aquatic species. Implementation of this opportunity will be limited to sections of the channel that do not include sheet piling and other structures.

TL2/TL3 – Coastal Bluff and Riparian Corridor Restoration

A 100–200-foot corridor of grassland and oak-hickory woodland is proposed along the shoreline and top bank of the flood control channel. This buffer zone would be measured landward from the Ordinary High Water Level (OHWL) of Lake Erie or the limits of the Smokes Creek Floodway. A site assessment of vegetation, composition of fill material, and any RCRA requirements apply. Restoration should focus on several key components: clean up of hazardous materials and debris; topographic contouring to mimic coastal shoreline landform, placement of soil cover and amendments; and establishment of native grassland and woodland communities. The target plant communities will be low stature species adapted to exposed conditions typical along the coast and may include scattered trees and shrubs. Access along the inside edges of these areas will provide opportunities for future park users to access the coastline and river while at the same time servicing as a protective buffer. Outside of the channel the area is disturbed and sparsely vegetated. The opportunity includes removing existing introduced grasses and any invasive species and reseeding to native short-height grasses and forbs. Subject to final soil conditions and future parks and open space plans, a vegetation landscape plan will be developed that is compatible with future uses of the site.

TL4 – Coastal Beach Restoration

The shoreline zone defined by TL4 is a sparsely vegetated, high-energy environment subject to waves, ice and occasional storms. As part of the site evaluation described for TL2/TL3, a geomorphic assessment of shoreline erosion potential, as well as lake level and wave and runup modelling, should be completed to quantify storm-related risks and alternatives to prevent shoreline erosion. Costs for TL4 are to be determined.

TL5 – Future Parks and Open Space

Ecological components of the future parks and open space plan will be developed in coordination with the ongoing parks and open space planning effort. Costs for TL5 are to be determined.

TL6 – Modifications to the Creek Mouth

Currently, the bar that forms at the mouth of Smokes Creek is regularly dredged as the creek velocities are not sufficient to mobilize the material deposited by the waves. This increases the risk of flooding upstream as the bar backs up the flows. The source of the bar material is likely the Smokes Creek Shoals rather than material being conveyed from upstream. Rubblemound jetties are common coastal structures used to manage sediment deposition at a channel mouth. The structures may reduce the frequency of dredging required, but it will not eliminate the bar permanently. The bar will also form further offshore, making dredging more difficult. An alternative could be widening the creek mouth. The creek mouth at present is constrained by high steel caissons on either side of the creek. The height of the bar or beach at the mouth is limited by the wave runup height. As such, a wider mouth could allow for a greater cross-sectional area for flow across the top of any bar or beach deposits in between dredging events. Given the already low velocities in the creek, it is unlikely that further reducing channel velocities will increase deposition at the mouth. Either alternative will need to be further

investigated with a combined flow, wave, and sediment transport 2-dimensional numerical model to assess the functionality of the alternatives. Costs for TL6 are to be determined.

TL7 – Shoals

Smokes Creek transports sediment to a "significant coastal habitat" – the 500-acre shallow water Smokes Creek Shoals – in Lake Erie. The Smokes Creek Shoals was designated a NYS DOS "significant coastal area" due to its importance as spawning and nursery grounds for walleye, smallmouth bass, perch, pike, and other species. The first mile of Smokes Creek is heavily degraded due to channelization from ACOE project and contamination from the Bethlehem Steel plant. Upstream from the ACOE flood control project, Smokes Creek does provide suitable habitat for fish although it is limited by lack of cover and passage blockages.

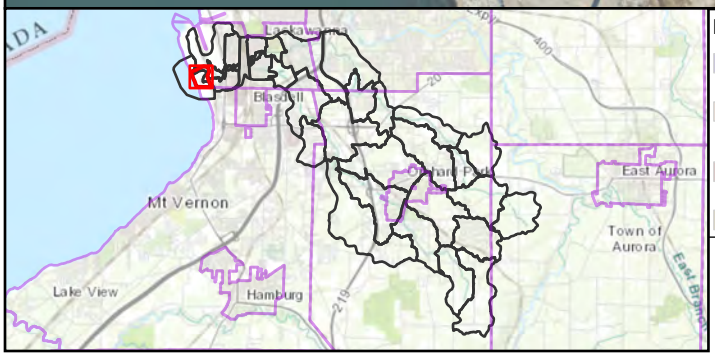
This recommendation opportunity includes research for new data (bathymetry, spawning, species composition, vegetation/forage availability, mussel populations and habitat, etc.) to understand how the shoals are functioning and changing, and to help guide fisheries management. In addition, evaluating the extent of mussel habitat and submerged/emergent aquatic vegetation will be important to determine the need for habitat restoration in line with the goals and objectives of the binational Lake Erie Lakewide Action and Management Plan and the Niagara River Area of Concern Remedial Action Plan. Costs for TL7 are to be determined.

Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design	Construction	Total
TL1	Riparian Enhancement	7 ac.	$3,000	$10,000	$13,000
TL2/TL3	Coastal Bluff and Riparian Corridor Restoration	24 ac.	$84,000	$280,000	$364,000
			$87,000	**290,000**	**$377,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate but will vary per project.
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection.
- Cost estimates for TL4-TL6 are not included because there is a high degree of variability for these items and factors related to open space planning and design work.



Legend

- Coastal Beach Restoration
- Coastal Bluff and Stream Corridor Restoration
- Flood Channel Invasive Management
- Future Parks and Open Space
- Modifications to the Creek Mouth
- Riparian Corridor Restoration
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 160 320 480

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Tecumseh-Lower Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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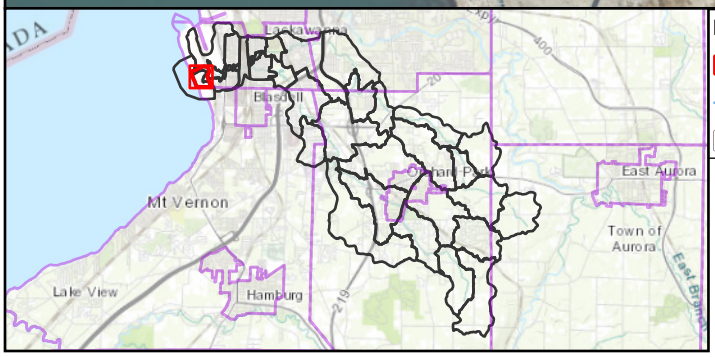

Legend

- Focus Area Boundary
- Stream Reach
- Private Land Parcels

Paper Size ANSI A

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US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Tecumseh-Lower Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Data source: GHD, 2023; Erie county; RAVI orthoimagery, 2023; DEC wetlands; World Topographic Map: Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA; World Topographic Map: Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS; USA NAIP Imagery: Natural Color: Esri, USDA Farm Service Agency; World Topographic Map: Province of Ontario,

Focus Area: Tecumseh - Upper (TU)

Location: City of Lackawanna, Lower Smokes Creek from entrance to Tecumseh downstream to solar panel field (42.811525, -78.847388)

Size: ~19 acres

Ownership: 100% Private – Tecumseh Redevelopment Inc.

Existing/historic conditions/land use: Historically the location of the Bethlehem Steel Corporation's Lackawanna facility. Iron and steel making ended in 1983, coke production ended in 2001, and steel rolling and galvanizing ended in 2009. Approximately 440 acres along two miles of Lake Erie waterfront are primarily manmade land where iron and steel slag and waste were disposed. The site is now managed under NYSDEC Resource Conservation and Recovery Act program.

Site Description: In this upper reach on the Tecumseh property, the creek flows through slag and waste deposits as a confined trapezoidal channel with a very low gradient, resulting in low velocities. The banks are vertical sheet pile, concrete vertical walls, or hardened vegetated banks. Where vegetation exists along the banks it is primarily shrubs with few trees. The bank material is composed of hard artificial materials like asphalt and packed slag material; however, vegetation covers most of the bank and immediate riparian area. This reach is part of the USACE flood control project.

Goals: Maintain/Restore water quality (thermal focus), Protect/Enhance natural communities

Recommended Opportunities (Refer to Tecumseh-Upper Implementation Plan Map):

<u>TU1 – Invasive Species Management</u>

This action proposes removing invasive plant species on the banks of the ACOE flood control channel and replacing them with native grass, forb and shrub species that will not reduce hydraulic capacity of the channel. A site assessment should be completed to characterize existing vegetative cover, soil (texture, organic content, nutrients) and hydrologic conditions with respect to expected frequency of inundation. The vegetation establishment will include establishment of vegetation on the lower banks of the channel that is adapted to periodic inundation while the middle and upper banks of the channel will be targeted to species that are suitable for dryer conditions. Not only will the native plants provide quality habitat for wildlife that uses the riparian zone but will also increase shade cover to the channel thereby reducing water temperatures and improving conditions for aquatic species.

TU2/TU3 – Oak Opening/Woodland Establishment

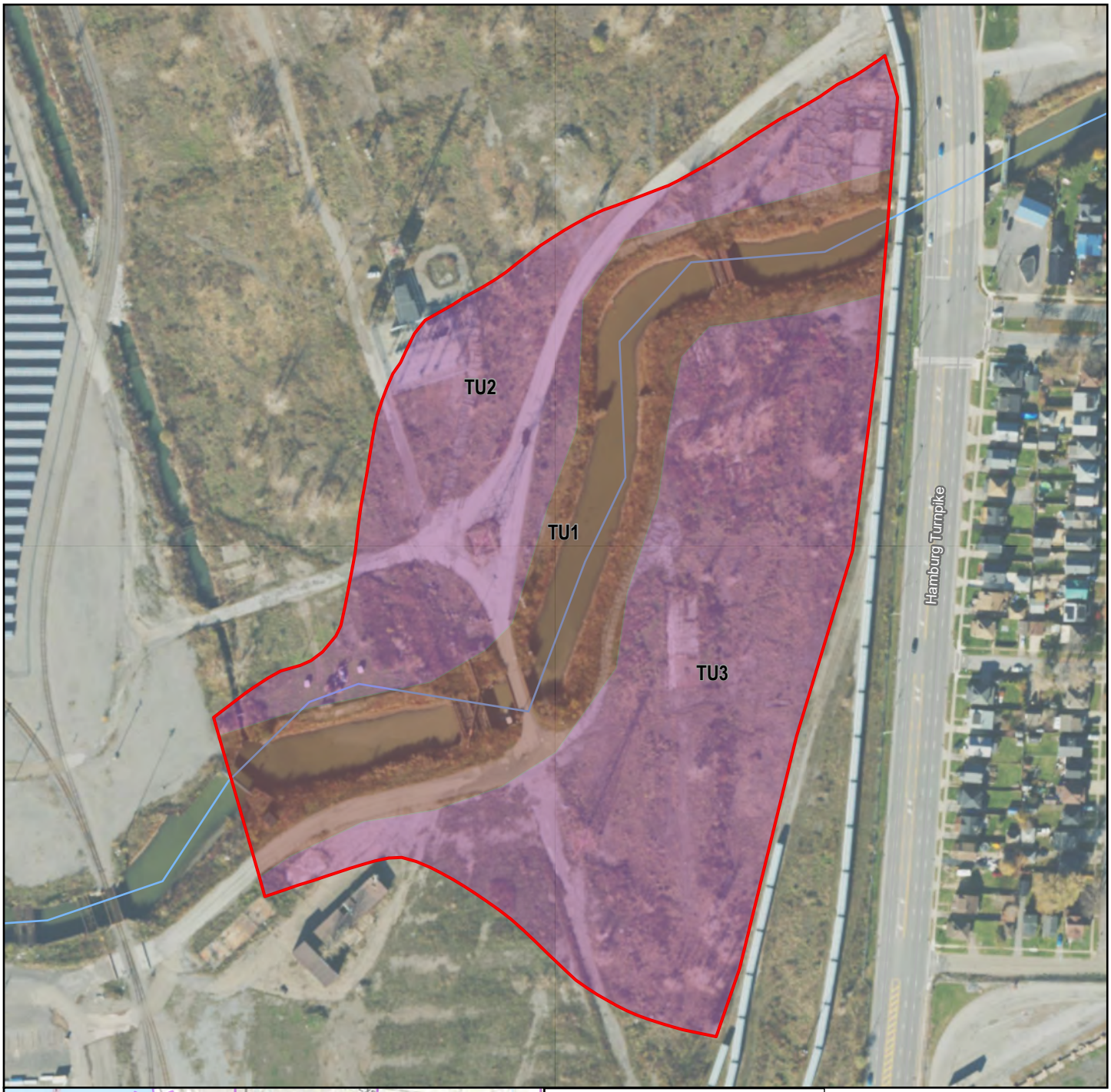
TU2 is an area north of the channel and TU3 is south of the channel; both areas are currently degraded and sparsely vegetated. This opportunity recommends restoring a native upland habitat to improve habitat function. Prior to establishing desired species, the existing introduced grasses and any invasive species should be removed. The target restoration outcome should be an oak-opening community which will eventually transition to an oak-hickory matrix forest. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

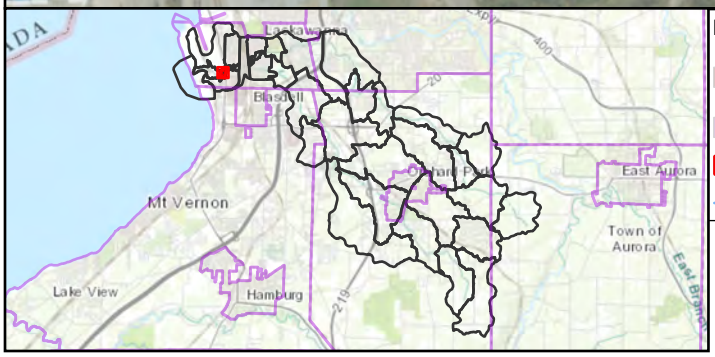
Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design	Construction	Total
TU1	Invasives Species Management	6 ac.	$1,000	$4,000	$5,000
TU2	Oak Opening/Woodland Establishment	5 ac.	$4,000	$14,000	$18,000
TU3	Oak Opening/Woodland Establishment	8 ac.	$7,000	$21,000	$28,000
			$12,000	**$39,000**	**$51,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate but will vary per project.
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection.





Legend

- Flood Channel Invasive Management
- Oak Woodland/Savanna
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 75 150 225

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Tecumseh-Upper Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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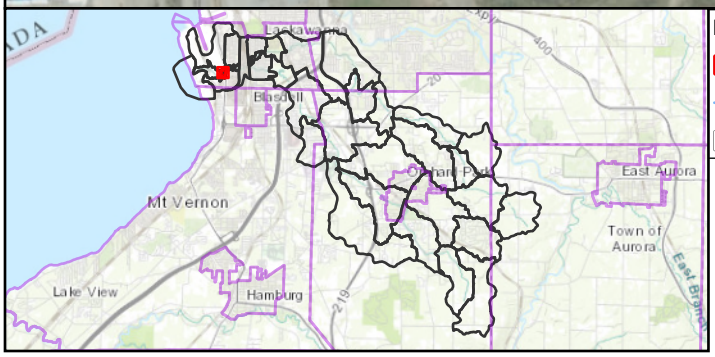

Legend

- Focus Area Boundary
- Stream Reach
- Private Land Parcels

Paper Size ANSI A

0 75 150 225

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Tecumseh-Upper Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Focus Area: Elmview (EV)

Location: From intersection of Abbott Rd. + W. Elmview Ave. to intersection of W. Elmview Ave. + S. Shore Blvd. (NRU-SCL4; 42.822369, -78.803315)

Size: ~10 acres

Ownership: 100% Public (City of Lackawanna) Refer to Elmview Land Ownership Map

Existing/historic conditions/land use: This parcel includes Smokes Creek and a narrow riparian zone with residential development to the north and the south.

Site Description: The site totals 10 acres and is bounded to the north and south by residential development. The east side of the site includes a church with a parking lot that drains directly to Smokes Creek. Downstream of the church, on an outside bend, a wooden retaining wall and rip-rap has been installed to protect residential properties. The retaining wall is experiencing severe erosion behind the structure resulting in holes and dangerous conditions. Although this entire site is on city-owned property, vegetation clearing, mowing, debris dumps and structures and filling into the stream channel occur throughout. A narrow strip of floodplain forest extends discontinuously along either bank on this site. This site is publicly owned land along the creek that offers opportunities to improve the riparian buffer and address stream bank erosion.

Goals: Maintain/Restore hydrologic functions, Maintain/Restore water quality (stormwater runoff focus), Restore longitudinal/lateral floodplain connectivity, Protect/enhance natural communities, Expand public environmental awareness and best management practices

Recommended Opportunities (Refer to Elmview Implementation Map):

<u>EV1 – Riparian Corridor Enhancement (9 acres)</u>
As detailed in Appendix F-Riparian Buffer Guidance, a three-zone riparian buffer should be applied on this site. In most cases, creating an undisturbed stream-side zone of 25-feet and a middle zone of 50-feet that is restored to floodplain forest is possible within the city-owned property. When combined with education and incentives that inform residential landowners on minimizing impacts within the structure setback zone, an effective riparian buffer could be implemented within the Elmview site. In cases where bluffs are present, the recommended setback of buildings and impervious surfaces from the top of bluff is 75-feet. Vegetation management within the streamside and middle zone should be focused on removal and management of invasive species and supplemental planting of floodplain forest (on lower lying flood prone areas) and mesic hardwood forest (on top and side of valley slope). Where existing residential property has encroached into the riparian buffer zone, the priority should be to manage the available area using the same three-zone framework. A detailed survey of instream habitat condition and stream bank erosion should be performed to identify problem areas to be addressed as part of the riparian corridor enhancement project. Aerial photos suggest that there are steep eroding banks that may benefit from bank stabilization through bank treatments like vegetated rock buttresses (detail 1 in Appendix D) or armor stone retaining walls (detail 2 in Appendix D).

EV2 – Streambank Stabilization and Stormwater Management (1 acre)

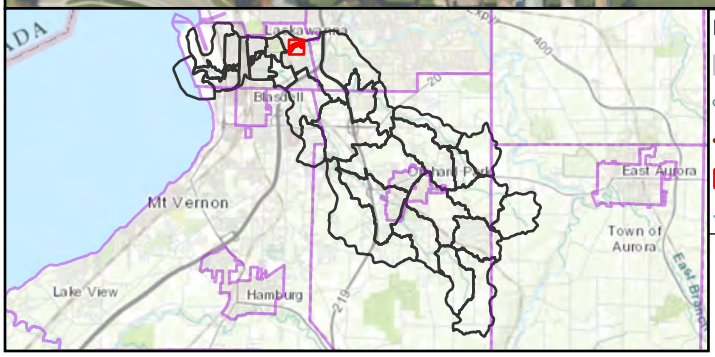
EV2 extends along approximately 400 feet of Smokes Creek and includes a failing wooden retaining wall and rip-rapped bank along an outside bend. Aerial imagery indicates that these structures are resulting in bank erosion immediately downstream of the retaining wall. Stabilizing the bank with a vegetated rock buttress (detail 1 in Appendix D) and armor stone toe may be a suitable alternative to the failing retaining wall. The almost 90^{o} bend in the creek, however, makes the outside bend very susceptible to erosion. A more detailed analysis of the hydraulics, for example with a 1D HEC-RAS model, should be conducted to assess whether the velocities will require a full armor stone retaining wall (detail 2 in Appendix D). In this instance, the upper slope could still be regraded and vegetated to provide some stream cover and additional bank stabilization. A full armor stone retaining wall may be required if there is not enough space to grade back the top of the bank. The impervious areas draining directly into Smokes Creek should be evaluated to determine stormwater design requirements needed to achieve local water quality standards and meet volume and rate control requirements. Potential options include permeable pavement, biofiltration swales or stormwater ponds constructed in accordance with the NY Department of Environmental Conservation Stormwater Management Design Manual. The entire area between the church/church parking lot and Smokes Creek should be planted with grasses and forbs with level spreaders or similar methods used to filter sheet flow runoff before entering Smokes Creek. Where possible, stormwater from impervious areas should be collected and treated within nearby stormwater facilities.

Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
EV1	Riparian Corridor Enhancement	9 ac.	$5,000	$16,000	$21,000
EV2	Bank Enhancement (Armor stone toe with Vegetated Rock Buttress)	400 lf.	$72,000	$240,000	$312,000
EV2	Stormwater Management	1 ac.	$30,000	$100,000	$130,000
			$107,000	**$356,000**	**$463,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate, but will vary per project
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection



Legend

- Riparian Corridor Enhancement
- Riparian Buffer
- Bank Enhancements
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 100 200 300

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Elmview Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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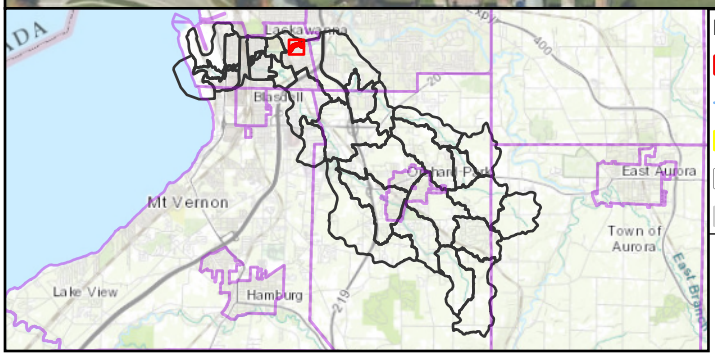

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels
- Other Land Parcels

Paper Size ANSI A

0 100 200 300

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Elmview
Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Focus Area: Hideaway (HA)

Location: 161 Cloverleaf Ave, Lackawanna, NY (NRU-SCL4; 42.823607, -78.799001)

Size: ~12 acres

Ownership: 5% Public, 53% Private, and 42% Unknown (Refer to Land Ownership Map)

Existing/historic conditions/land use: The land use has remained unchanged since before 1995. A nine-hole golf course and driving range is in the eastern portion of the project area.

Site Description: The Hideaway site encompasses eleven acres of riparian corridor along Lower Smokes Creek. The west ½ of the site is bounded on all sides by residential development. The east ½ extends through the Hideaway driving range and a nine-hole golf course. The dominant soils on the site are moderately well drained Teel silt loam. The vegetative cover is dominated by moderate quality floodplain forest.

This site was selected as a potential restoration location based on the following characteristics:

- Some public land along the creek that offer opportunities to improve the riparian buffer
- Potential site to provide naturalized open space and environmental education components (next to residential areas)
- Opportunity to address streambank erosion

Goals: Maintain/restore hydrologic functions, Maintain/restore water quality (thermal focus), Protect and enhance upland natural communities, Expand public access opportunities and environmental awareness

Recommended Opportunities (Refer to Hideaway Implementation Plan Maps (East and West)):

<u>HA1/HA2 – Riparian Corridor Enhancement</u>

The existing riparian corridor is a mixture of floodplain forest, maintained turf and old field that is periodically mowed. This reach includes several areas (generally on outside bends) that have vertical banks and erosion. Area HA1 should be maintained or restored to floodplain forest. The existing tree canopy should be supplemented with additional species to fill in canopy gaps where present and add diversity. Understory shrubs and groundcover grasses and herbs characteristic of drier floodplain forest sites should be introduced through seeding and planting. Invasive species should be removed and managed on an on-going basis. Area HA2 should be converted to short height native grassland that would provide habitat for grassland-obligate species. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. The proximity of this area to nearby residential neighborhood provides an excellent opportunity to engage the community on helping to establish and maintain the grassland and could include incorporation of trails, pollinator patch plantings, and management of invasive species.

<u>HA3 – Riparian Corridor Enhancement</u>

HA3 encompasses a narrow, discontinuous corridor that extends through the golf course and driving range. Existing tree cover should be maintained, and additional tree cover should be planted in gaps to create continuous tree canopy cover within this reach. Supplemental plantings should include floodplain forest trees, shrubs, and groundcover grasses and forbs that are characteristic of drier floodplain sites. Where tree cover is incompatible with the nine-hole course or driving range, short-height native grasses and forbs should be planted

and restricted from mowing except as necessary to maintain the desired grassland vegetation. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. This reach of Smokes Creek should be evaluated to determine if bank stabilization and/or instream measures are warranted.

HA1/HA3 – Streambank Stabilization

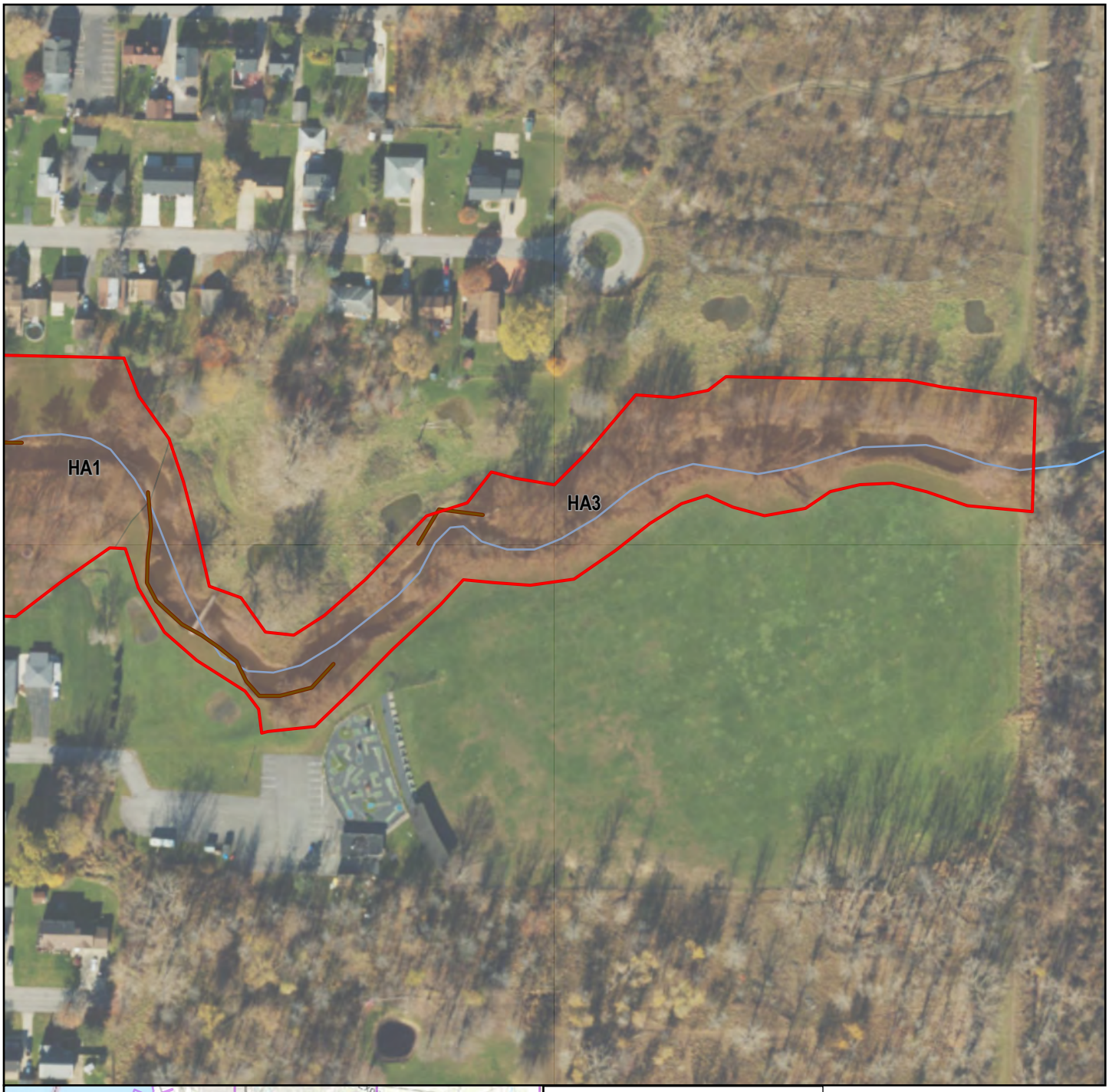
As noted above, there are vertical eroding banks along the outside bends of the stream through HA1 and HA3. Hideaway Implementation Plan Map (West) shows bank segments that may benefit from bank stabilization and enhancement. Using bank treatments like coir logs and live stake plantings (detail 4 in Appendix D) may be well suited to this reach of stream where infrastructure is not at risk, but local stability would aid in reducing the fine sediment load to the creek. This treatment can only be used on lower energy banks. Other options include vegetated rock buttresses (detail 1 in Appendix D) and vegetated layering with stone toe (detail 5 in Appendix D) for areas with higher velocities and shear stresses where infrastructure may need to be protected. These bioengineering treatments provide bank stabilization, will reduce turbidity downstream when applied to actively eroding banks, and will provide stream cover to help regulate stream temperature and improve instream habitat. Where there is limited space to regrade nearly vertical slopes, for example because of nearby buildings, armor stone retaining walls could also be considered (detail 2 in Appendix D).

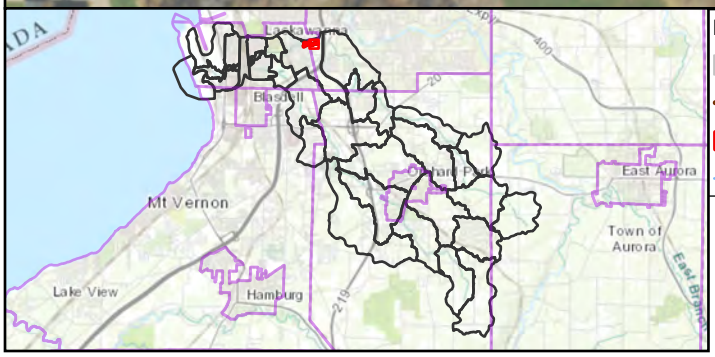
Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design	Construction	Total
HA1 & HA3	Streambank Stabilization (Vegetated Rock Buttress)	1200 lf.	$72,000	$240,000	$312,000
HA1	Riparian Corridor Enhancement	6.8 ac.	$4,000	$13,000	$16,000
HA2	Riparian Corridor Enhancement	1.2 ac.	$1,000	$2,000	$3,000
HA3	Riparian Corridor Enhancement	3.4 ac.	$2,000	$6,000	$7,000
			$79,000	**$261,000**	**$338,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimates, but will vary per project.
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection.
- The construction cost estimate provided for bank stabilization assumes a vegetated rock buttress treatment is chosen for all segments shown in the Hideaway Implementation Plan Map (West). The actual costs will vary considerably depending on re-grading needs and selected bank treatment.





Legend

- Riparian Corridor Enhancement
- Bank Enhancements
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 60 120 180

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Hideaway (East) Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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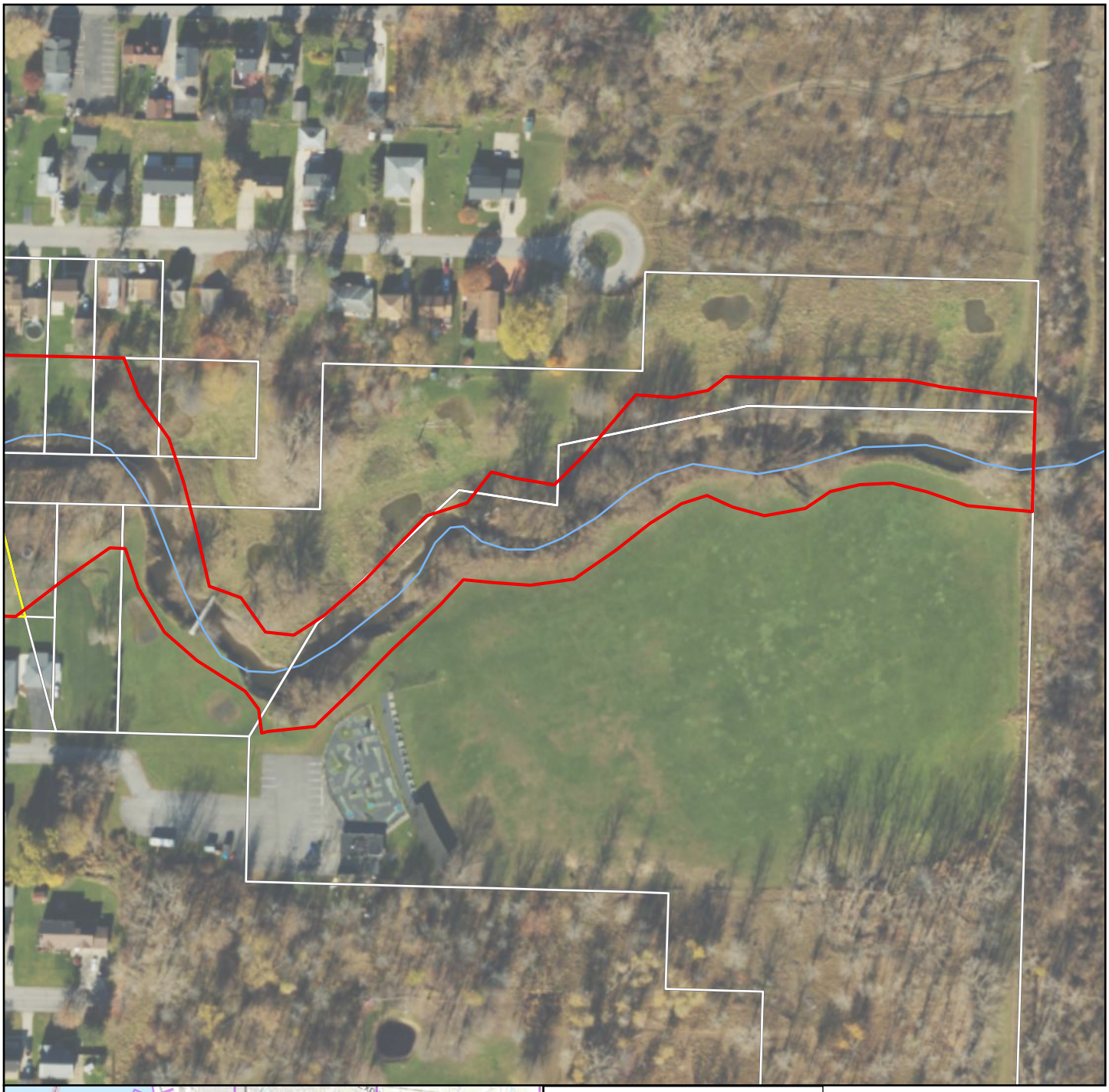

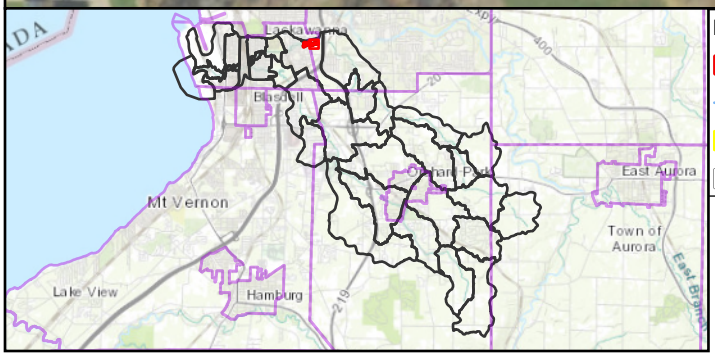

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels

Paper Size ANSI A

0 60 120 180

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Hideaway (East) Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Focus Area: Cemetery (CEM)

Location: City of Lackawanna, the mouth of Smokes Creek at Lake Erie
(NRU-SCL5; 42.819968, -78.818570)

Size: ~38 acres

Ownership: 12% Public and 87% Private and a small portion is Unknown (refer to Cemetery Land Ownership Map)

Existing/historic conditions/land use: In general, the project area has remained unchanged since before 1995. In 1971, the creek was channelized as a part of the Army Corps of Engineers Flood Control Project to minimize flooding to the City of Lackawanna.

Site Description: The Cemetery focus area encompasses 38-acres on either side of the Smokes Creek flood control channel and includes 2,500 linear feet of the flood control channel itself. The portion of the site south of the channel includes both private and city-owned land and could be expanded further south to include additional wetland area. The portion of the site north of the channel is on property owned by Catholic Cemeteries. Soils on the site include moderately well-drained Teel silt loam, and poorly drained Wayland soils, which are classified by the NRCS as a hydric soil. Soils in the flood control channel and adjacent areas are modified by cut and fill activity and may not reflect characteristics noted for the Teel and Wayland soils. The site is bounded on the north by the cemetery, much of which is maintained turf. To the east, the site is bounded by a rail corridor and residential area. The south and west side of the site is bounded by a mixture of commercial, residential, and public parkland. The Smokes Creek flood control channel though this site is approximately 150 feet wide by 12 feet deep and receives stormwater from the north and south portions of the site. The north side of the site includes an emergent marsh and adjacent floodplain forest. The remnants of the former Smokes Creek channel extend through portions of the north side and outlet to the flood control channel. Vegetation on this site is a mixture of dry and wet floodplain forest, emergent marsh, and semi-maintained grassland. At other locations the banks of the flood control channel are dominated by invasive herbaceous species, particularly Japanese Knotweed.

This site was selected as a potential restoration location based on the following characteristics:

- Although not shown on maps, this area could potentially link into South Park Focus Area via City School property
- Site contains emergent marsh and forested wetland with remnants of old river channel that might be re-purposed to route local stormwater
- Potential site to provide naturalized city park/open space with trail and environmental education components (next to school and residential areas)
- Subject to compatibility with floodplain regulations, there may be opportunities to manage stormwater and improve water quality

Goals: Maintain/restore hydrologic functions, Restore longitudinal/lateral floodplain connectivity

Recommended Opportunities:

CEM1 – Floodplain Forest Enhancement/Wetland Watercourse Restoration

A site assessment is recommended to evaluate the quality of the floodplain forest and associated wetland communities, as well as opportunities to create a meandering channel within the wetlands to improve floodplain hydrology. The site assessment should include hydrologic/hydraulic modeling to evaluate the benefits of hydrologic restoration and ensure that the project will not have negative impacts to flood stage and conveyance. Stormwater runoff from the north (including much of the cemetery) flows south into the floodplain forest and an emergent marsh on the east side of CEM1. Storm flows then outlet from the emergent marsh to the flood control channel. The site assessment should evaluate the feasibility of directing flows from the emergent marsh into a restored meandering stream that would outfall into the flood control channel at the west (downstream) boundary of CEM1. This hydrologic modification could improve hydrologic functions within the floodplain forest wetland and provide additional in-stream habitat. Further, the restored stream and forested wetland area, could retain flows within the floodplain, potentially improving flood risk to areas adjacent to the focus area. Given the focus area does include the USACE flood control project, however, it is important that the assessment includes modelling of the hydrologic and hydraulic processes under restored conditions. Vegetation management within the floodplain forest should be guided by the site assessment; but may include invasive species management and supplemental planting of floodplain trees, shrub, and herbaceous species. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

CEM2 – Floodplain Forest Enhancement

The intent of this floodplain forest restoration is to provide greater connectively to habitat north and south of the flood control channel. Subject to landowner interest and compatibility with existing land uses, a corridor could be extended along the public land ownership between CEM2 the South Park focus area. This would create an ecological connection between lower Smokes Creek and the South Branch within the heart of Lackawanna's residential district. Vegetation management within the floodplain forest may include invasive species management and supplemental planting of floodplain tree, shrub, and herbaceous species. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

CEM3 – Riparian Corridor Enhancement

This action proposes removing invasive plant species within the riparian corridor and replacing them with comparable sized natives so the flood capacity of the channel will not be altered. Not only will the native plants provide quality habitat for wildlife that uses the riparian zone but will also increase shade cover to the channel thereby regulating water temperatures and improving conditions for aquatic species. As the reach is within the USACE flood control project, riparian enhancement should not alter floodplain roughness, otherwise it must remain outside of the 100-year floodplain, to avoid altering the flood capacity.

Project Summary and Implementation

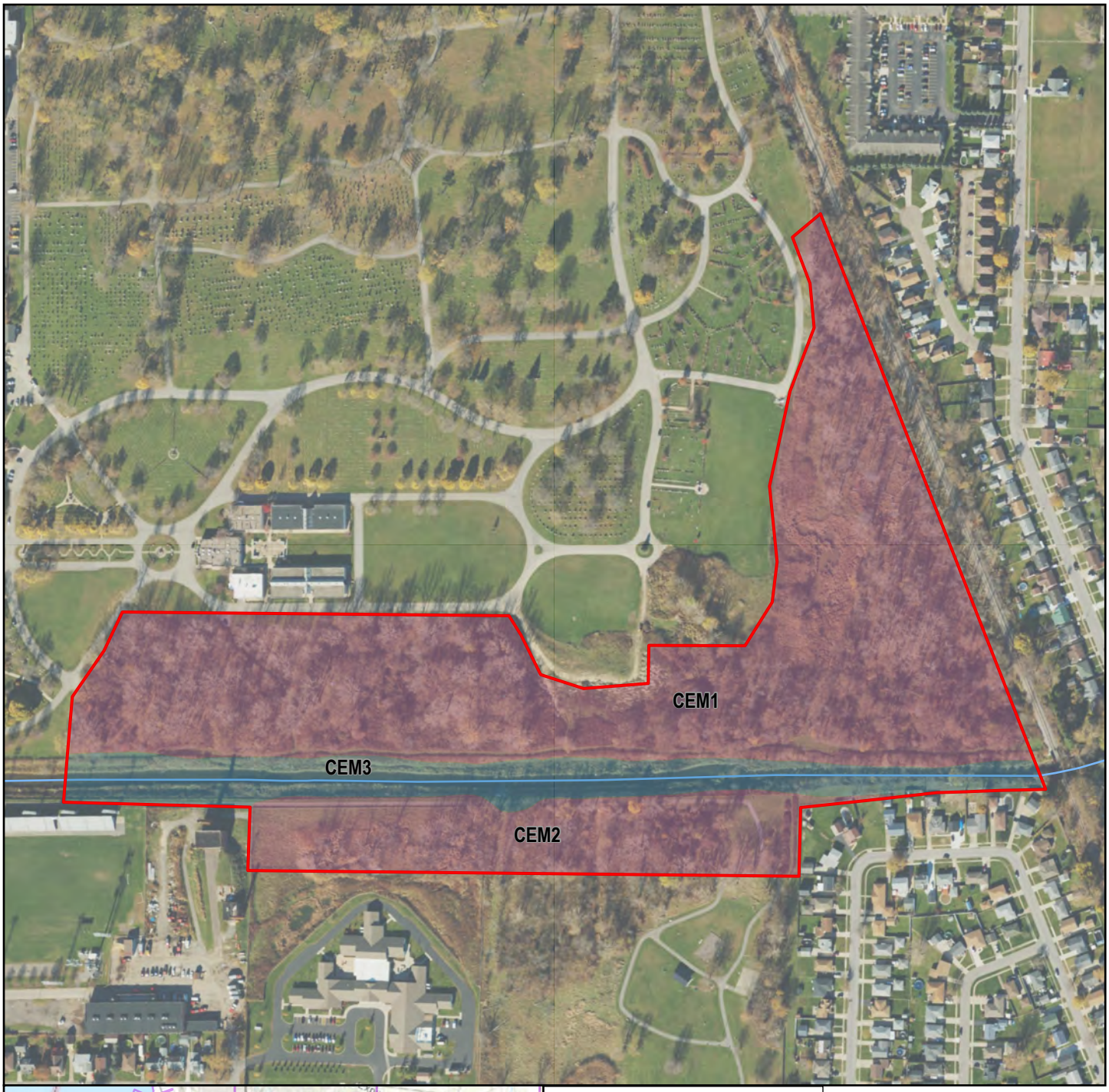
Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design	Construction	Total
CEM1	Wetland Watercourse Restoration	3000 lf.	$540,000	$1,800,000	$2,340,000
CEM1	Floodplain Forest Restoration	25 ac.	$24,000	$80,000	$104,000
CEM2	Floodplain Forest Enhancement	7 ac.	$7,000	$23,000	$29,000
CEM3	Riparian Corridor Enhancement	6 ac.	$1,000	$2,000	$3,000
			$572,000	**$1,905,000**	**$2,476,000**

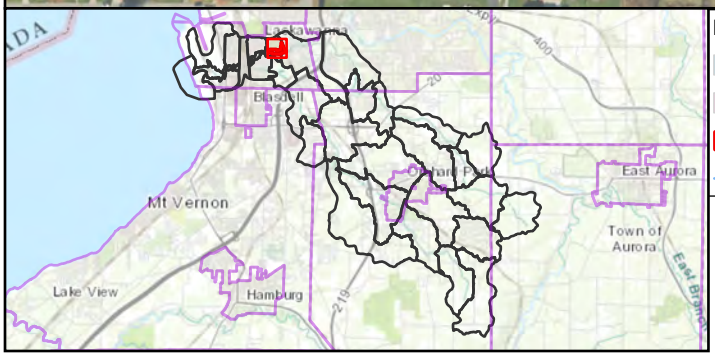
Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate, but will vary per project
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection

Conceptual projects presented in this report are intended for use by NYSDEC as potential improvements to the Smokes Creek Watershed to achieve habitat enhancement goals. Implementation of the conceptual plans would require additional analyses (e.g. hydraulic and hydrologic), design engineering, procuring funding, obtaining all applicable permits, and/or land acquisitions that were not addressed during this project. In addition, it's important to note that any implementation projects within a mapped floodway and/or floodplain will require evaluation and permitting by the local government having jurisdiction for that municipality. Mitigation may also be necessary.

Projects within the limits of the Smokes Creek Flood Protection Project will require Article 16 Flood Control Land Use Permits from NYSDEC and Section 408 Permissions from the U.S. Army Corps of Engineers. Project Integrity and Unimpeded Access for Project Operation & Maintenance are requirements for issuing an Article 16 Flood Control Land Use Permit. Smokes Creek Flood Protection Project “As-Built” Drawings, Real Estate Key Maps, and the project’s O&M Manual should be utilized during project planning.





Legend

- Flood Control-Invasive Management
- Floodplain Forest Restoration
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 130 260 390

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Cemetery Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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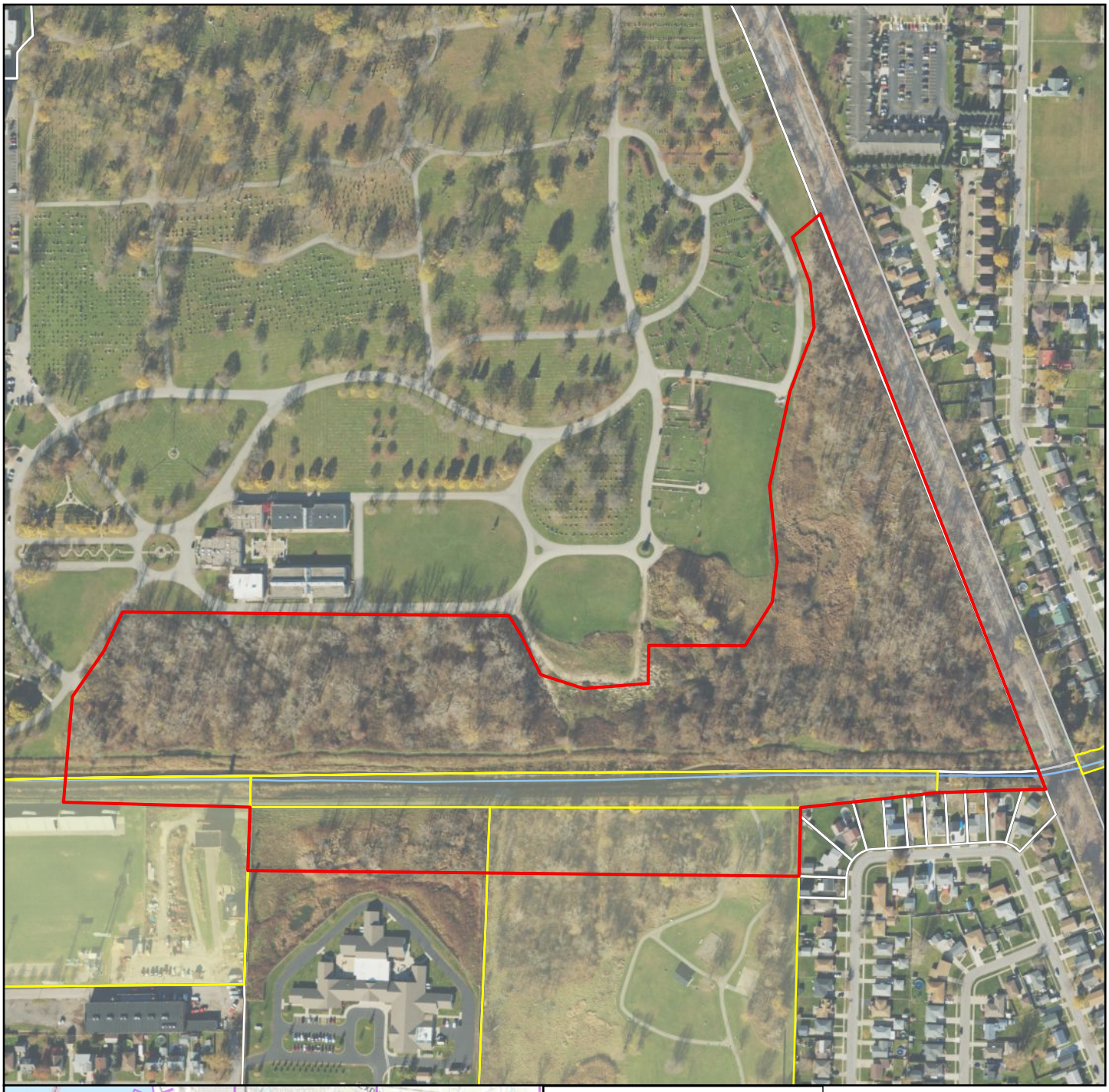

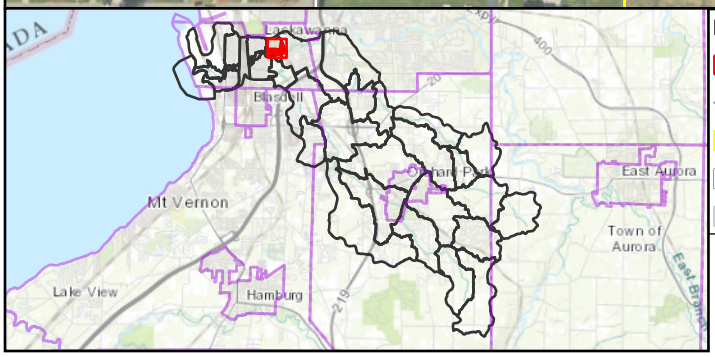

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels
- Other Land Parcels

Paper Size ANSI A

0 130 260 390

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Cemetery Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Focus Area: South Park (SP)

Location: North of Sharon Parkway, Lackawanna, NY (NRU-SBL3; 42.811455, -78.815415)

Size: ~116 acres

Ownership: 87% Public and 8% Private (Refer to South Park Land Ownership Map)

Existing/historic conditions/land use: Prior to implementation of the flood control project in 1971, the south branch of Smokes Creek beginning downstream of this site was comprised of a more natural, meandering channel. This focus area includes the largest area of semi-natural floodplain and stream on the lower part of South Branch.

Site Description: This project is in the upstream end of the U.S. Army Corps of Engineers flood control project of 1971, and it runs through an undeveloped parcel of land owned by the city of Lackawanna. South Park (SP) totals 115 acres and encompasses over one mile of meandering stream channel. The vegetative cover is dominated scrub-shrub with numerous wetland inclusions and floodplain forest. NRCS mapped soils include Wayland soils complex, a poorly drained hydric soil, poorly drained to moderately well drained Niagara, Teel and Collamer silt loams and borrow disposal areas. The site is bounded on the west, north and east by residential and commercial development and on the south by an old rail corridor. Plant communities on the site include low quality silver maple-ash swamp, floodplain forest and extensive areas of scrub-shrub and old field with wetlands common on flat or concave landscape features. Although introduced and invasive species are common, the site contains a good diversity of native wetland species. The topography of the site has been altered through placement of dredge spoil, construction of drainage swales and channelization of a tributary that drains residential areas west of the site. The site contains several areas of bank erosion, one of which threatens adjacent residential property, the other resulting from off road vehicle use. This is a focus area because it is public land along the creek that offers opportunities to address several ongoing issues with erosion.

Goals: Maintain/Restore hydrologic functions, Restore longitudinal/lateral floodplain connectivity, Protect/enhance native habitat communities

Recommended Opportunities (Refer to South Park Implementation Plan Map):

<u>SP1 – Wetland Restoration</u>

SP1 encompasses 48-acres of partially drained wetland, borrow disposal area and excavated channel. An earthen berm to contain the dredge spoil and excavated swales bisects the eastern half of the area. Restoration of SP1 would require more detailed topographic surveys and hydrologic/hydraulic modeling to better characterize existing drainage and options to restore wetland hydrology that do not increase flooding on adjacent residential areas. Hydrologic restoration may include grading out dredge spoil wind rows, removal of dredge disposal containment berms and drainage swales, re-meandering the channelized tributary, ditch blocks, and/or level spreaders to distribute flows across site. Restoration targets for SP1 may include shallow emergent marsh, wet meadow, shrub swamp and floodplain forest, subject to expected hydrologic conditions that result

from restoration work. Following site excavation work, vegetation establishment should include seeding, planting, recruitment from native seed bank and management of invasive species within pockets of existing wetland. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

SP2 – Streambank Stabilization

SP2 extends for approximately 1,200 linear feet of the South Branch channel and begins where the naturally meandering channel abruptly changes to an excavated flood control channel. Approximately 250 feet of streambank has been armored with riprap placed by the private landowners. A large scour pool has formed at the downstream end of the rip-rapped bank and is evidence of downcutting of the channel bed. Without grade control, downcutting will likely continue as well as migrate upstream, threatening the existing bank protection. Vortex rock weirs (see detail 6 in Appendix D) are instream boulder structures that deflect flow towards the center of the channel. Adding a series of vortex rock weirs along the approximately 300 feet of stream immediately upstream of the flood control channel (see inset 1, South Park Implementation Plan Map) may help reduce streambank erosion, dissipate energy, prevent upstream migration of the scour pool, and create pool habitat between vanes. Bank enhancement is also recommended to improve stability and habitat by adding topsoil and plantings on top of the rip-rap structure. Extending this treatment beyond the existing rip-rap structure may be desired to further enhance the habitat of the lower rip rap bank upstream. It is important to note that the recommended stabilization treatments for SP2 appear to be within the USACE flood control project (USACE, 1965) and additional modelling and analysis would be required to ensure any changes do not increase the 100-year flood limit.

SP3 – Streambank Stabilization

This area encompasses a series of off-road vehicle (ORV) trails that cross the South Branch at multiple locations. The ORV trails have destabilized the stream banks and are contributing to increased bank erosion, stream turbidity, and subsequent sedimentation in the channel as siltation in pools, formation of in-stream bars or embedding riffle. Adjacent wetland and floodplain forest communities have also been damaged by the ORV use. ORV use should be restricted from this and other sensitive areas along the South Branch through local controls. Localized repairs should be implemented where ORV trails have damaged the banks. Coir logs and live stakes (see details 4 and 7 in Appendix D, respectively) can be used to stabilize and enhance low energy stream banks where ORV use has compacted soils and removed vegetation. This form of bank treatment can be accomplished without heavy machinery, which would further disturb the existing vegetation. The coir logs do not provide a hard control on the bank location and would allow for natural evolution of the watercourse in the future. Based on aerial imagery of the site from April 2023, approximate recommended location of bank treatment extents is shown in inset 2 of South Park Implementation Plan Map. Field reconnaissance will be needed to determine more accurate bank treatment needs. As part of the bank stabilization, riparian corridor vegetation should also be restored including establishment of temporary and permanent grasses, forbs, shrubs, and trees that are characteristic of local, native floodplain forest.

SP4 – Floodplain Forest Restoration

SP4 includes two areas east and west of the South Branch that are dominated by old field grasses and forbs with scattered shrubs and small trees. Invasive species including common buckthorn, autumn olive, spotted

knapweed and introduced grasses should be treated to prepare the site for establishment of floodplain forest species. The floodplain forest restoration should utilize a successional approach that includes establishment of short/medium-term woodland grasses and forbs coupled with tree and shrub establishment. Initially after planting, the site will be dominated by native woodland edge grasses and forbs along with tree and shrub plantings. Over time, the tree and shrub plantings and volunteer seedlings from adjacent forest edges will fill in over the herbaceous ground cover. Where existing vegetative cover is dominated by native shrubs and tree saplings, they should be supplemented with additional tree and shrub species to increase diversity and accelerate succession to a closed canopy forest. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

SP5 – Riparian Corridor Enhancement

SP5 extends along South Branch near the center of the site. Enhancement of this area should be focused on control of glossy buckthorn and supplemental planting of floodplain forest tree and shrub species. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. SP5 includes several areas of cut bank located on outside bends that should be retained as nesting habitat for cavity-nesting species. To minimize erosion on these exposed areas, targeted vegetation management upslope of these areas may be implemented. J-hooks, root wads and other measures may be installed to divert flow from the cut bank toe and to improve instream habitat.

SP6/SP7 – Mesic Forest Restoration

Mesic hardwood forest restoration is proposed on upland areas adjacent to the dredge borrow area. The restoration should include removal of invasive buckthorn species and supplemental planting of trees and shrubs characteristic of mesic forest. The herbaceous layer will need to be evaluated to determine the need for seeding or planting of these species. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

SP8 – Grassland Establishment

SP8 is maintained turf grass. Where doing so will not conflict with school facilities, SP8 can be converted to native warm season grassland and forbs. SP8 could function as an upland buffer to the proposed wetland restoration area described for SP1 and would provide opportunities to engage students in all aspects of the grassland establishment, including planting and seeding species important to pollinators, managing for control of invasive species and monitoring success of the plantings and their use by pollinator species. The grassland establishment will require removal of turf grass, seedbed preparation, seeding and planting and monitoring and maintenance for a period of approximately five years. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

SP9 – Stormwater Management

SP9 is vegetated with turf grass and located within a sloping drainage swale that outlets to SP1. Substantial areas of maintained turf and impervious pavement and buildings associated with the school appear to drain into SP9 (unless there is a subsurface stormwater collection system that outfalls elsewhere). SP9 and the area draining to it should be evaluated to determine stormwater design requirements needed to achieve local water quality standards and meet volume and rate control requirements. Potential options include wetland treatment,

biofiltration swales or stormwater ponds constructed in accordance with the NY Department of Environmental Conservation Stormwater Management Design Manual.

Cost Estimate for Implementation

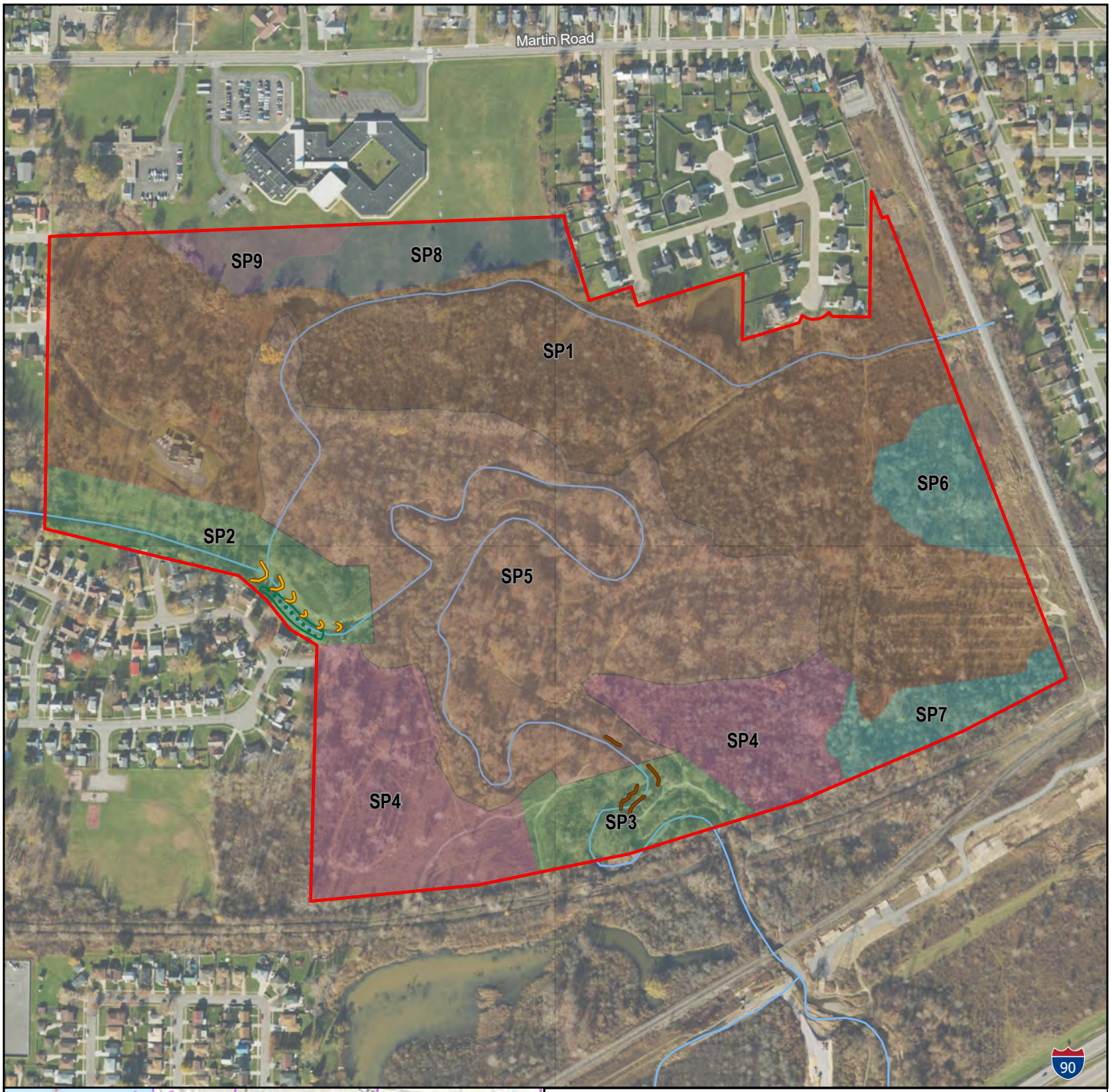
Project ID	Name	Acre (ac.) / Linear feet (lf.)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
SP1	Wetland Restoration	48 ac.	$324,000	$1,080,000	$1,404,000
SP2	Vortex Rock Weirs	300 lf.	$8,000	$24,000	$32,000
SP2	Streambank Enhancement of Rip-Rap Structure	250 lf.	$14,000	$45,000	$59,000
SP3	Coir Logs and Live Stake Bank Treatment	350 lf.	$16,000	$51,000	$67,000
SP4	Floodplain Forest Restoration	14 ac.	$6,000	$20,000	$25,000
SP5	Riparian Corridor Enhancement	32 ac.	$17,000	$56,000	$73,000
SP6	Mesic Forest Restoration	3 ac.	$3,000	$10,000	$13,000
SP7	Mesic Forest Restoration	3 ac.	$3,000	$10,000	$13,000
SP8	Grassland Establishment	4 ac.	$2,000	$5,000	$7,000
SP9	Stormwater Management	2 ac.	$30,000	$100,000	$130,000
			$423,000	**$1,401,000**	**$1,823,000**

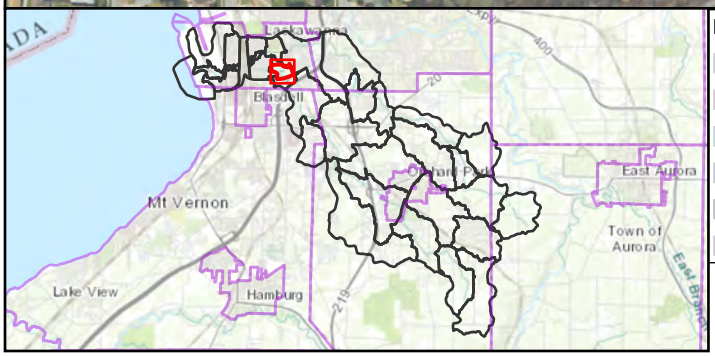
Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate but will vary per project.
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection.

Conceptual projects presented in this report are intended for use by NYSDEC as potential improvements to the Smokes Creek Watershed to achieve habitat enhancement goals. Implementation of the conceptual plans would require additional analyses (e.g. hydraulic and hydrologic), design engineering, procuring funding, obtaining all applicable permits, and/or land acquisitions that were not addressed during this project. In addition, it's important to note that any implementation projects within a mapped floodway and/or floodplain will require evaluation and permitting by the local government having jurisdiction for that municipality. Mitigation may also be necessary.

Projects within the limits of the Smokes Creek Flood Protection Project will require Article 16 Flood Control Land Use Permits from NYSDEC and Section 408 Permissions from the U.S. Army Corps of Engineers. Project Integrity and Unimpeded Access for Project Operation & Maintenance are requirements for issuing an Article 16 Flood Control Land Use Permit. Smokes Creek Flood Protection Project “As-Built” Drawings, Real Estate Key Maps, and the project’s O&M Manual should be utilized during project planning.





Legend

- Bank Stabilization
- Floodplain Forest Restoration
- Mesic Forest Restoration
- Native Grassland Establishment
- Riparian Corridor Enhancement
- Stormwater Management
- Wetland Restoration
- Bank Enhancement
- Vortex Rock Weirs
- Bank Enhancements
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 170 340 510

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

South Park Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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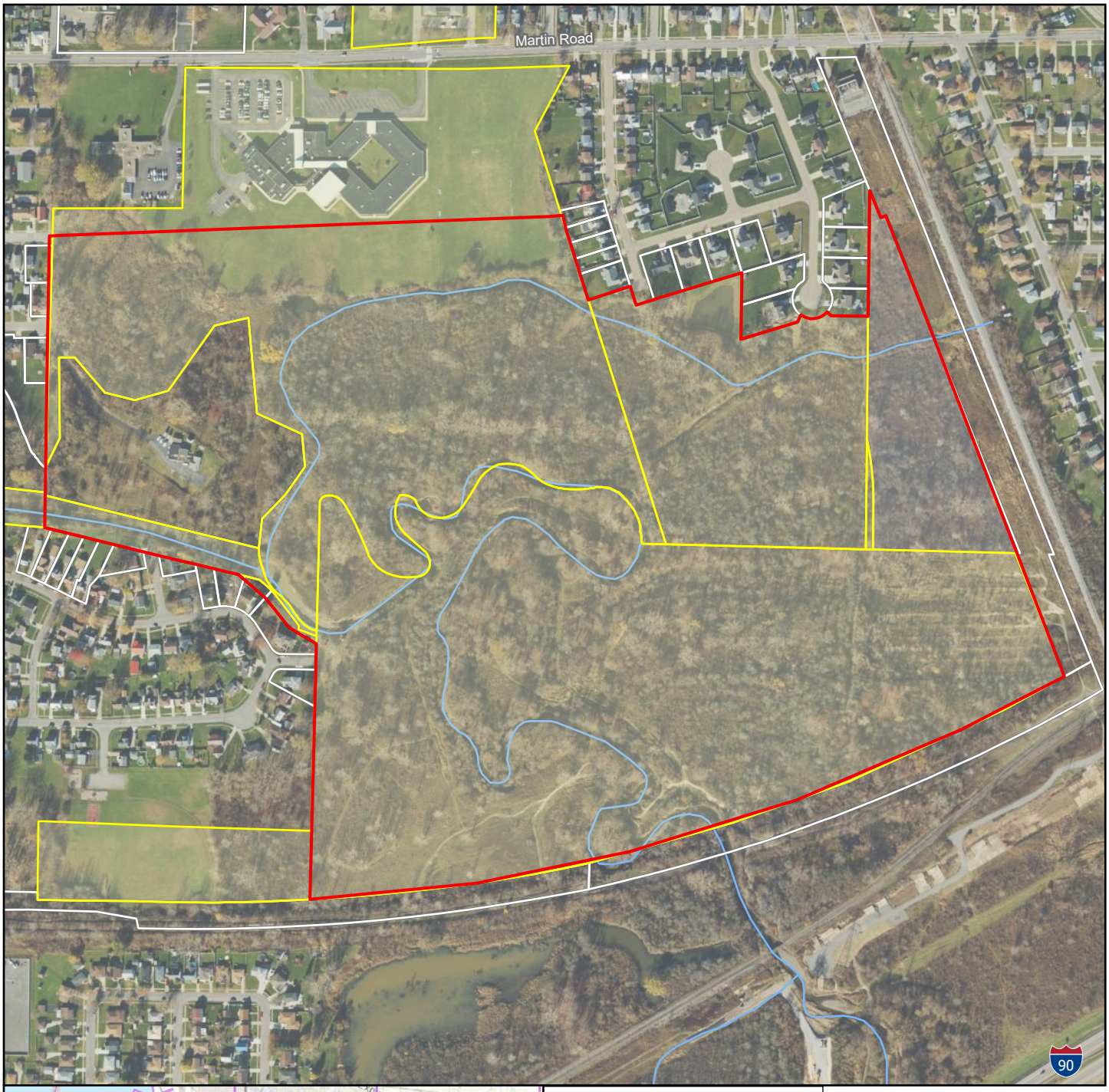

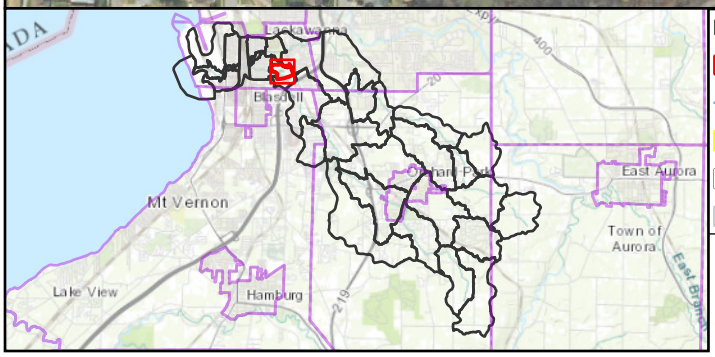

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels
- Other Land Parcels

Paper Size ANSI A

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US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

South Park Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Focus Area: Bills Stadium (BS)

Location: Intersection of Southwestern Blvd and California Road south to Big Tree Road (NRUs-SBUT1, SBUT2, SBU3; 42.773484, -78.782834)

Size: ~108 acres

Ownership: 29% Public and 71% Private, refer to Bills Stadium Land Ownership Map

Existing/historic conditions/land use: The Bills Stadium borders the western boundary of the focus project area. The stadium was opened in 1973 and in 2023, plans were put into action to build a new stadium less than a quarter mile to the west of the current stadium location.

Site Description: This 108-acre site encompasses the main stem of the South Branch, two major tributaries, over two miles of stream channel and a floodplain forest corridor that extends from Big Tree Road to Southwestern Boulevard. The site is bounded on the west by the Bills Stadium, parking, and vacant lots with nearly 100% impervious cover. The east side of the site is a mix of commercial/industrial and residential land uses. A Niagara-Mohawk Power Corporation (NMPC) transmission line corridor bisects much of the site and is managed to control woody vegetation. Plant communities present on the site generally include fair quality floodplain forest that transitions to rich mesophytic hardwood forests along valley slopes, successional hardwoods, and scrub-shrub. Groundwater seeps and groundwater-dependent hardwood swamps occur along the floodplain valley slopes throughout this site. Invasive species present include common buckthorn and glossy buckthorn.

This site was selected as a potential restoration location based on the following characteristics:

- Part of Bills Stadium Redevelopment
- One of the larger tracts of riparian forest/floodplain forest in lower watershed
- Area mapped as Conservation Area
- Two major and four minor tributaries converge at this location
- Instream habitat is rated as good, but stressed by adjacent land uses
- Opportunities to integrate Low Impact Development, innovative stormwater, and other amenities into Bills Stadium Redevelopment

Goals: Restore longitudinal and lateral connectivity to the floodplain, Protect/enhance native communities, Maintain/Restore hydrologic functions

Recommended Opportunities (Refer to Bills Stadium Implementation Plan Map):

<u>BS1 – Riparian Corridor Enhancement (68 acres), Streambank Stabilization (600 linear feet), and Instream Habitat Creation (500 linear feet)</u>

Prior to conducting riparian corridor enhancement work, this opportunity recommends completing a site-wide inventory of plant communities, groundwater-dependent natural resources, and invasive species density/distribution. From this inventory, a Riparian Corridor Enhancement Plan should be created that includes invasive woody and herbaceous species control; supplemental tree, shrub, and herbaceous species planting/seeding; and restoration of groundwater-dependent features including seeps, fens, and hardwood swamps. Where the corridor borders or extends into the NMPC corridor, woody vegetation management and site access for NMPC inspection and maintenance should be addressed in the Enhancement Plan. The

Enhancement Plan should identify vegetation targets, vegetation establishment procedures, invasive species control, use of herbicide, and long-term monitoring and maintenance, in coordination with NMPC, DEC and the County.

Based on a desktop analysis using aerial photos from April 2023 and local topographic data, there are several points where the stream appears to be in contact with the valley wall. When this occurs on the outer bend of the stream, natural erosive processes can destabilize the valley wall by oversteepening the slope. This may threaten infrastructure at the top of slope. The Bills Stadium (South) Implementation Plan Map shows the identified valley wall contacts that may be a concern. Valley toe erosion can be mitigated using bioengineering bank treatments like vegetated rock buttresses (detail 1 in Appendix D) or more hard engineering treatments like armor stone. Armor stone can be used to stabilize the toe of slope in high energy environments and in cases where additional slope stabilization is required, an armor stone retaining wall can be used (detail 2 in Appendix D). Detail 8 in Appendix D illustrates a vegetated rock buttress with armor stone at the toe.

Exposed shale was observed on the stream bed during site visits (Photo 1). Boulder clusters (detail 3 in Appendix D) may provide improved fish habitat where shale bed is exposed, for example along the segment shown in the Bills Stadium (South) Implementation Plan Map. Rapid geomorphic assessments are recommended for the stream reaches throughout the Bill's Stadium focus area to identify concerning valley wall contacts and opportunities for improving stream bed features. Any instream/streambank improvement work that results in temporary disturbances within BS1 should be stabilized and re-planted as part of the Enhancement Plan.

Photo 1 - Example of exposed shale on stream bed that may be improved with boulder clusters (facing upstream)

<u>BS2/BS3/BS5/BS9 – Riparian Corridor Restoration (6/3/2/2 acres)</u>

BS2 and BS3 are paved areas that encroach into the riparian corridor or floodplain valley slopes. BS5 is an unpaved overflow parking lot that is located on the west side of South Branch. BS9 is a recently constructed roadway with maintained turf that extends into the riparian buffer of the north tributary. As detailed in Appendix F-Riparian Buffer Guidance, the combined habitat buffer setback of structures and impervious surfaces from the stream meander belt, groundwater dependent resources and critical habitat is 100-feet. Where bluffs are present, the recommended setback of buildings and impervious surfaces from the top of bluff is 75-feet. Within the expanded riparian zone, the outer 25-feet of the riparian corridor can be planted to native grassland or forest and may include stormwater controls that filter runoff and distribute flows over a broad area. The remaining portions (inner and middle zone) of the riparian corridor should be planted to mesic hardwood forest (at top and side of valley slope) or floodplain forest (at bottom of valley slope).

<u>BS4 – Stormwater Management (3 acres)</u>

BS4 is an unpaved overflow parking lot that extends into the 100-year floodplain and to within 50-feet of South Branch. Drainage from the parking lots north of the Bills Stadium, that is not otherwise intercepted by the Bills Stadium stormwater collection system, drains across BS4. The three-zone buffer guidance described in Appendix F should be implemented to expand the total buffer width to a minimum of 100 feet from the meander belt with pretreatment of any stormwater discharged into South Branch.

BS6 – Streambank Stabilization (1,400 linear feet)

BS6 encompasses the reach of South Branch and the south tributary that extend into the NMPC corridor and/or border private land at the confluence of South Branch and the south tributary. There are multiple locations with vertical, eroding banks where the stream appears to be in contact with the valley wall, typically at the outside bend. When there are important assets above valley wall contacts, the eroding banks may be threatening infrastructure in the NMPC corridor or on private property (Bills Stadium (North) Implementation Plan Map). Streambank erosion in these areas is compounded by parking lots, cut and fill activity, off-road vehicle uses and trails that run through the NMPC corridor. Riparian buffers in BS6 are either lacking or poor quality. The recommended actions for BS6 include implementing the three-zone buffer framework described for BS2/BS3/BS5 and vegetation management prescribed for the NMPC corridor. Each streambank erosion site (Bills Stadium (North) Implementation Plan Map) should be evaluated on a case-by-case basis but can be stabilized using a combination of instream techniques that direct flows away from eroding banks (e.g. vortex rock weirs, see detail 6 in Appendix D), armoring the toe of slope, re-grading vertical banks and vegetating the banks. Vegetated rock buttresses, possibly with armor stone at the toe (detail 8 in Appendix D), could be considered for valley wall contact bank treatments. Armor stone retaining walls may be required where the bank is steep and there is no room to reduce the grade (detail 2 in Appendix D).

BS7/BS8 – Mesic Forest Restoration (5/11 acres)

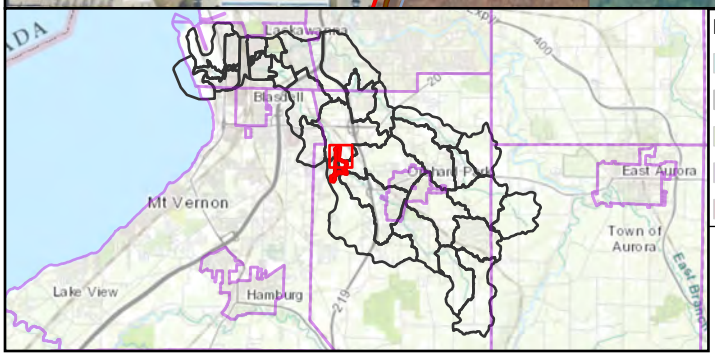
BS7/BS8 are successional forest and scrub-shrub with scattered pockets of wetland with groundwater seeps. The boundaries of groundwater-dependent features should be located and evaluated to determine likely pre-disturbance wetland community type. The restoration target may include sedge meadow, rich fen or hardwood swamp. The restoration target for remaining (upland) portions of BS7/BS8 forest should rich mesophytic forest. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. The mesic forest restoration should utilize a successional approach that includes establishment of short/medium-term woodland grasses and forbs coupled with tree and shrub establishment. Initially after planting, the site will be dominated by native woodland edge grasses and forbs along with tree and shrub plantings. Over time, the tree and shrub plantings and volunteer seedlings from adjacent forest edges will fill in over the herbaceous ground cover. Where existing vegetative cover is dominated by native shrubs and tree saplings, they should be supplemented with additional tree and shrub species to increase diversity and accelerate succession to a closed canopy forest. The mesic forest restoration should also incorporate control of common buckthorn, glossy buckthorn and other invasive species as needed.

Cost Estimate for Implementation:

Project ID	Name	Acre (ac) / Linear feet (lf.)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
BS1	Valley Wall Contact Toe Stabilization	600 lf.	$126,000	$420,000	$546,000
BS1	Instream Habitat Enhancement (Boulder Clusters)	500 lf.	$2,000	$7,000	$9,000
BS1	Riparian Corridor Enhancement	68 ac.	$42,000	$139,000	$180,000
BS2	Riparian Corridor Restoration	6 ac.	$12,000	$38,000	$49,000
BS3	Riparian Corridor Restoration	6 ac	$4,000	$11,000	$14,000
BS4	Stormwater Management	3 ac.	$30,000	$100,000	$130,000
BS5	Riparian Corridor Restoration	2 ac.	$4,000	$12,000	$15,000
BS6	Valley Wall Contact Toe Stabilization	1,400 lf.	$294,000	$980,000	$1,274,000
BS7	Mesic Forest Restoration	5 ac.	$6,000	$19,000	$25,000
BS8	Mesic Forest Restoration	11 ac.	$13,000	$42,000	$55,000
BS9	Riparian Corridor Restoration	2 ac.	$2,000	$5,000	$7,000
			$535,000	**$1,773,000**	**$2,304,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate, but will vary per project
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection



Legend

- Mesic Forest Restoration
- Riparian Corridor Enhancement
- Riparian Corridor Restoration
- Stormwater Management
- Streambank Stabilization
- Riparian Buffer
- Boulder Clusters
- Bank Enhancements
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 160 320 480

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Bills Stadium (North) Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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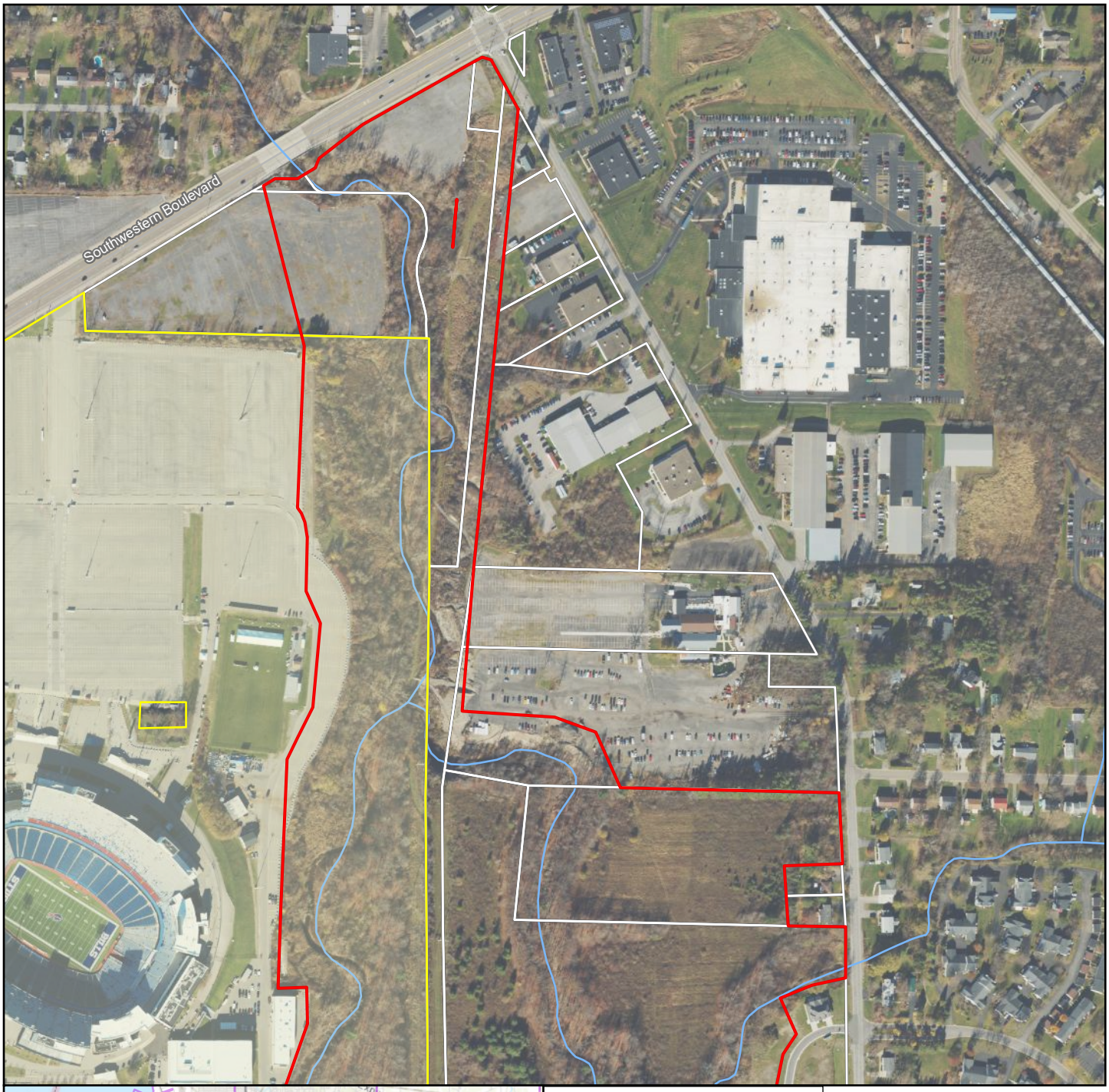

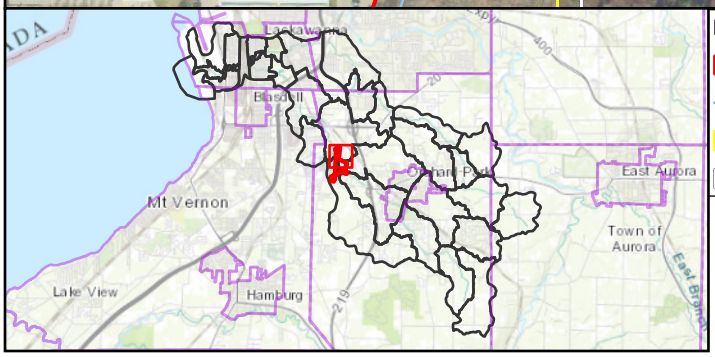

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels

Paper Size ANSI A

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US Feet

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Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Bills Stadium (North) Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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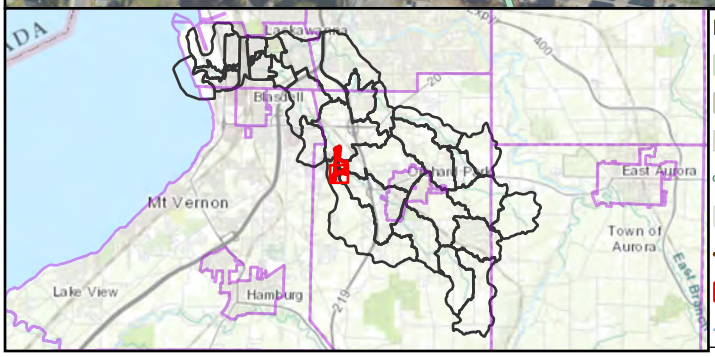

Legend

- Mesic Forest Restoration
- Riparian Corridor Enhancement
- Riparian Corridor Restoration
- Riparian Buffer
- Boulder Clusters
- Bank Enhancements
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

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US Feet

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Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Bills Stadium (South) Implementation Plan

Project No. **12572245**
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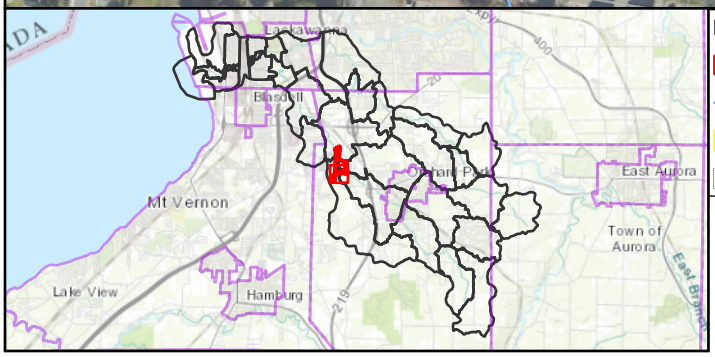

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels

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Bills Stadium (South) Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Print date: 17 May 2024 - 10:54

Data source: GHD, 2023; Erie county; RAVI orthoimagery, 2023; DEC wetlands; World Topographic Map: Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA; World Topographic Map: Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS; USA NAIP Imagery: Natural Color: Esri, USDA Farm Service Agency; World Topographic Map: Province of Ontario,

Focus Area: Brush Mountain Park (BRU)

Location: 4520 California Road, Town of Orchard Park (a.k.a. California Road Recreation Area) (NRU-SBUT1; 42.759614, -78.777273)

Size: ~17 acres

Ownership: 100% Public (Town of Orchard Park)

Existing/historic conditions/land use: Baseball fields were established prior to 1995. The area of the Community Activity Center was forested, then turned into a parking lot around 2011. The Activity Center was completed in 2020. Western portion of the site is large, forested wetland DEC Class 2 (total of 110.7 regulated acres)

Site Description: The 17-acre site encompasses portions of the Brush Mountain Park Community Center and adjacent private parcels, including 13 acres of maintained turf/old field and 4 acres of riparian forest. NRCS soils include Patchin silt loam and frequently flooded Fluvaquents/Udifluvents, both of which are hydric. The location and extent of upland soils has been altered by cut and fill activities, but historically was dominated by Orpark silt loam. This publicly owned land offers opportunities to improve the riparian buffer and address stream bank erosion.

Goals: Maintain/Restore hydrologic functions, Maintain/restore water quality (thermal and sediment filtering focus), Restore longitudinal and lateral floodplain connectivity, Protect/enhance wetland and upland communities, Expand public awareness opportunities and environmental awareness

Recommended Opportunities (Refer to Brush Mountain Park Implementation Plan Map):

<u>BRU1 – Stream Restoration</u>
Approximately 2,000 linear feet of stream channel should be further evaluated for instream and streambank improvements. Channelized reaches could be meandered to reduce stream velocities and downstream erosion, support sediment transport, and improve instream habitat. The available area for river meandering is constrained, however, by the baseball diamonds, private properties, and three mound-shaped hills within the park. Where possible, increasing connectivity to the floodplain is also encouraged to promote overbank storage. At the downstream end of the focus area, the existing concrete pipe culverts are likely limiting fish passage and restricting sediment transport (see inset 1 of Brush Mountain Park Implementation Plan Map). Replacing culverts at road crossings with either a bridge or open bottom culvert that is sized to support local hydraulic and geomorphic processes will improve natural stream functions. Replacing the concrete steps downstream of the culvert (see inset 1 of Brush Mountain Park Implementation Plan Map) with a vegetated rock buttress (detail 1 in Appendix D) or other bioengineering treatments, will also enhance stream functions by providing additional habitat and stream cover. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats.

<u>BRU2 – Riparian Corridor Restoration (6 acres)</u>
A new riparian corridor should be created along the reaches of the South Branch that have maintained turf or semi-maintained old field up to the bank or where the existing riparian corridor is narrow. The new riparian corridor should extend along either bank 100 feet or more, where adjacent property physical space and landownership permits. The south segment of the corridor that follows the entrance road into Brush Mountain Community Center may include one or more stormwater facilities sized to treat stormwater runoff from the

roadway and other impervious surfaces. The target plant community within the riparian corridor restoration area should be floodplain forest. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats and riparian zones.

BRU3/BRU5 – Riparian Corridor Enhancement (3 acres)

The existing riparian corridor along South Branch (BRU3) and the tributary (BRU5) should be managed for invasive woody and herbaceous species and where appropriate, tree, shrub and herbaceous species should be planted or seeded to improve native species diversity and wildlife habitat. Any instream works (described in BRU1) that result in temporary disturbances within BRU3 should be stabilized and re-planted as part of the riparian corridor enhancement. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats and riparian zones.

BRU4 – Wetland Restoration (1 acre)

BRU4 contains recently cultivated field and old field that is mapped by the NRCS Soil Survey as frequently flooded hydric soil. This entire area is located on private land, and any restoration would be subject to landowner approval. Floodplain forest, the likely plant community that once occurred at this location should be established through planting and seeding of trees, shrubs, and herbaceous species. This restoration will increase the riparian buffer along the South Branch by up to 200 feet. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats and riparian zones.

BRU6/BRU7 – Native Grassland Establishment (6 acres)

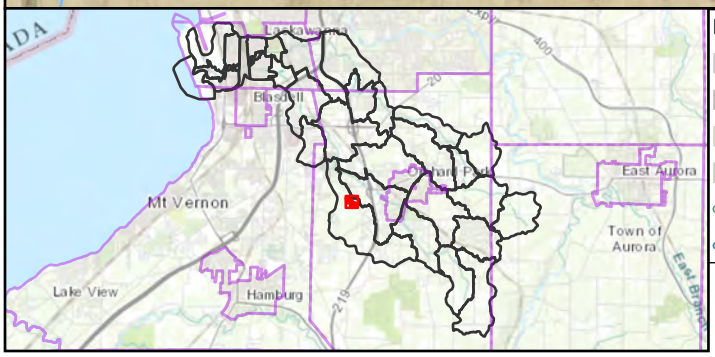
BRU6 and BRU7 encompass three mound-shaped hills along the west side of the South Branch. These topographic features are vegetated with semi-maintained old field vegetation and have open, southwest aspects that are well suited to dry-mesic grassland vegetation. The more shaded northeast facing slopes provide a less exposed, moister site suitable for mesic grassland vegetation. A short-height dry and mesic grassland is recommended to maintain visibility across these areas and provide diverse habitat for pollinator species that favor forb-rich grassland habitat. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. The restoration target for BRU6/BRU7 will be achieved by removing existing introduced grasses and any invasive species and reseeding to native short grassland. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats.

Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design	Construction	Total
BRU1	Culvert Replacement	NA	$60,000	$200,000	$260,000
BRU1	Bank Enhancement (Vegetated Rock Buttress)	100 lf.	$15,000	$50,000	$65,000
BRU1	Channel Meandering	2000 lf.	$360,000	$1,200,000	$1,560,000
BRU2	Riparian Corridor Restoration	6 ac.	$7,000	$21,000	$28,000
BRU3	Riparian Corridor Enhancement	1 ac.	$1,000	$3,000	$3,000
BRU4	Wetland Restoration	1 ac.	$9,000	$30,000	$39,000
BRU5	Riparian Corridor Enhancement	2 ac.	$2,000	$5,000	$6,000
BRU6	Native Grassland Establishment	4 ac.	$2,000	$5,000	$7,000
BRU7	Native Grassland Establishment	2 ac.	$1,000	$3,000	$4,000
			$457,000	**$1,517,000**	**$1,972,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate, but will vary per project
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection



Legend

- Native Grassland Establishment
- Riparian Corridor Enhancement
- Riparian Corridor Restoration
- Wetland Restoration
- Riparian Buffer
- Stream Restoration
- Bank Enhancement
- Culvert Replacement
- Focus Area Boundary
- Stream Reach
- Wetlands (DEC, Erie County, NY)

Paper Size ANSI A

0 80 160 240

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Brush Mountain Park Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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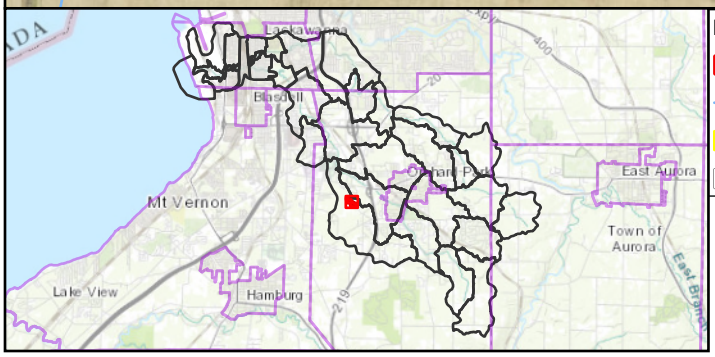

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels

Paper Size ANSI A

0 80 160 240

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Brush Mountain Park Parcel Ownership

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Data source: GHD, 2023; Erie county; RAVI orthoimagery, 2023; DEC wetlands; World Topographic Map: Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA; World Topographic Map: Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS; USA NAIP Imagery: Natural Color: Esri, USDA Farm Service Agency; World Topographic Map: Province of Ontario,

Focus Area: California Road (CR)

Location: immediately south of Brush Mountain Park, Town of Orchard Park
(NRU-SBUT1; 42.754324, -78.777076)

Size: ~80 acres

Ownership: 100% Private (one landowner, refer to California Road Land Ownership Map)

Existing/historic conditions/land use: The project site has been an agricultural field and forest since before 1995.

Site Description: The site is mix of row crop agricultural field with a ditched tributary and forested corridor along the main stem of South Branch and includes approximately 67 acres of cropland and 13 acres of riparian forest. Approximately 30 acres of the agricultural field are mapped by the NRCS Soil Survey as Patchin Silt Loam, which is classified as a hydric soil. The NRCS Soil Survey also identifies hydric soils (Fluvaquents/Udifluvents) along the South Branch. The remaining soils are dominated by Farnham Channery Silt Loam. The site is bounded to the south and west by large blocks of rich mesic and beech-maple forest identified as having high conservation value and to the east by floodplain forest along the mainstream of South Branch. DEC wetland BU-12 is a Class 2 wetland that extends along the west and northwest side of the site. This project will expand BU-12 by an additional 30 acres and will connect two large blocks of identified conservation area.

This site was selected as a potential restoration location based on the following characteristics:

- Includes channelized mainstem of SB and ditched section of tributary to SB
- Approximately 50% of project is hydric soils/drained wetland
- Borders mapped Conservation Area and DEC mapped wetland (BU12) – quality hardwood swamp
- Located immediately south of Brush Mountain Park Focus Area
- Will incorporate approximately 2000 linear feet of new restored stream
- Will mitigate stream bank erosion to downstream areas and attenuate stormwater flows and improve water quality
- Large wetland restoration area

Goals: Restore/Maintain hydrologic functions, Protect/Enhance wetland communities, Protect/Enhance upland communities, restore connectivity to floodplain, Restore longitudinal/lateral connectivity

Recommended Opportunities (Refer to California Road Implementation Plan Map):

<u>CR1 – Stream Restoration</u>
This opportunity recommends realigning the approximately 2,000 linear feet of channelized ditch that runs north-south along the west side of the focus area with a more natural meandering pattern. Allowing the stream to meander through a restored stream corridor will support natural fluvial processes, improving instream habitat while reducing downstream velocities and erosion through flow attenuation and increased floodplain storage. The new stream channel will also improve upstream/downstream (longitudinal) connectivity between the headwaters tributary and wetlands to the south and restoration efforts proposed for Brush Mountain Park. Overbank flow will support hydrology to the adjacent wetland restoration area (see C2 – Wetland Restoration).

CR2 – Wetland Restoration (30 acres)

Wetland restoration is recommended for portions of the site that are mapped in the NRCS Soil Survey as Patchin Silt Loam or Fluvaquents/Udifluvents. These areas should be evaluated to identify surface and subsurface drainage features that flow into the north-south ditch. Hydrologic restoration could include removing tiles, ditch plugs, level spreaders and limited grading, as well as raising the channel profile of the re-meandered stream to promote overbank flow to the wetland restoration area. Improving lateral connectivity between the stream and its floodplain and adjacent wetlands will support sediment and nutrient retention and may also help mitigate flooding downstream. Subject to frequency, depth and duration of ponding and soil saturation, wetland community restoration targets may include sedge meadow, shrub swamp and hardwood swamp.

CR3/CR5 – Mesic Forest Restoration (39 acres)

Restoration of beech-maple and rich mesophytic hardwood forest is recommended on areas of the site mapped as Farnham Channery Silt Loam. The mesic forest restoration should utilize a successional approach that includes establishment of short/medium-term woodland grasses and forbs coupled with tree and shrub establishment. Initially, the site will be dominated by native woodland edge grasses and forbs along with tree and shrub plantings. Over time, the tree and shrub plantings and volunteer seedlings from adjacent forest edges will fill in over the herbaceous ground cover. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. The mesic forest restoration area may encompass the entire area mapped as CR3/CR5 or may be limited to a 100-foot buffer that extends around the perimeter of restored wetland (CR2) or the riparian corridor denoted as CR6.

CR4/CR6 – Riparian Corridor Enhancement (12 acres)

The existing riparian corridors that extend along the South Branch and the north-south ditch should be enhanced though invasive species control and supplemental planting of native herbaceous, shrub and tree species. The width of the riparian corridor along the west side of CR6 should be increased to a minimum of 100 feet as described for CR3. Any instream work that results in temporary disturbances within CR4 should be stabilized and re-planted as part of the CR4 riparian corridor enhancement.

Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
CR1	Channel Meandering	2,000 lf.	$360,000	$1,200,000	$1,560,000
CR2	Wetland Restoration	30 ac.	$11,000	$37,000	$47,000
CR3	Mesic Forest Restoration	32 ac.	$36,000	$118,000	$153,000
CR4	Riparian Corridor Enhancement	5 ac.	$4,000	$13,000	$16,000
CR5	Mesic Forest Restoration	4 ac.	$5,000	$15,000	$20,000
CR6	Riparian Corridor Enhancement	8 ac.	$5,000	$17,000	$22,000
			$421,000	**$1,400,000**	**$1,818,000**

Notes:

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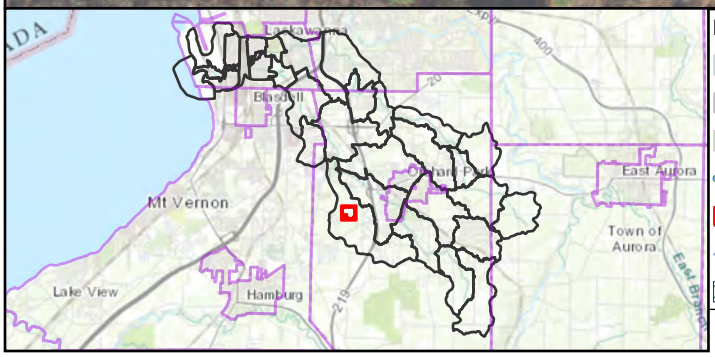
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection



Legend

- Mesic Forest Restoration
- Riparian Corridor Enhancement
- Wet Meadow Restoration
- Stream Restoration
- Focus Area Boundary
- Stream Reach
- Wetlands (DEC, Erie County, NY)

Paper Size ANSI A

0 100 200 300

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

California Road Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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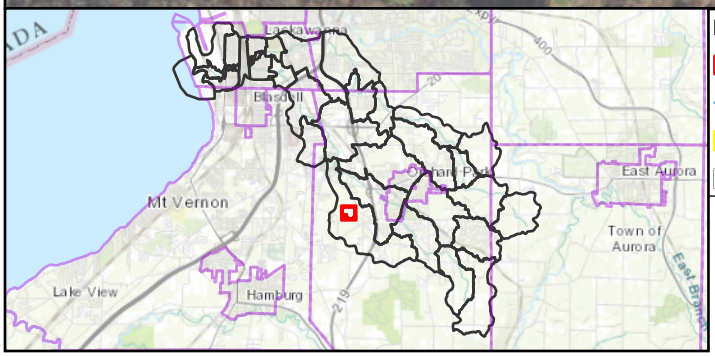

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels

Paper Size ANSI A

0 100 200 300

US Feet

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Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

California Road Parcel Ownership

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Focus Area: Birdsong Park (BSP)

Location: Jewett Holmwood Road & Birdsong Parkway, Town of Orchard Park
(NRU-SCU3; 42.753278, -78.724323)

Size: ~58 acres

Ownership: 62% Public and 38% Private (one landowner), refer to Birdsong Park Land Ownership Map

Existing/historic conditions/land use: Based on Google Earth historic imagery, sometime between 1995-2002, the nature trail was reconfigured, ponds were constructed, and houses were built along Rock Dove Lane and Birdsong Parkway with an associated stormwater pond.

Site Description: The site is located within Birdsong Park and two adjoining private parcels and totals approximately 60 acres. The site is bounded on the west by an equestrian facility, Orchard Park Country Club and residential; on the south and east by maintained parkland and residential; and to the north by forest land. Natural communities include successional southern hardwoods on upland areas and mosaic of silver maple-ash swamp, floodplain forest, shrub swamp and deep emergent marsh wetlands within the constructed ponds. Soils are very poorly or poorly drained Patchin silt loam and Wayland complex and are rated as hydric. Hydrologic modifications to Smokes Creek and adjacent wetlands occurred between 1995 and 2002 and included construction of walking trails and boardwalk, pond construction and partial re-routing of Smokes Creek around the constructed ponds and trails. This focus area is part of a Conservation Area that includes a large forest complex to the north. DEC-mapped wetland OP-6 extends through the center of this focus area.

This site was selected as a potential restoration location based on the following characteristics:

- Mostly publicly owned land along the creek that offers opportunities to improve the riparian buffer and address stream bank erosion.

Goals: Maintain/Restore hydrologic functions, Protect/Enhance natural communities, Expand public access opportunities and environmental awareness

Recommended Opportunities (Refer to Birdsong Park Implementation Plan Map):

<u>BSP1 – Floodplain Forest Restoration, Streambank Stabilization (29 acres)</u>
BSP1 extends along either side of the main trail that bisects Birdsong Park. This forest has a patchy canopy and varies from very wet to dry and includes cut/fill associated with pond and trail construction. Glossy buckthorn often dominates the subcanopy and shrub layer. The herbaceous layer is generally dominated by native species. A more detailed site assessment should be completed to determine restoration targets; however, silver maple-ash floodplain forest and red maple hardwood swamp are likely targets. Restoration should be focused on removal and long-term management of glossy buckthorn and supplemental planting of floodplain and hardwood swamp tree and shrub species. The restoration should include an assessment of Smokes Creek and the channels that outlet the adjacent ponds to determine if there are opportunities to improve instream habitat and connectivity within this reach of Smokes Creek. Further, bank stabilization treatments (e.g., vegetated rock buttress as shown in detail 1 in Appendix D may benefit the downstream portion of Smokes Creek, near Freeman Rd, as it appears to be in contact with the valley wall. Local bank stabilization may be necessary and could be completed through live stake planting (detail 7 in Appendix D), coir log bank treatment (detail 4 in Appendix D) or vegetated layering with stone toe (detail 5 in Appendix D). Local culvert crossings should be

assessed with respect to fish passage, geomorphic function, and hydraulic capacity and replaced as needed. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats and riparian zones.

BSP2 – Wetland Restoration (11 acres)

BSP2 is a shrub wetland bisected by a channelized tributary to Smokes Creek. The southwest boundary of BSP2 transitions to upland and along this boundary there are ground-water seeps that support wetland hydrology. An assessment of groundwater-dependent features and any effects the channelized tributary have on this wetland should be completed to refine vegetation and hydrology targets for this restoration. Restoration of BSP2 may include ditch blocks, re-meandering the tributary channel, removal of fill areas that block flow into Smokes Creek, invasive species control, and supplemental seeding or planting consistent with vegetative targets. The restoration targets in the vicinity of ground-water discharge areas may include rich fen or red maple hardwood swamp. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats.

BSP3 – Mesic Forest Restoration (14 acres)

BSP3 is included in this focus area to provide an upland buffer to BSP1 and BSP2. BSP3 is mapped as a southern successional hardwood forest. This forest is dominated by young sapling to pole-sized hardwood species characteristic of beech-maple and rich mesophytic hardwood forest. This forest should be evaluated with respect to canopy, shrub and herbaceous species composition and invasive species. The restoration should include invasive species control and management and supplemental planting to improve species diversity of canopy, shrub, and herbaceous strata. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats.

BSP4 – Native Grassland Establishment (4 acres)

BSP4 is currently maintained turf grass. Where doing so would not conflict with active uses of Birdsong Park, BSP4 can be converted to a native grassland with short height grasses and forbs. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. BSP4 would function as an upland buffer to the proposed wetland restoration area described for BSP1 and would provide opportunities to engage the community in all aspects of the grassland establishment, including planting and seeding species important to pollinators, managing for control of invasive species and monitoring success of the plantings and their use by pollinator species. The grassland establishment would require removal of turf grass, seedbed preparation, seeding and planting, and monitoring and maintenance for a period of approximately five years. The landward boundary of BSP4 should a extend a minimum of 100 feet from the meander belt of Smokes Creek and could be expanded further into other areas along the trail to the north. Adding educational signage about the benefits of this recommendation may help the public better understand the need for native habitats.

Cost Estimate for Implementation

Project ID	Name	Acre (ac.) / Linear feet (lf.)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
BSP1	Floodplain Forest Restoration	29 ac.	$28,000	$93,000	$120,000
BSP1	Valley Wall Contact Toe Stabilization	500 lf.	$75,000	$250,000	$325,000
BSP2	Wetland Restoration	11 ac.	$50,000	$165,000	$215,000
BSP3	Mesic Forest Restoration	14 ac.	$14,000	$45,000	$58,000
BSP4	Native Grassland Establishment	4 ac.	$2,000	$5,000	$7,000
			$169,000	**$558,000**	**$725,000**

Notes:

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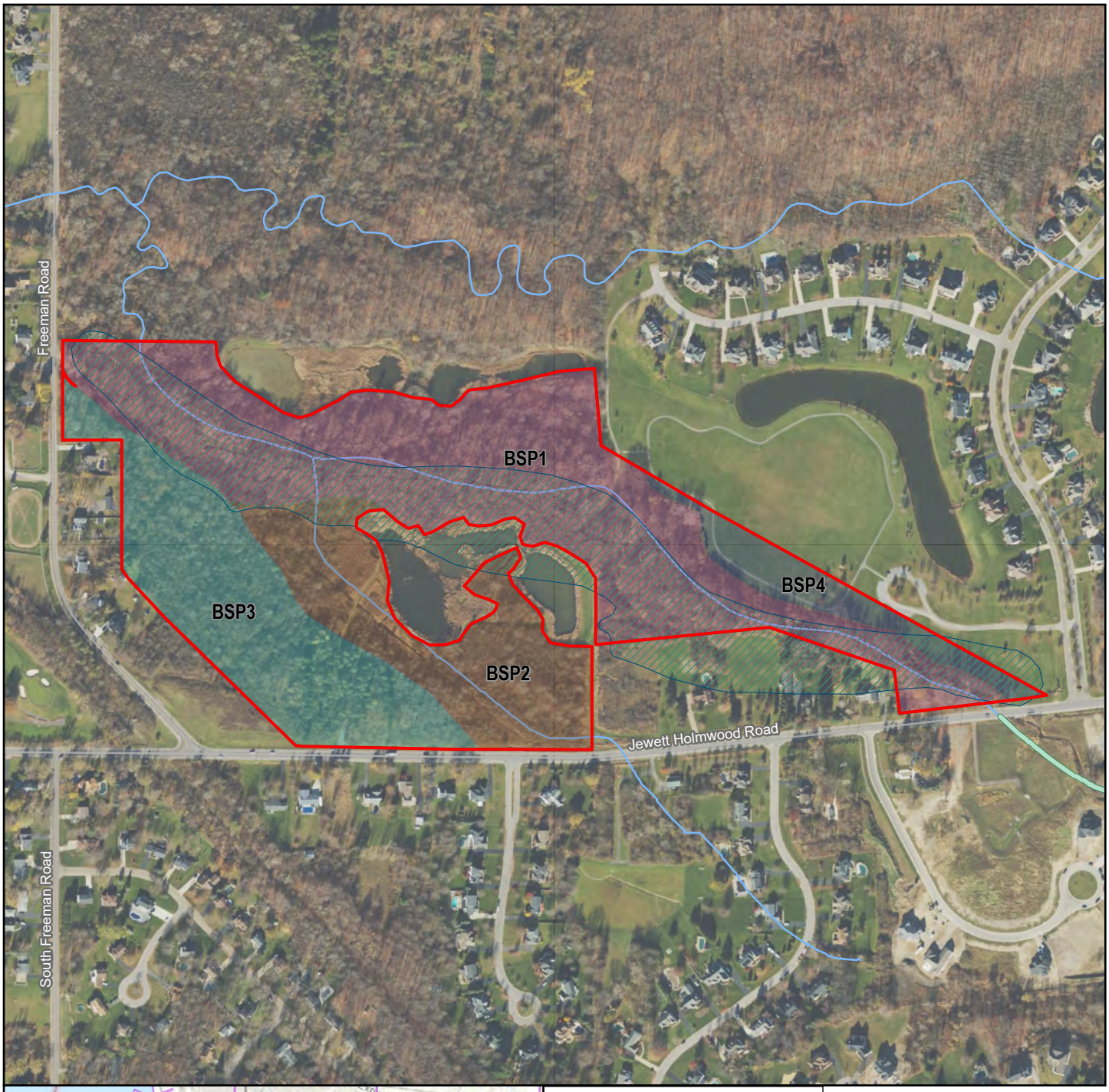

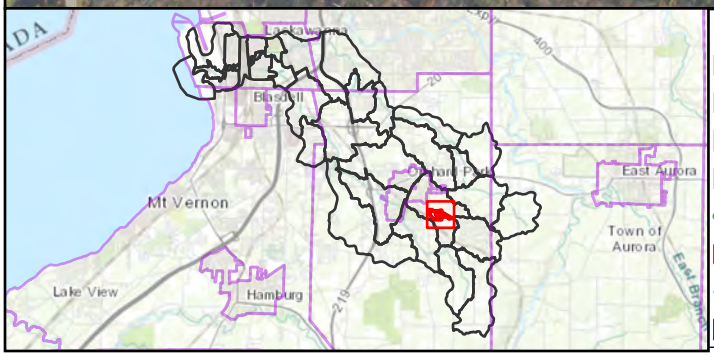

Legend

- Floodplain Forest Restoration
- Mesic Forest Restoration
- Native Grassland Establishment
- Wetland Restoration
- Riparian Buffer
- Focus Area Boundary
- Stream Reach
- Wetlands (DEC, Erie County, NY)

Paper Size ANSI A

0 190 380 570

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

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Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Bird Song Park Implementation Plan

Project No. **12572245**
Revision No. **-**
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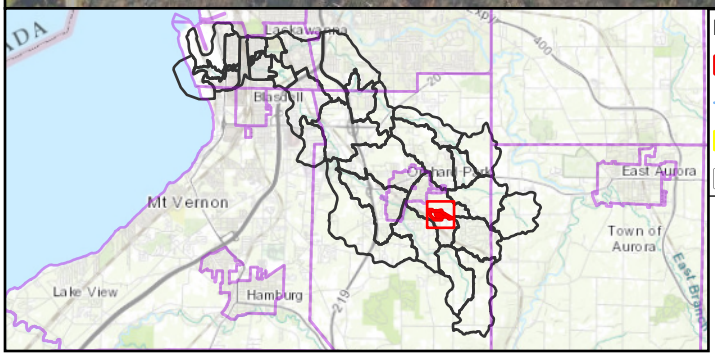

Legend

- Focus Area Boundary
- Stream Reach
- Public Land Parcels
- Private Land Parcels

Paper Size ANSI A

0 190 380 570

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

N

GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Bird Song Park
Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Print date: 17 May 2024 - 10:56

Focus Area: Transit Road (TR)

Location: North of 7782 Quaker Road, Orchard Park, NY (NRU-SCUT1E; 42.811455, -78.815415)

Size: ~140 acres (total acreage-assume 110 acres implemented as described below)

Ownership: 100% Private (Refer to Transit Rd Land Ownership Map)

Existing/historic conditions/land use: This area has been used as an agricultural field since before 1995.

Site Description: The Transit Road focus area is 140-acres with approximately 100-acres mapped by the NRCS Soil Survey as Canandaigua silt loam and Lakemont mucky silt loam, both of which are poorly drained hydric soil. The south ¾ of the site are row crop and pasture/hayfield, while the north ½ and west side of the site are partially drained wetland. There are two drainageway/ditch systems that enter and flow in a northwesterly direction to the north boundary of the site and another drainage system that flows along the northwest boundary. These drainages outlet to a large wetland complex north of the site that includes DEC Mapped Wetlands. This wetland is a mosaic of red maple-hardwood swamp and shrub swamp at the headwaters of a tributary to Smokes Creek. This site is located entirely on private land and includes portions of five separate parcels.

This site was selected as a potential restoration location based on the following characteristics:

- One of the largest blocks of cropped hydric soils with surface (and potential subsurface) tiling
- Abuts large, forested wetland complex (DEC Wetland OP-4)
- Abuts good quality instream habitat of SC tributary
- Project provides upstream storage to attenuate stormwater flows and improve water quality
- Large wetland restoration area

Goals: Maintain/restore hydrologic functions, Protect/enhance wetland communities

Recommended Opportunities (Refer to Transit Rd Implementation Plan Map):

<u>TR1 – Wetland Restoration (138 acres)</u>
Implementing this project will depend on landowner interest and compatibility with existing land use and agricultural operations. The actual boundaries and scope of restoration work will depend on which parcels, or portions thereof, are available. A detailed site assessment that includes an investigation of subsurface (tiles) and surface drainage, shallow groundwater depth, soils and existing vegetation would be required to assess restoration potential and approaches. The ecological restoration targets would be informed by the site assessment but could include sedge meadow, wet meadow, rich fen, shrub swamp, hardwood swamp and mesic forest (on upland buffers). The key elements of the restoration include hydrologic restoration, wetland vegetation establishment and enhancement of existing wetland communities. The hydrologic restoration could include removal or blockage of ditches and tiles, re-contouring grades, construction of level spreaders or low berms to redistribute flows. The vegetation establishment could include conversion of row crops, hayfield or pasture to native wetland grasses, forbs, shrubs, and trees. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. Enhancement of existing wetland communities could include removal and management of invasive species including glossy buckthorn and reed canary grass, management of native seed soil bank, overseeding or planting to increase species

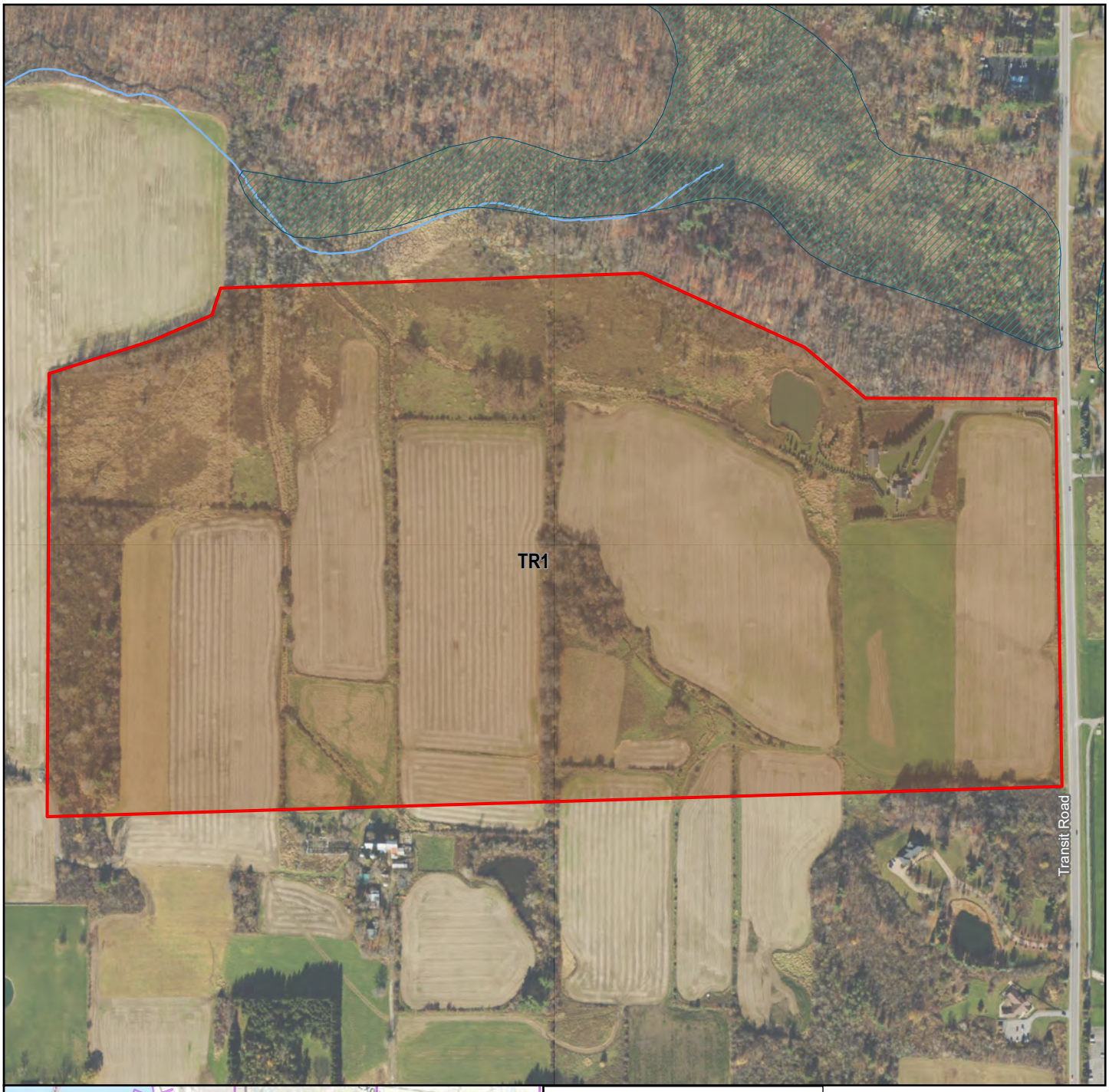
diversity or reseeding/planting where existing seed bank and/or species diversity is lacking. Subject to landowner preferences, restored or enhanced wetland areas should be protected with upland buffers. The costs estimates provided for TR assume 100 acres of combined wetland restoration and enhancement and 10 acres of upland buffer along the south boundary.

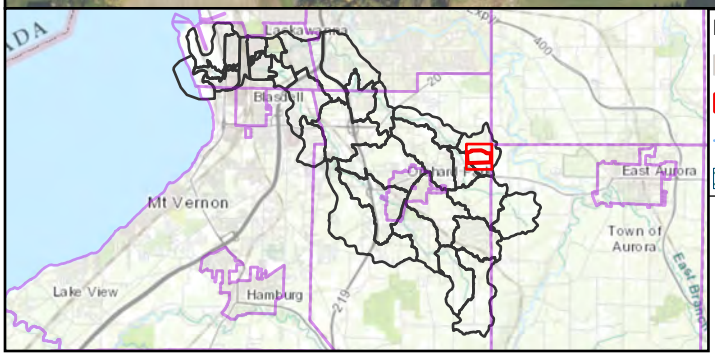
Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
TR1	Wetland Restoration	110 ac.	$668,000	$2,114,000	$2,891,000
			$668,000	**$2,224,000**	**$2,891,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate but will vary per project.
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection.
- Cost estimate does not include potential land acquisition costs.





Legend

- Wetland Restoration
- Focus Area Boundary
- Stream Reach
- Wetlands (DEC, Erie County, NY)

Paper Size ANSI A

0 180 360 540

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

N

GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Transit Rd Wetland Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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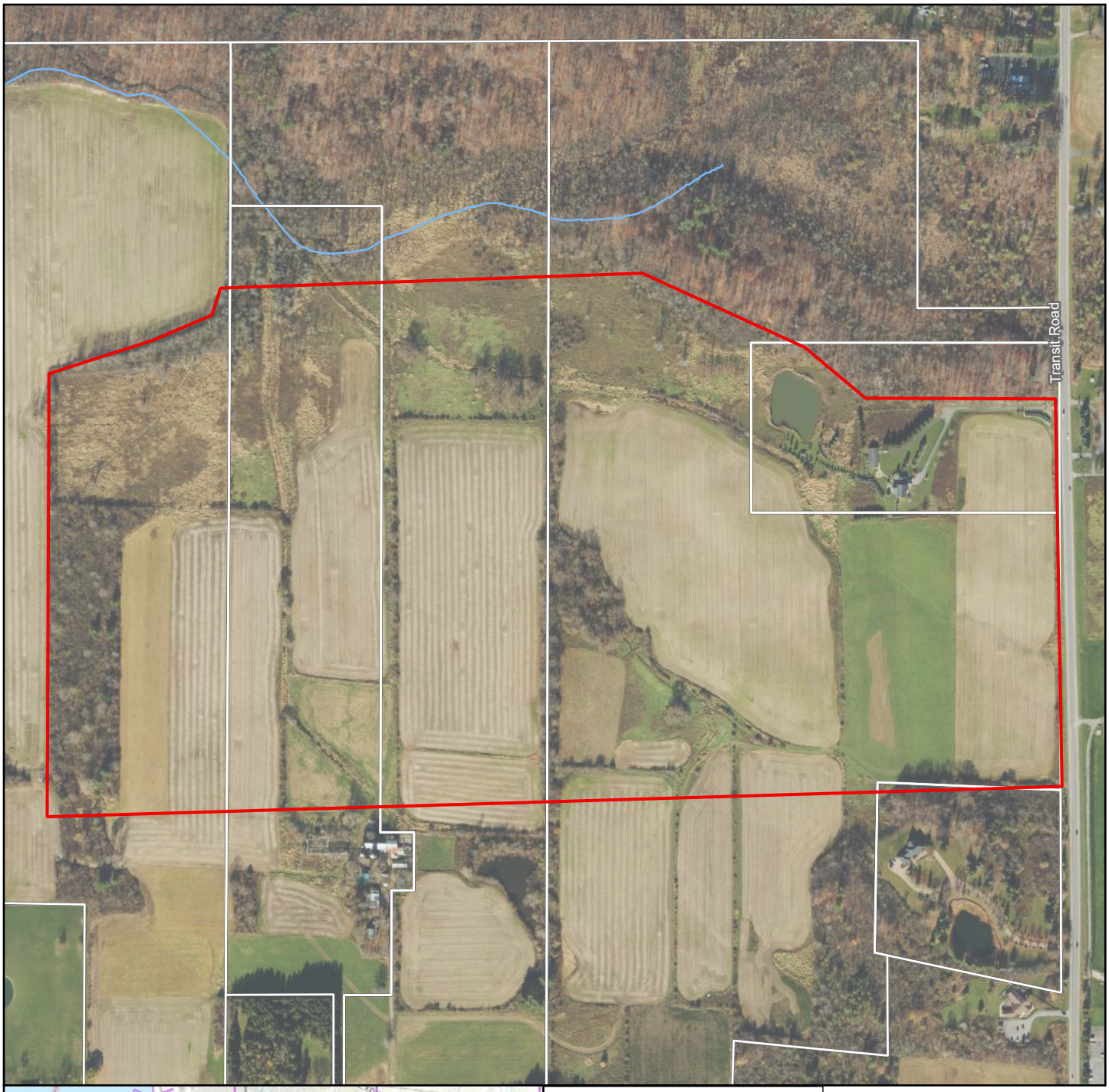

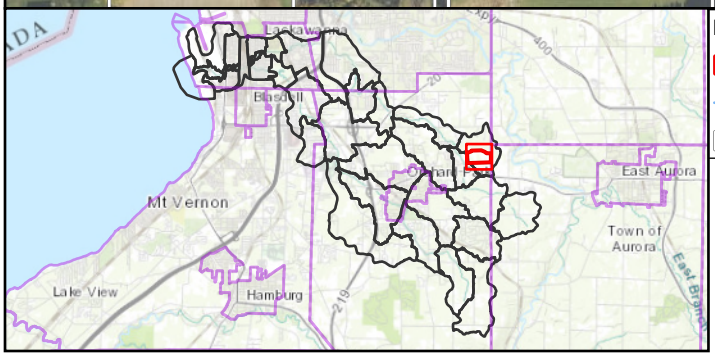

Legend

- Focus Area Boundary
- Stream Reach
- Private Land Parcels

Paper Size ANSI A

0 180 360 540

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Transit Rd Wetland Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Print date: 17 May 2024 - 11:25

Data source: GHD, 2023; Erie county; RAVI orthoimagery, 2023; DEC wetlands; World Topographic Map: Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA; World Topographic Map: Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS; USA NAIP Imagery: Natural Color: Esri, USDA Farm Service Agency; World Topographic Map: Province of Ontario,

Focus Area: Jewett Holmwood (HH)

Location: 905 Jewett Holmwood Road, Orchard Park, NY (NRU-SCUT1A; 42.753037, -78.675550)

Size: ~25 acres

Ownership: 100% Private (refer to Jewett Holmwood Land Ownership Map)

Existing/historic conditions/land use: The project area has been agricultural land since before 1995.

Site Description: The Jewett Holmwood site is a 26-acre site bisected by Jewett Holmwood Road. The site is located on two private parcels and include the entire south parcel and portions of the north parcel. Existing land use on the south parcel is pasture and hayfield. The north parcel is a mix of row crop and pasture. The south parcel includes partially drained wet meadow and a small area of beech-maple forest. A channelized headwaters tributary to Smokes Creek drains through the site. There are no apparent subsurface tile connections to this tributary; however, there is at least one drainage swale that flows into the tributary on the north parcel. Soils are dominated by Canandaigua silt loam and Wayland soils complex, which are poorly drained hydric soils. Adjacent upland areas are dominated by Derby silt loam, a somewhat poorly drained soil that may have hydric soil inclusions.

This site was selected for restoration opportunities based on the following characteristics:

- Headwaters of Smokes Creek Tributary
- Channelized stream
- Drained (ditched) cropland on hydric soils
- Option to implement project on one or both sides of road
- Project provides upstream storage to attenuate stormwater flows and improve water quality
- Large wetland restoration area

Goals: Maintain/restore hydrologic functions, Protect/enhance natural communities

Recommended Opportunities (Refer to Jewett Holdwood Implementation Map):

<u>HH1 – Wetland Enhancement</u>

HH1 is a partially drained wet meadow with pasture. A site assessment that identifies surface and subsurface drainage and composition of the existing wetland community is recommended. Wetland enhancement would include hydrologic restoration and vegetation enhancement. The hydrologic restoration could include removal or blockage of ditches and tiles and possibly shallow excavation to restore original grades. The vegetation enhancement could include conversion of hayfield or pasture to native wetland grasses, forbs, shrubs and trees, management of invasive species, management of native seed soil bank, overseeding or planting to increase species diversity or reseeding/planting where existing seed bank and/or species diversity is lacking. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

<u>HH2 – Riparian Corridor Establishment and Wetland Restoration</u>

Riparian corridor establishment is recommended on the north parcel. The three-zone buffer guidance described in Appendix D may be followed to guide design the layout and suggested vegetation establishment and land

uses within each zone. The riparian corridor could integrate the existing pond and depending on site conditions could also include re-meandering portions of the tributary channel. The southeast area of row crop field may be suitable for additional wetland restoration which could be implemented as described for H1. The target plant communities could include sedge meadow/wet meadow along the tributary channel and areas mapped as hydric soils and short-height grassland species on the upland buffer portion of the riparian corridor. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

HH3/HH4/HH5 – Mesic Forest Restoration and Enhancement

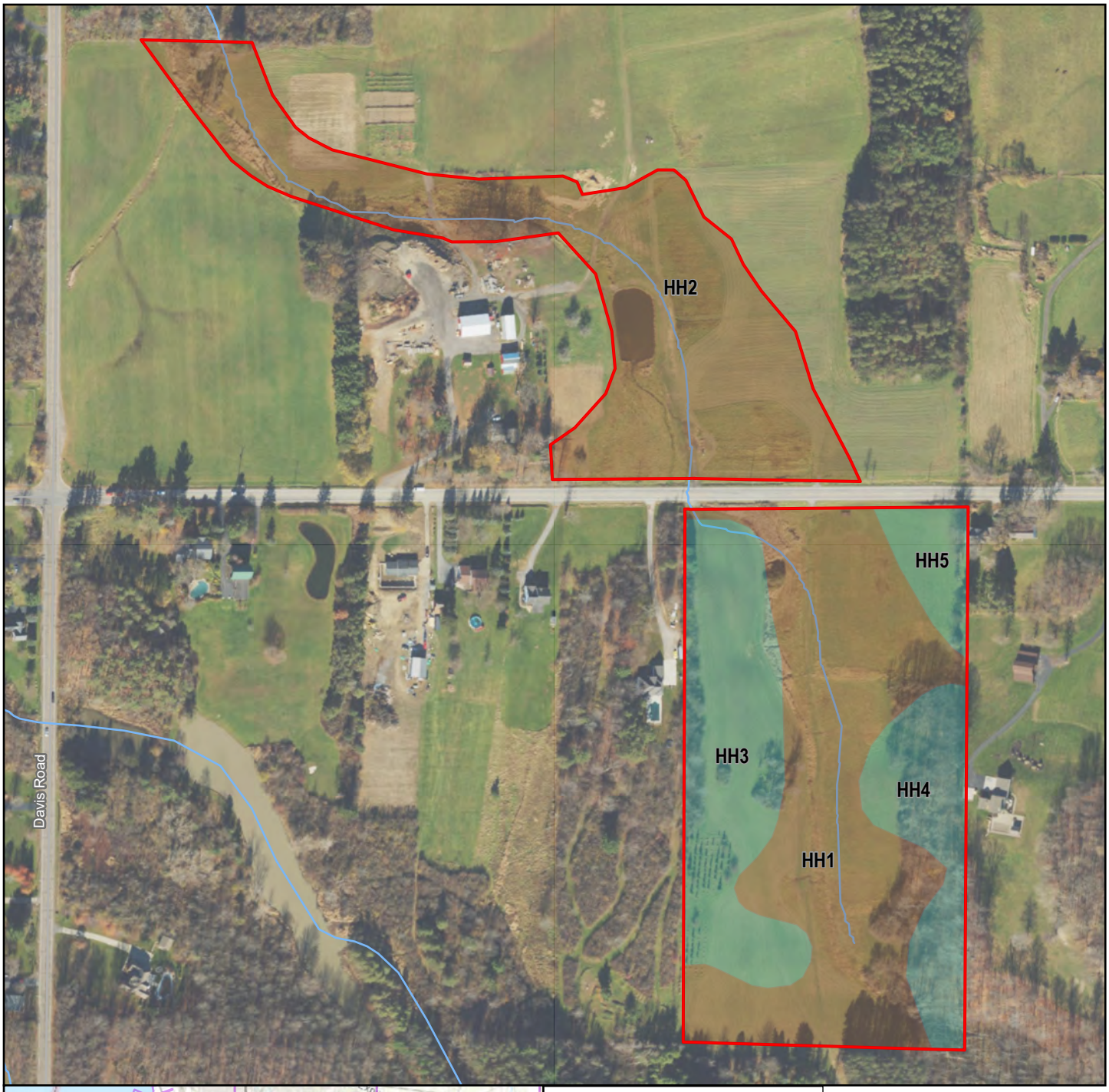
Mesic hardwood forest restoration is proposed on upland areas adjacent to area HH1. The mesic forest restoration on pasture hayfield areas could include planting of trees, shrubs, groundcover species characteristic of mesic forest. The existing forest areas could be enhanced through invasive species control and supplemental planting of native trees, shrubs, and herbaceous species to increase species diversity. The forest restoration target for these areas is beech-maple forest. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance.

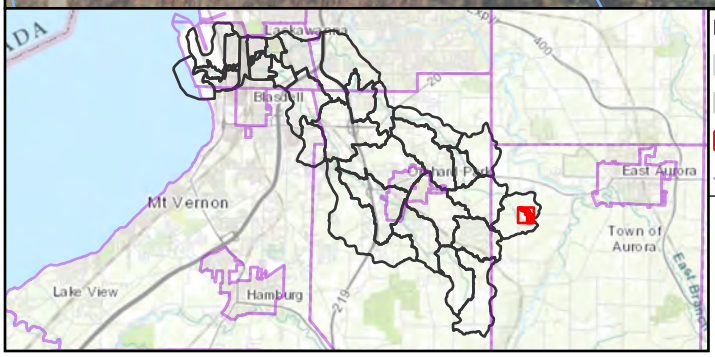
Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design	Construction	Total
HH1	Wetland Enhancement	9 ac.	$41,000	$135,000	$176,000
HH2	Wetland Restoration and Riparian Corridor Enhancement	9 ac.	$81,000	$270,000	$351,000
HH3/HH4/HH5	Mesic Forest Restoration and Enhancement	7 ac.	$8,000	$26,000	$34,000
			$130,000	**$431,000**	**$561,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate but will vary per project.
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection.





Legend

- Mesic Forest Restoration
- Wetland Restoration
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 110 220 330

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

N

GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Jewett Holmwood Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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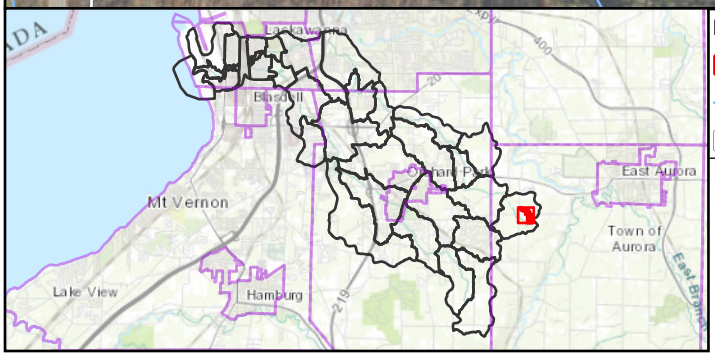

Legend

- Focus Area Boundary
- Stream Reach
- Private Land Parcels

Paper Size ANSI A

0 110 220 330

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Jewett Holmwood Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Print date: 17 May 2024 - 11:15

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Focus Area: Benning Road (BR)

Location: 6220 Benning Road, West Falls, NY (NRU-SCU1; 42.714827, -78.07756)

Size: ~10 acres

Ownership: 100% Private (refer to Benning Road Land Ownership Map)

Existing/historic conditions/land use: This area has been used as agricultural row crops since before 1995 to present.

Site Description: The site is currently a mix of row crops, partially drained wet meadow wetland, and old field along headwaters of Smokes Creek. The site is situated in a sloping drainageway with a shallow ditch that drains north and outfalls into Smokes Creek just west of Benning Road. Soils identified by the NRCS Soil Survey include Lyons, which is classified as a hydric soil, and Marilla channery silt loam. The site is bounded to the west by fair to good quality beech maple forest identified as a Conservation Area.

This site was selected as a potential restoration location based on the following characteristics:

- Headwaters of Creek flows through site
- Drained (ditched) cropland on hydric soils
- Abuts conservation area and potentially links other conservation areas together
- Mapped as riparian buffer improvement project
- Project provides upstream storage to attenuate stormwater flows and improve water quality
- Large wetland restoration area

Goals: Maintain/Restore hydrologic functions, protect and enhance natural communities

Recommended Opportunities (Refer to Benning Road Implementation Plan Map):

<u>BR1 – Wetland Restoration (7 acres)</u>
Wetland restoration is proposed for areas of the site that contain Lyons soils or are within the drainageway defined by BR1. The ditch that extends down the center of BR1 and any adjacent spoils, should be graded to pre-ditch contours and/or level spreaders should be employed to redirect channelized flow over the wetland restoration area. Tiles, if present should be removed or disabled. Subject to frequency, depth and duration of ponding and soil saturation, wetland community restoration targets may include sedge meadow, wet meadow, and shrub swamp. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. Establishment of these wetland communities should include control of reed canary grass, cattail and other invasive species followed by seeding and planting of native grasses, sedges, forbs, and woody species where applicable.

<u>BR2/BR3 – Mesic Forest Restoration (3 acres)</u>
Restoration of beech-maple and rich mesophytic hardwood forest is proposed on non-wetland areas of the site mapped as Marilla Channery Silt Loam. The mesic forest restoration should utilize a successional approach that includes establishment of short/medium-term woodland grasses and forbs coupled with tree and shrub establishment. Initially, the site will be dominated by native woodland edge grasses and forbs along with tree and shrub plantings. Over time, the tree and shrub plantings and volunteer seedlings from adjacent forest edges

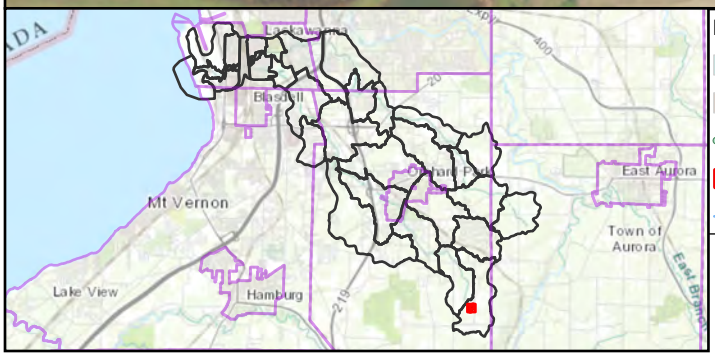
will fill in over the herbaceous ground cover. See relevant New York Natural Heritage Program's ecological community conservation guides in Appendix E for planting assistance. The mesic forest restoration area may encompass the entire area mapped as BR2/BR3 or may be limited to a 100-foot buffer that extends around the east and west perimeter of restored wetland (BR1). Subject to landowner approval, the wetland buffer should also be expanded into the residential lots north and southeast of BR1.

Cost Estimate for Implementation

Project ID	Name	Acre (ac) / Linear feet (lf)	Approximate Implementation Costs		
			Planning & Design (30%)	Construction	Total
BR1	Wetland Restoration	7 ac.	$63,000	$210,000	$273,000
BR2	Mesic Forest Restoration	1 ac.	$2,000	$5,000	$7,000
BR3	Mesic Forest Restoration	2 ac.	$3,000	$9,000	$12,000
			$68,000	**$224,000**	**$292,000**

Notes:

- Planning and Design costs are estimated as 30% of the Construction cost estimate, but will vary per project
- Construction cost estimates do not include fees for mobilization/demobilization, access, water management, access restoration, or contract administration/construction inspection



Legend

- Mesic Forest Restoration
- Wetland Restoration
- Riparian Buffer
- Focus Area Boundary
- Stream Reach

Paper Size ANSI A

0 50 100 150

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

N

GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Benning Road Implementation Plan

Project No. **12572245**
Revision No. **-**
Date **15 May 2024**

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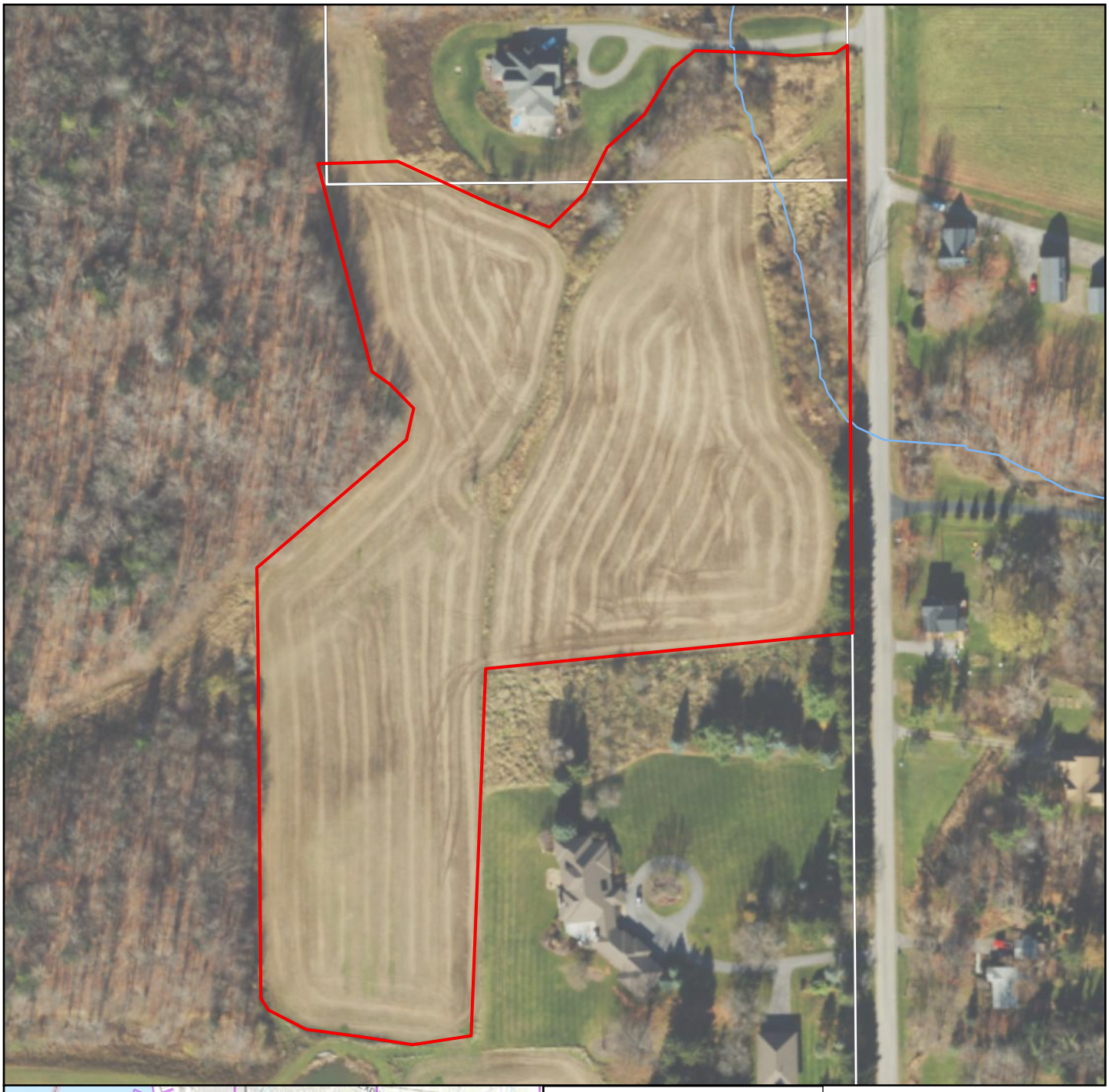

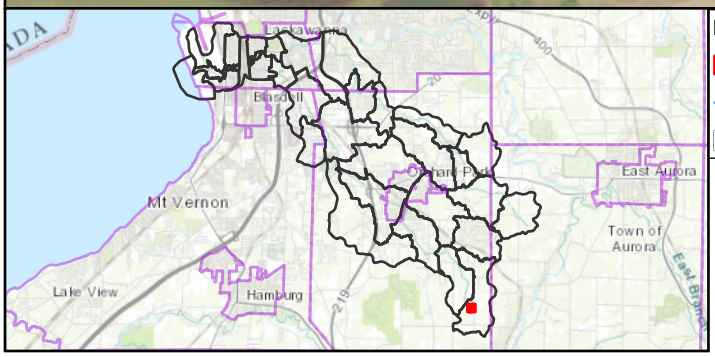

Legend

- Focus Area Boundary
- Stream Reach
- Private Land Parcels

Paper Size ANSI A

0 50 100 150

US Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane New York West FIPS 3103 Feet

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GHD

New York State Office of General Services
Department of Environmental Conservation
Smokes Creek Habitat Connectivity and Improvement Opportunity Project - Phase III

Benning Road Parcel Ownership

Project No. **12572245**
Revision No. **-**
Date **17 May 2024**

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Print date: 17 May 2024 - 10:49

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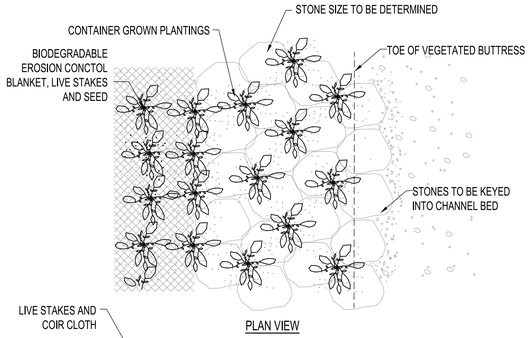
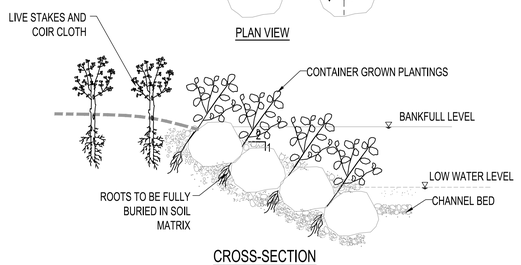
Appendix D

Potential Instream Treatment Alternatives



PLAN VIEW

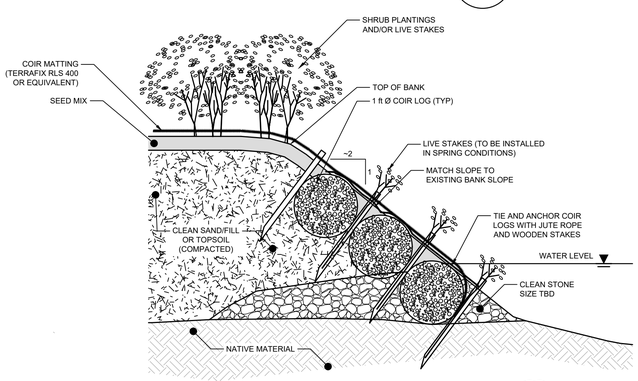


CROSS-SECTION

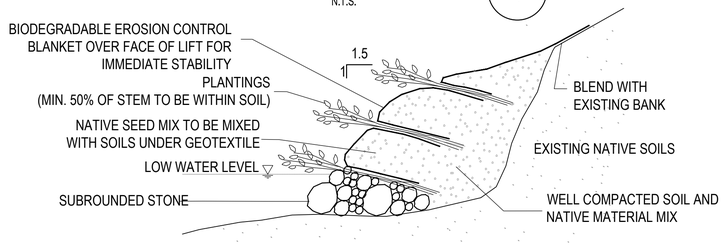
NOTES

1. VEGETATED BUTTRESS TO BE INSTALLED IN LIFTS.
2. NUMBER OF LIFTS DEPENDENT ON BANK HEIGHT, SLOPE AND STONE SIZE.
3. STONE TO BE KEYED INTO CHANNEL BED.
4. PLANTS TO BE INSTALLED ONE METRE APART HORIZONTALLY IN EACH LAYER. SPECIES ARRANGEMENT TO BE RANDOM. PLANT PLACEMENT SHALL BE STAGGERED SUCH THAT THEY ARE NOT VERTICALLY ALIGNED AND ARE PLANTED 'ON CENTRE'
5. CONTAINER GROWN PLANTINGS TO BE USED IN NON DORMANT SEASON

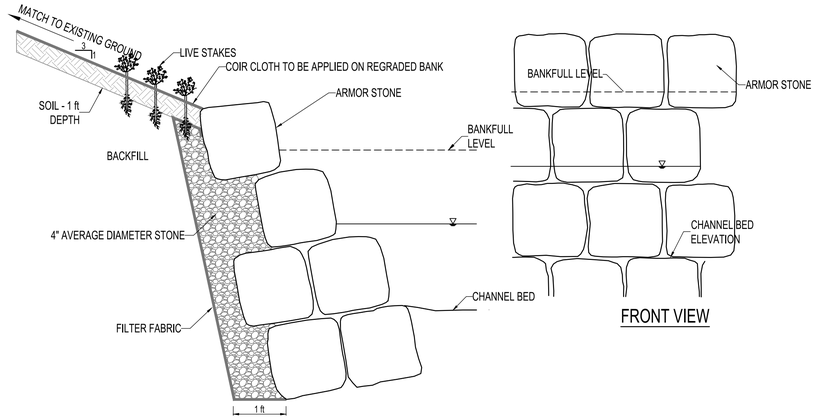
VEGETATED ROCK BUTTRESS 1
N.T.S.



COIR LOG BANK TREATMENT 4
N.T.S.



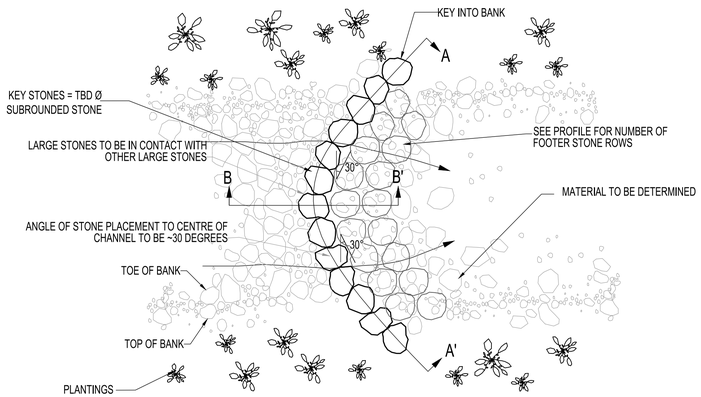
VEGETATED LAYERING WITH STONE TOE 5
N.T.S.



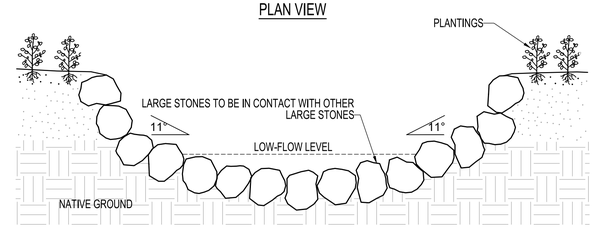
CROSS-SECTION

FRONT VIEW

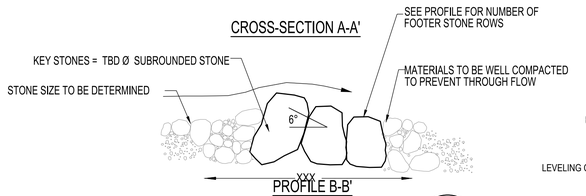
ARMOR STONE RETAINING WALL 2
N.T.S.



PLAN VIEW

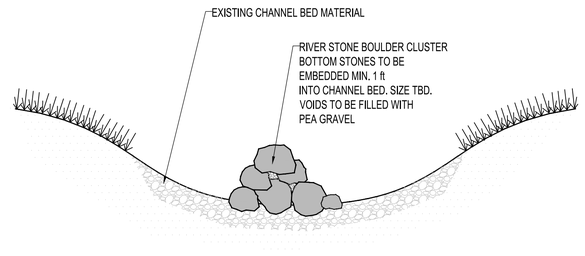


CROSS-SECTION A-A'

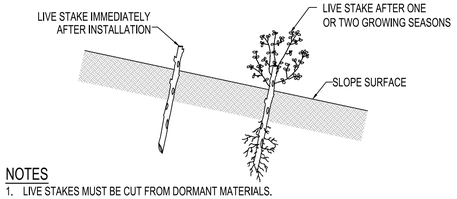


PROFILE B-B'

ROCK VORTEX WEIR 6
N.T.S.



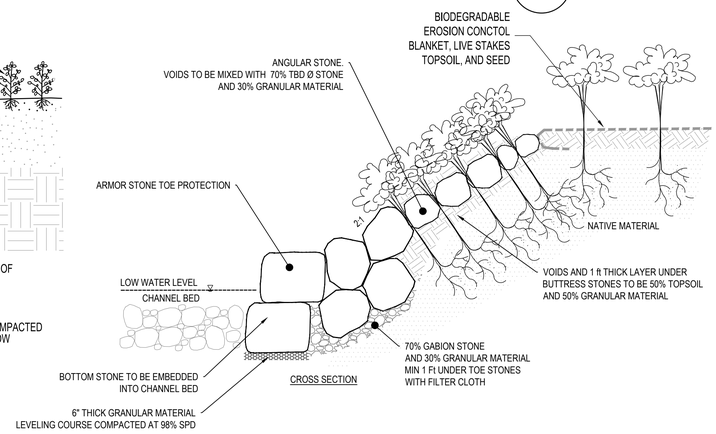
BOULDER CLUSTER 3
N.T.S.



NOTES

1. LIVE STAKES MUST BE CUT FROM DORMANT MATERIALS.
2. LIVE STAKES SHALL BE PLANTED THE SAME DAY AS HARVESTED, OR STORED FOR A PERIOD NO LONGER THAN TWO (2) DAYS.
3. THE CONTRACTOR SHALL PROTECT PLANT MATERIALS FROM DRYING AND OVERHEATING AT THE TIME OF HARVEST, DURING TRANSPORT AND DURING THE CONSTRUCTION PROCESS.
4. LIVE STAKES TO BE 1-3" DIAMETER AND CUT TO A LENGTH OF 3-4 ft
5. MAKE AN ANGLE CUT AT THE BASAL END, OR BOTTOM OF THE STAKE.
6. TRIM ALL SIDE BRANCHES, TAKING CARE NOT TO DAMAGE THE BARK.
7. DO NOT PLANT UPSIDE DOWN.
8. LIVE STAKES SHOULD BE INSTALLED USING A DEADBLOW HAMMER (LARGE RUBBER MALLET WITH THE HEAD FILLED WITH LEAD PELLETS).
9. 80 PERCENT OF STAKE TO BE BELOW SURFACE.
10. GENTLY TAMP THE LIVE STAKE INTO THE GROUND AT RIGHT ANGLES TO THE SLOPE.
11. IF THE SOIL IS COMPACT A PILOT HOLE MADE WITH A STEEL BAR SHOULD BE USED.
12. IF USING A PILOT HOLE REPACK SOIL AROUND THE STAKE.
13. DENSITY OF LIVE STAKES TO BE 3 PER SQUARE YARD.

LIVE STAKE DETAIL 7
N.T.S.



VEGETATED ROCK BUTTRESS WITH ARMOR STONE TOE 8
N.T.S.

DRAFT FOR DISCUSSION

KEY MAP

No.	Revision	Drawn	Job Manager	Project Director	Date

Drawing Revisions

Note: * indicates signatures on original issue of drawing or last revision of drawing

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Client **NY OGS & NY DEC**

Project **SMOKES CREEK HABITAT CONNECTIVITY AND IMPROVEMENT**

Title **POTENTIAL RESTORATION TREATMENT OPTIONS**

Scale	AS NOTED	**DO NOT SCALE**
Drawn	J.C.	
Designer	X.X.	
Drafting Check	X.X.	
Design Check	X.X.	
Approved (Project Director)	XXXXXXXXXX	
Date	XXXXXXXXXX	

This Drawing must not be used for Construction unless signed as Approved

Drawing No.

Original Size **Arch D**

Rev. **001**

Appendix E

NYNHP Natural Community Conservation Guides

NYNHP

Beech-Maple Mesic Forest

Beech-maple mesic forest on the midslope of The Pinnacle in Washington County, NY
Gregory J. Edinger

System
Terrestrial

Subsystem
Forested Uplands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S3?

Vulnerable in New York (most likely) - Conservation status is uncertain, but most likely vulnerable to disappearing from New York due to rarity or other factors (but not currently imperiled); typically 21 to 80 populations or locations in New York, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines. More information is needed to assign a firm conservation status.

Global Conservation Status Rank

G4

Apparently Secure globally - Uncommon in the world but not rare; usually widespread, but may be rare in some parts of its range; possibly some cause for long-term concern due to declines or other factors.

Contents

Summary

Did you know?

American witch-hazel (*Hamamelis virginiana*) is a common shrub found in beech-maple mesic forests. It was used by native peoples for thousands of years and later by American settlers. Although witch hazel is not as popular as it was in the 1900s, it is still used to prevent infection from cuts, soothe insect bites and sunburn, relieve pain and swelling, reduce acne, tone skin, and as an aftershave.

State Ranking Justification

There are several hundred to a few thousand occurrences statewide. Some documented occurrences have good viability and many are protected on public land or private conservation land. This community has statewide distribution and includes several very large, high quality, old-growth examples. The current trend of this community is probably declining due to moderate and imminent threats related to beech bark disease and development pressure.

Short-term Trends

The number and acreage of beech-maple mesic forests in New York have declined moderately in recent decades as a result of logging, agriculture, and other development.

Long-term Trends

The number and acreage of beech-maple mesic forests in New York have probably declined substantially from historical numbers likely correlated with past logging, agiculture, and other development.

Conservation and Management

Threats

Threats to forests in general include changes in land use (e.g., clearing for development), forest fragmentation (e.g., roads), and invasive species (e.g., insects, diseases, and plants). Other threats may include over-browsing by deer, and air pollution (e.g., ozone and acidic deposition). When occurring in expansive forests, the largest threat to the integrity of beech-maple mesic forests are activities that fragment the forest into smaller pieces. These activities, such as road building and other development, restrict the movement of species and seeds throughout the entire forest, an effect that often results in loss of those species that require larger blocks of habitat (e.g., black bear, bobcat, certain bird species). Additionally, fragmented forests provide decreased benefits to neighboring societies from services these societies often substantially depend on (e.g., clean water, mitigation of floods and droughts, pollination in agricultural fields, and pest control) (Daily et al. 1997). American beech (*Fagus grandifolia*) trees in this community are threatened by the following diseases: 1) **Beech Bark Disease** causes significant mortality and defect in American beech. The disease results

when bark, attacked and altered by the beech scale (*Cryptococcus fagisuga*), is invaded and killed by fungi, primarily *Nectria coccinea* var. *faginata* and sometimes *N. galligena* (Houston and O'Brien 1983). This disease is common across New York State (NYS DEC); 2) **Beech Leaf Disease** was first discovered in 2012 from northeastern Ohio (Ewing et al. 2019). The disease was first observed in New York in 2018 in Chautauqua County and was found in Suffolk and Nassau counties in 2019 (NYS DEC). It has since spread throughout western, central, and southern NY (NYS DEC). The foliar nematode *Litylenchus crenatae* ssp. *mcannii* is responsible for beech leaf disease and is believed to be non-native in North America (Carta et al. 2020, Reed et al. 2020). Beech leaf disease can kill beech trees of all ages though younger trees appear to die more quickly (NYS DEC).

Conservation Strategies and Management Practices

Management should focus on activities that help maintain regeneration of the species associated with this community. Develop a plan to eliminate or control beech bark disease. Deer have been shown to have negative effects on forest understories (Miller et al. 1992, Augustine & French 1998, Knight 2003) and management efforts should strive to ensure that regenerating trees and shrubs are not so heavily browsed that they cannot replace overstory trees. Avoid cutting old-growth examples and encourage selective logging in areas that are under active forestry.

Development and Mitigation Considerations

Strive to minimize fragmentation of large forest blocks by focusing development on forest edges, minimizing the width of roads and road corridors extending into forests, and designing cluster developments that minimize the spatial extent of the development. Development projects with the least impact on large forests and all the plants and animals living within these forests are those built on brownfields or other previously developed land. These projects have the added benefit of matching sustainable development practices (for example, see: The President's Council on Sustainable Development 1999 final report, US Green Building Council's Leadership in Energy and Environmental Design certification process at http://www.usgbc.org/).

Inventory Needs

Inventory any remaining large and/or old-growth examples across the state.

Research Needs

Critically compare this community to maple-basswood rich mesic forest and confirm that occurrences of each are properly classified. Regularly assess the presence and degree of impact that beech bark disease has on this forest community.

Rare Species

- *Aconitum noveboracense* (Northern Monkshood) (guide)
- *Agastache nepetoides* (Yellow Giant Hyssop) (guide)
- *Agrimonia rostellata* (Woodland Agrimony) (guide)
- *Andersonglossum boreale* (Northern Wild Comfrey) (guide)
- *Aplectrum hyemale* (Puttyroot) (guide)
- *Asimina triloba* (Pawpaw) (guide)
- *Botrychium oneidense* (Blunt-lobed Grape Fern) (guide)
- *Carex arcta* (Northern Clustered Sedge) (guide)
- *Carex jamesii* (James' Sedge) (guide)
- *Carya laciniosa* (Big Shellbark Hickory) (guide)
- *Cirriphyllum piliferum* (Hair-pointed Moss) (guide)
- *Corallorhiza striata* var. *striata* (Striped Coralroot) (guide)
- *Criorhina nigriventris* (Bare-cheeked Bumblefly) (guide)
- *Crotalus horridus* (Timber Rattlesnake) (guide)
- *Cystopteris protrusa* (Lowland Fragile Fern) (guide)
- *Frasera caroliniensis* (Green Gentian) (guide)
- *Galium concinnum* (Shining Bedstraw) (guide)
- *Geothlypis formosa* (Kentucky Warbler) (guide)
- *Geum virginianum* (Cream-colored Avens) (guide)
- *Haliaeetus leucocephalus* (Bald Eagle) (guide)
- *Lasiurus borealis* (Eastern Red Bat) (guide)
- *Lindbergia brachyptera* (Papillose Fine-branch Moss) (guide)
- *Myotis leibii* (Eastern Small-footed Myotis) (guide)
- *Myotis lucifugus* (Little Brown Bat) (guide)
- *Myotis septentrionalis* (Northern Long-eared Bat) (guide)
- *Myotis sodalis* (Indiana Bat) (guide)
- *Perimyotis subflavus* (Tri-colored Bat) (guide)
- *Pieris virginiensis* (West Virginia White) (guide)

- *Platanthera hookeri* (Hooker's Orchid) (guide)
- *Poa sylvestris* (Forest Blue Grass) (guide)
- *Pseudotaxiphyllum distichaceum* (Two-ranked moss) (guide)
- *Pterospora andromedea* (Pine Drops) (guide)
- *Setophaga cerulea* (Cerulean Warbler) (guide)
- *Sylvilagus transitionalis* (New England Cottontail) (guide)
- *Triphora trianthophora* (Nodding Pogonia) (guide)

Range

New York State Distribution

This community is widespread throughout Upstate New York. It is probably represented by different ecoregional variants. It forms the matrix forest of the Northern Appalachian Ecoregion in the Adirondacks and Tug Hill. Beech-maple mesic forest is also present in the Lower New England, the Great Lakes, and the High Allegheny Plateau ecoregions. This community is absent from the North Atlantic Coast Ecoregion where it is replaced by the similar coastal oak-beech forest.

Global Distribution

This somewhat broadly-defined community is probably widespread throughout the northeastern U.S. The range is estimated to span north to southern Canada, west to Minnesota, southwest to Indiana and Tennessee, southeast to Virginia, and northeast to Nova Scotia.

Best Places to See

- Pixley Falls State Park (Oneida County)
- Catskill Park (Ulster County)
- Cherry Plain State Park (Rensselaer County)
- Grafton Lakes State Park (Rensselaer County)
- Tug Hill Wildlife Management Area (Oswego County)
- West Canada Lakes Wilderness Area (Hamilton, Herkimer Counties)
- Adirondack Park (Hamilton County)

Identification Comments

General Description

Beech-maple mesic forest communities are closed-canopy hardwood forests with codominating sugar maple (Acer saccharum) and American beech (Fagus grandifolia). This is a broadly defined community type with several regional and edaphic variants. These forests occur on moist, well drained, usually acid soils. There are many spring ephemerals that bloom before the canopy trees leaf out. Hemlock (Tsuga canadensis) may be present at a low density. In the Adirondacks a few red spruce (Picea rubens) may also be present.

Characters Most Useful for Identification

The codominance of American beech and sugar maple and a variety of herbaceous species, including a good display of spring ephermals, identify this community. Typically there is also an abundance of tree seedlings, especially of sugar maple; beech and sugar maple saplings are often the most abundant small trees in the understory, along with shrubs such as American witch-hazel (Hamamelis virginiana) and hobblebush (Viburnum lantanoides).

Elevation Range

Known examples of this community have been found at elevations between 320 feet and 4,186 feet.

Best Time to See

Because the key to distinguishing a beech-maple mesic forest from related types is its vascular plant composition and diversity, it is easiest to identify the community during the growing season, from late May through summer. Striking seasonal leaf color can be enjoyed in the fall.

Beech-Maple Mesic Forest Images

Beech-maple mesic forest on the midslope of The Pinnacle in Washington County, NY
Gregory J. Edinger

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Sugar Maple - Yellow Birch - American Beech / Hobblebush Forest (CEGL006631)
- Sugar Maple - Yellow Birch - Black Cherry Forest (CEGL006045)
- Sugar Maple - American Beech - White Ash / Jack-in-the-Pulpit Forest (CEGL006632)
- Sugar Maple - (White Ash) / Jack-in-the-Pulpit Forest (CEGL006211)
- American Beech - Sugar Maple Glaciated Midwest Forest (CEGL005013)
- Northern Red Oak - Sugar Maple - American Beech / Mapleleaf Viburnum Forest (CEGL006633)

- Northern Red Oak - Sugar Maple / Mapleleaf Viburnum - Northern Spicebush Forest (CEGL006635)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Laurentian-Acadian Northern Hardwood Forest (CES201.564)
- North-Central Interior Beech-Maple Forest (CES202.693)

Characteristic Species

Trees > 5m

Acer rubrum var. *rubrum* (common red maple)
Acer saccharum (sugar maple)
Betula alleghaniensis (yellow birch)
Betula lenta (black birch)
Fagus grandifolia (American beech)
Fraxinus americana (white ash)
Ostrya virginiana (hop hornbeam, ironwood)
Picea rubens (red spruce)
Prunus serotina var. *serotina* (wild black cherry)
Quercus rubra (northern red oak)
Tsuga canadensis (eastern hemlock)

Shrubs 2 - 5m

Acer pensylvanicum (striped maple)
Carpinus caroliniana ssp. *virginiana* (musclewood, ironwood, American hornbeam)
Cornus alternifolia (pagoda dogwood, alternate-leaved dogwood)
Hamamelis virginiana (witch-hazel)
Viburnum lantanoides (hobblebush)

Shrubs < 2m

Viburnum acerifolium (maple-leaved viburnum)

Herbs

Ageratina altissima var. *altissima* (common white snakeroot)
Aralia nudicaulis (wild sarsaparilla)
Arisaema triphyllum ssp. *triphyllum* (common jack-in-the-pulpit)
Brachyelytrum erectum (southern shorthusk)
Carex pensylvanica (Pennsylvania sedge)
Dennstaedtia punctilobula (hay-scented fern)
Dryopteris carthusiana (spinulose wood fern)
Dryopteris intermedia (evergreen wood fern, fancy wood fern, common wood fern)
Dryopteris marginalis (marginal wood fern)
Epifagus virginiana (beech-drops)
Erythronium americanum ssp. *americanum* (yellow trout-lily)
Eurybia divaricata (white wood-aster)
Huperzia lucidula (shining firmoss)
Lysimachia borealis (starflower)
Maianthemum canadense (Canada mayflower)
Maianthemum racemosum ssp. *racemosum* (false Solomon's-seal)
Medeola virginiana (Indian cucumber-root)
Mitchella repens (partridge-berry)
Oclemena acuminata (whorled wood-aster)
Oxalis montana (northern wood sorrel)
Podophyllum peltatum (may-apple)
Polygonatum biflorum var. *biflorum* (small Solomon's-seal)
Polygonatum pubescens (hairy Solomon's-seal)
Polystichum acrostichoides (Christmas fern)
Solidago caesia var. *caesia* (blue-stemmed goldenrod, wreath goldenrod)
Tiarella cordifolia (foamflower)
Trillium erectum (purple trillium, stinking Benjamin)
Trillium undulatum (painted trillium)
Uvularia sessilifolia (wild-oats, sessile-leaved bellwort)
Viola spp.

Similar Ecological Communities

- Coastal oak-beech forest (guide)

  Beech-maple mesic forests occur on moister soils than coastal oak-beech forests and have a higher diversity of canopy, shrub,

and herbaceous species. Beech-maple mesic forests occur throughout the state and have characteristic regional variants, whereas coastal oak-beech forests occur only on the Atlantic Coastal Plain.

- Maple-basswood rich mesic forest (guide)

  Maple-basswood rich mesic forests have a higher diversity of rich-soil herbs, including a variety of fern species and many spring ephemerals. Beech-maple mesic forests have more acid-tolerant herbs and ferns, and a slightly lower diversity.

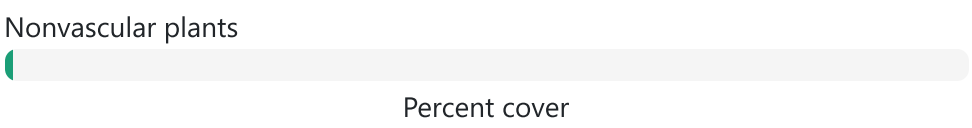
- Maritime beech forest (guide)

  Maritime beech forest is a hardwood forest with American beech (Fagus grandifolia) dominant that usually occurs on north-facing exposed bluffs and the back portions of rolling dunes in well-drained fine sands. Wind and salt spray cause the beech trees to be stunted (average height 4 m to 15 m) and multiple-stemmed with contorted branches, especially on the exposed bluffs.

- Rich mesophytic forest (guide)

  Rich mesophytic forests occur on the Allegheny Plateau of southern New York and have a richer herb component, including such herbs as Canada waterleaf (Hydrophyllum canadense), running strawberry bush (Euonymus obovata), yellow mandarin (Disporum lanuginosum), and black bugbane (Cimicifuga racemosa).

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Beech-Maple Mesic Forest. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

References

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Links

- Beech Bark Disease (Ohio State University Extension)
- Beech Bark Disease (UMass Amherst, UMass Extension)
- Beech Leaf Disease (NYS DEC)
- Beech Leaf Disease (UMass Amherst, UMass Extension)
- Five Ponds Wilderness (NYS DEC)
- Forest Health Protection-Beech Bark Disease (USDA Forest Service)

About This Guide

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NYNHP

Coastal Oak-Hickory Forest

Coastal oak-hickory forest
David Hunt

System
Terrestrial

Subsystem
Forested Uplands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S3

Vulnerable in New York - Vulnerable to disappearing from New York due to rarity or other factors (but not currently imperiled); typically 21 to 80 populations or locations in New York, few

individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines.

Global Conservation Status Rank
G4

Apparently Secure globally - Uncommon in the world but not rare; usually widespread, but may be rare in some parts of its range; possibly some cause for long-term concern due to declines or other factors.

Contents

Summary

Did you know?

Pignut hickory (Carya glabra), and sweet pignut hickory (Carya ovalis) are two species of hickory that occur within coastal oak-hickory forests. These two species of hickory are actually very difficult to distinguish from each other most of the year. The main difference between the two species is the husk of the fruit. "The fruit of pignut hickory is pearshaped and the husks splits only about halfway down. This last feature is the only trustworthy one, since the other characteristics intergrade" (Harlow 1957).

State Ranking Justification

There are less than 10 documented occurrences statewide. These occurrences have good viability and are protected on private or public conservation land. The community is restricted to interior portions of

coastal lowlands in Suffolk and possibly Nassau Counties and is concentrated on knolls and mid to upper slopes of moraines. The acreage, extent, and condition of coastal oak-hickory forests in New York is suspected to be declining.

Short-term Trends

The acreage, extent, and condition of coastal oak-hickory forests in New York is suspected to be declining due to fragmentation and extirpation from residential and commercial development, heavy deer browse, and invasive species.

Long-term Trends

The number, extent, and viability of coastal oak-hickory forests in New York are suspected to have declined substantially over the long-term. These declines are likely correlated with the settlement of Long Island and the subsequent residential, agricultural and commercial development.

Conservation and Management

Threats

The threats to the coastal oak-hickory forest are many and varied: displacement of the community by commercial and residential development; invasive species; roads and trails causing forest fragmentation and erosion; and deer browse. Some of the invasive species that have been observed in the forest include Japanese barberry (Berberis thunbergii), Black locust (Robinia pseudo-acacia), bittersweet (Celastrus orbiculatus), garlic mustard (Alliaria petiolata) and multiflora rose (Rosa multiflora). Deer browse on seedlings and saplings are causing a loss of forest canopy regeneration.

Conservation Strategies and Management Practices

To promote a dynamic forest mosaic, allow natural processes, including gap formation from blowdowns and tree mortality, as well as, in-place decomposition of fallen coarse woody debris and standing snags, to operate, particularly in mature and old growth examples (Spies and Turner 1999). Management efforts should focus on the control or local eradication of invasive exotic plants and the reduction of white-tailed

deer densities. Consider deer exclosures or population management, particularly if studies confirm that canopy species recruitment is being affected by heavy browse. Generally, management should focus on activities that help maintain regeneration of the species associated with this community. Deer have been shown to have negative effects on forest understories (Miller et al. 1992, Augustine and French 1998, Knight 2003) and management efforts should strive to ensure that tree and shrub seedlings are not so heavily browsed that they cannot replace overstory trees. If active forestry must occur, use silvicultural techniques and extended rotation intervals that promote regeneration of a diversity of canopy, subcanopy and shrub species over time (Busby et al. 2009) while avoiding or minimizing both short-term and persistent residual disturbances such as soil compaction, loss of canopy cover due to logging road construction, and the unintended introduction of invasive plants.

Development and Mitigation Considerations

Fragmentation of coastal forests should be avoided. It is also important to maintain connectivity with adjacent natural communities, not only to allow nutrient flow and seed dispersal, but to allow animals to move between them seasonally. Strive to minimize fragmentation of large forest blocks by focusing development on forest edges, minimizing the width of roads and road corridors extending into forests, and designing cluster developments that minimize the spatial extent of the development. Development projects with the least impact on large forests and all the plants and animals living within these forests are those built on brownfields or other previously developed land. These projects have the added benefit of matching sustainable development practices (for example, see: The President's Council on Sustainable Development 1999 final report, US Green Building Council's Leadership in Energy and Environmental Design certification process at http://www.usgbc.org/). A cross-section of coastal oak-hickory forest occurrences should be protected, including the largest ones, the most mature ones, and the ones in the best landscape block.

Inventory Needs

Survey for additional large examples in central to western Suffolk County. Some leads to follow up on include Caleb Smith State Park, Wildwood State Park, and Butler-Huntington Preserve among others.

Research Needs

A critical assessment of the long-term effects of heavy deer browse on this community, particularly addressing oak and other canopy species seedling recruitment, is needed.

Rare Species

- *Ageratina aromatica* var. *aromatica* (Small White Snakeroot) (guide)
- *Asclepias variegata* (White Milkweed) (guide)
- *Calycopis cecrops* (Red-banded Hairstreak) (guide)
- *Carex nigromarginata* (Black-edged Sedge) (guide)
- *Citheronia regalis* (Regal Moth) (guide)
- *Crataegus uniflora* (Dwarf Hawthorn) (guide)
- *Crocanthemum dumosum* (Bushy Rock Rose) (guide)
- *Cyperus echinatus* (Globe Flat Sedge) (guide)
- *Diospyros virginiana* (Persimmon) (guide)
- *Hypericum stragulum* (Low St. John's Wort) (guide)
- *Lasiurus borealis* (Eastern Red Bat) (guide)
- *Lechea tenuifolia* (Narrow-leaved Pinweed) (guide)
- *Ligusticum scoticum* ssp. *scoticum* (Scotch Lovage) (guide)
- *Myotis septentrionalis* (Northern Long-eared Bat) (guide)
- *Parrhasius m-album* (White-m Hairstreak) (guide)
- *Satyrium favonius ontario* (Northern Oak Hairstreak) (guide)
- *Viburnum dentatum* var. *venosum* (Southern Arrowwood) (guide)

Range

New York State Distribution

Coastal oak-hickory forests are restricted to the coastal lowlands in Suffolk and possibly Nassau Counties. They are concentrated on knolls and mid to upper slopes of glacial moraines. The range of this community possibly extends westward into northeastern Nassau County and on the end moraine of western Long Island (Greller 1977).

Global Distribution

This natural community occurs along the coast from Maine to Maryland. This community is similar to the mesic coastal plain mixed oak forest of New Jersey.

Best Places to See

- Sag Harbor State Park (Suffolk County)
- Heckscher State Park (Suffolk County)
- Caleb Smith State Park Preserve (Suffolk County)
- Wildwood State Park (Suffolk County)
- Northwest Creek SCFWH (Suffolk County)
- Hither Hills State Park (Suffolk County)
- Mashomack Preserve (Suffolk County)
- Barcelona Neck Natural Resource Management Area (Suffolk County)
- Caumsett State Park (Suffolk County)

Identification Comments

General Description

The forest is usually codominated by two or more species of oaks, usually white oak (Q. alba), black oak (Quercus velutina) and chestnut oak (Q. montana). Scarlet oak (Quercus coccinea) is also a common associate. Mixed with the oaks, usually at moderate densities, are one or more of the following hickories: pignut (Carya glabra), mockernut (C. alba), and sweet pignut (C. ovalis). These hickories can range from nearly pure stands to as little as about 25% cover. There is typically a subcanopy stratum of small trees and tall shrubs including flowering dogwood (Cornus florida) and highbush blueberry (Vaccinium corymbosum). The shrublayer and groundlayer flora may be diverse. Common low shrubs include maple-leaf viburnum (Viburnum acerifolium), blueberries (Vaccinium angustifolium, V. pallidum) and black huckleberry (Gaylussacia baccata). Characteristic groundlayer herbs are Swan's sedge (Carex swanii), panic grass (Panicum dichotomum), poverty grass (Danthonia spicata), cow-wheat (Melampyrum lineare), spotted wintergreen (Chimaphila maculata), rattlesnake weed (Hieracium venosum), white wood aster (Aster divaricatus), false Solomon's seal (Maianthemum racemosum), Pennsylvania sedge (Carex pensylvanica), and white goldenrod (Solidago bicolor).

Characters Most Useful for Identification

A hardwood forest with oaks (Quercus spp.) and hickories (Carya spp.) codominant that occurs in dry well-drained, loamy sand of knolls, upper

slopes, or south-facing slopes of glacial moraines of the Atlantic coastal plain.

Elevation Range

Known examples of this community have been found at elevations between 4 feet and 150 feet.

Best Time to See

Early spring is a good time to catch many of the understory trees and shrubs in bloom. Flowering dogwood and maple-leaf viburnum provide visual sprays of color in the spring. Mid to late summer is a good time to snack on ripening blueberries and huckleberries.

Coastal Oak-Hickory Forest Images

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- (White Oak, Northern Red Oak, Black Oak) / Hickory species / Mapleleaf Viburnum Forest (CEGL006336)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Northern Atlantic Coastal Plain Dry Oak-Hardwood Forest (CES203.475)

Characteristic Species

Trees > 5m

Acer rubrum var. *rubrum* (common red maple)
Carya cordiformis (bitternut hickory)
Carya glabra (pignut hickory)
Carya ovata var. *ovata* (shagbark hickory)
Cornus florida (flowering dogwood)
Prunus serotina var. *serotina* (wild black cherry)
Quercus alba (white oak)
Quercus coccinea (scarlet oak)
Quercus montana (chestnut oak)
Quercus palustris (pin oak)
Quercus rubra (northern red oak)
Quercus stellata (post oak)
Quercus velutina (black oak)
Sassafras albidum (sassafras)

Shrubs 2 - 5m

Acer rubrum var. *rubrum* (common red maple)
Amelanchier canadensis var. *canadensis* (coastal shadbush)
Carya glabra (pignut hickory)
Carya ovata var. *ovata* (shagbark hickory)
Carya tomentosa (mockernut hickory)
Cornus florida (flowering dogwood)
Hamamelis virginiana (witch-hazel)
Lindera benzoin (spicebush)

Quercus alba (white oak)
Quercus coccinea (scarlet oak)
Quercus montana (chestnut oak)
Quercus palustris (pin oak)
Quercus rubra (northern red oak)
Quercus velutina (black oak)
Sassafras albidum (sassafras)
Vaccinium corymbosum (highbush blueberry)
Viburnum acerifolium (maple-leaved viburnum)

Shrubs < 2m

Clethra alnifolia (coastal sweet-pepperbush)
Cornus florida (flowering dogwood)
Gaylussacia baccata (black huckleberry)
Quercus coccinea (scarlet oak)
Quercus montana (chestnut oak)
Quercus rubra (northern red oak)
Quercus velutina (black oak)
Vaccinium angustifolium (common lowbush blueberry)
Vaccinium corymbosum (highbush blueberry)
Vaccinium pallidum (hillside blueberry)
Viburnum acerifolium (maple-leaved viburnum)
Viburnum dentatum

Herbs

Aralia nudicaulis (wild sarsaparilla)
Carex pensylvanica (Pennsylvania sedge)
Carex swanii (Swan's sedge)
Chimaphila maculata (spotted-wintergreen)
Danthonia spicata (poverty grass)
Dichanthelium dichotomum ssp. *dichotomum* (forked rosette grass)
Eurybia divaricata (white wood-aster)
Gaultheria procumbens (wintergreen, teaberry)
Hieracium venosum (rattlesnake hawkweed)
Maianthemum canadense (Canada mayflower)
Maianthemum racemosum
Melampyrum lineare (cow-wheat)
Polygonatum biflorum var. *biflorum* (small Solomon's-seal)
Solidago bicolor (silver-rod)
Thelypteris noveboracensis (New York fern)

Similar Ecological Communities

- Appalachian oak-hickory forest (guide)

  This is a hardwood forest that occurs on well-drained sites, usually on ridgetops, upper slopes, or south- and west-facing slopes. The soils are usually loams or sandy loams. This is a broadly defined forest community with several regional and edaphic variants. The dominant trees include one or more of the following oaks: red oak (Quercus rubra), white oak (Q. alba), and black oak (Q. velutina). Mixed with the oaks, usually at lower densities, are one or more of the following hickories: pignut (Carya glabra), shagbark (C. ovata), and sweet pignut (C. ovalis). Common associates are white ash (Fraxinus americana), red maple (Acer rubrum), and hop hornbeam (Ostrya virginiana). This forest is typically somewhat enriched with a subcanopy stratum of small trees and tall shrubs. Appalachian oak-hickory forests differ from coastal oak-hickory forests in that they only occur north of the Coastal Lowlands ecozone.

- Coastal oak-beech forest (guide)

  This is a hardwood forest with oaks (Quercus spp.) and American beech (Fagus grandifolia) codominant that occurs in dry well-drained, loamy sand of morainal coves of the Atlantic coastal plain. Some occurrences are associated with maritime beech forest. Beech can range from nearly pure stands to as little as about 25% cover. The forest is usually codominated by two or more species of oaks, usually black oak (Quercus velutina) and white oak (Q. alba). Scarlet oak (Quercus coccinea) and chestnut oak (Q. montana) are common associates. Red oak (Quercus rubra) may be present at low density and is a key indicator species along with sugar maple (Acer saccharum) and paper birch (Betula papyrifera). There are relatively few shrubs and herbs. Coastal oak-beech forests differ from coastal oak-hickory forests due to the significant amount of beech in the canopy, and by typically having poorer diversity in the herbaceous plant strata.

- Coastal oak-heath forest (guide)

This is a large patch to matrix low diversity hardwood forest that typically occurs on dry, well-drained, sandy soils of glacial outwash plains or moraines of the Atlantic coastal plain. The forest is usually codominated by two or more species of oaks: scarlet oak (Quercus coccinea), white oak (Q. alba) and black oak (Q. velutina). Chestnut oak (Quercus montana) is also a common associate. Pitch pine (Pinus rigida) and trees of other genera, if present, typically occur at less than 1% cover each in the canopy. The shrublayer is well-developed typically with a low, nearly continuous, cover of dwarf heaths such as blueberries (Vaccinium pallidum, V. angustifolium) and black huckleberry (Gaylussacia baccata). Coastal oak-heath forests differ from coastal oak-hickory forests from the lack of hickory in the overstory, having a low continuous cover of heath species in the shrub layer, and a general overall low diversity of shrubs and herbaceous plants.

- Coastal oak-holly forest (guide)

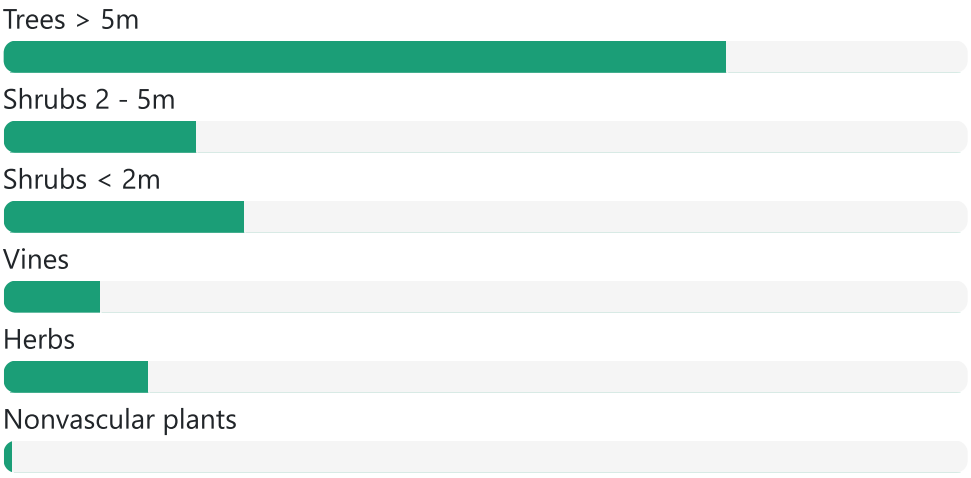
  This is a mixed deciduous-evergreen broadleaf forest that occurs on somewhat moist and moderately well drained silt and sandy loams in low areas on morainal plateaus. The elevation afforded by the raised plateau protects these areas from overwash and salt spray. In New York State, this forest is best developed on the narrow peninsulas of eastern Long Island. The trees are usually not stunted, and are removed from the pruning effects of severe salt spray. Coastal oak-holly forests differ from coastal oak-hickory forests from the lack of significant hickory in the overstory, being generally on moister sites, and typically having less species diversity.

- Coastal oak-laurel forest (guide)

  This is a large patch low diversity hardwood forest with broadleaf canopy and evergreen subcanopy that typically occurs on dry well-drained, sandy and gravelly soils of morainal hills of the Atlantic coastal plain. This forest is similar to the chestnut oak forest of the Appalachian Mountains; it is distinguished by lower abundance of chestnut oak (Quercus montana) and absence of red oak (Quercus rubra), probably

correlated with the difference between the sand and gravel of glacial moraines versus the bedrock of mountains.

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Coastal Oak-Hickory Forest. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

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Links

- How to Identify Hickory Trees
- Mashomack Preserve (NYS DEC)
- Mashomack Preserve (TNC)

About This Guide

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NYNHP

Floodplain Forest

Floodplain forest at Saratoga National Historical Site (plot SBB1)
Gregory J. Edinger

System
Palustrine

Subsystem
Forested Mineral Soil Wetlands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S2S3

Imperiled or Vulnerable in New York - Very vulnerable, or vulnerable, to disappearing from New York, due to rarity or other factors; typically 6 to 80 populations or locations in New York, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines. More information is needed to assign either S2 or S3.

Global Conservation Status Rank

G3G4

Vulnerable globally, or Apparently Secure - At moderate risk of extinction, with relatively few populations or locations in the world, few individuals, and/or restricted range; or uncommon but not rare globally; may be rare in some parts of its range; possibly some cause for long-term concern due to declines or other factors. More information is needed to assign either G3 or G4.

Contents

Summary

Did you know?

Floodplain forests once covered wide stretches along rivers in New York, yet only a tiny fraction of this original extent remains today. Minerals and other nutrients carried in rivers are deposited here after floods; these forests were among the first to be cleared because they produce very productive farmland. Urban expansion is also common along rivers, and floodplain forests are often cleared for such expansion and altered by

flood control structures. They serve as an important wildlife corridor between habitats and reduce flooding and excessive siltation downstream. Floodplain forests are one of the few places you can find the green dragon (*Arisaema dracontium*), a jack-in-the-pulpit plant relative.

State Ranking Justification

There are several hundred occurrences statewide, although most are likely small and degraded. Some documented occurrences have good viability and many are protected on public land or private conservation land. This community is somewhat limited to the floodplains of large streams and rivers across the state, and includes a few very large, high quality, old-growth examples. The current trend of this community is probably stable for occurrences on public land and private conservation land, or declining slightly elsewhere due to moderate threats related to development pressure. This community has declined substantially from historical numbers likely correlated with past logging, agriculture, and other development.

Short-term Trends

The number and acreage of floodplain forests in New York have probably remained stable, or have slightly increased, in recent decades as a result of riparian protection regulations, floodplain restoration efforts, and agricultural abandonment followed by natural succession.

Long-term Trends

The number and acreage of floodplain forests in New York have substantially declined (about 50%) from historical numbers likely correlated with the onset of agricultural development of these areas. The number of floodplain forests may have increased slightly from historical numbers as formerly large matrix examples were fragmented by development into numerous large and small patches.

Conservation and Management

Threats

Historically, floodplain forests were cleared for agricultural purposes because of the mineral rich soil. Many examples were reduced to narrow bands along river shores. River floodplains provided logical sites for

transportation corridors, as nearly every large stream and river in the state now has a parallel road, canal, and/or railroad. In recent decades, floodplains have been threatened by development (e.g., agriculture, residential, commercial), habitat alteration (e.g., clearing, excessive logging, pollution, dumping, utility ROWs), and recreational overuse (e.g., camp sites, hiking trails, fishing, boating, ATVs). Alteration to the natural seasonal flood regime is also a threat to this community (e.g., dikes, dredging, channelization, beaver).

Nearly all examples of floodplain forest are threatened by invasive species, such as garlic mustard (*Alliaria petiolata*), shrubby honeysuckles (*Lonicera morrowii, L. tatarica*), multiflora rose (*Rosa multiflora*), Japanese stilt grass (*Microstegium vimineum*), moneywort (*Lysimachia nummularia*), European stinging nettle (*Urtica dioica* ssp. *dioica*), dame's rocket (*Hesperis matronalis*), and Japanese knotweed (*Reynoutria japonica* var. *japonica*). Non-native trees in some floodplain forests include white willow (*Salix alba*) and black locust (*Robinia pseudoacacia*).

The emerald ash borer (Agrilus planipennis) is an Asian beetle that infests and kills North American ash trees. All native ash trees are susceptible, including white ash, green ash, and black ash. In New York, emerald ash borer has been found mostly south of the Adirondack Mountains, but in 2017 it was recorded in Franklin and St. Lawrence Counties. Natural communities dominated or co-dominated by ash trees would likely be most impacted by emerald ash borer invasion.

Conservation Strategies and Management Practices

Prevent alterations to annual flood regime, and prevent logging and grazing within floodplain forests. Develop plans to remove or control invasive plants at high quality floodplain forests. Discontinue or limit land conversion and fragmentation activities within and around floodplain forests. Allow floodplain areas to recover from past human activity.

Development and Mitigation Considerations

The few remaining floodplain forests should be left intact to the extent possible, particularly because of their role in reducing floods elsewhere. Any constructed access to the river should maintain connectivity between the watercourse and the floodplain, and should minimize

restrictions to high water flow throughout the floodplain. Maintain a full tree canopy throughout the floodplain forest and minimize edge effects on this forest by including an upland buffer of natural area (ideally forest) on the uphill side of the community. When considering road construction and other development activities, minimize actions that will change what water carries and how water travels to this community, both on the surface and underground. Water traveling over-the-ground as run-off usually carries an abundance of silt, clay, and other particulates during (and often after) a construction project. While still suspended in the water, these particulates make it difficult for aquatic animals to find food; after settling to the bottom of the wetland, these particulates bury small plants and animals and alter the natural functions of the community in many other ways. Thus, road construction and development activities near this community type should strive to minimize particulate-laden run-off into this community. Water traveling on the ground or seeping through the ground also carries dissolved minerals and chemicals. Road salt, for example, is becoming an increasing problem both to natural communities and as a contaminant in household wells. Fertilizers, detergents, and other chemicals that increase the nutrient levels in wetlands cause algae blooms and eventually an oxygen-depleted environment where few animals can live. Herbicides and pesticides often travel far from where they are applied and have lasting effects on the quality of the natural community. So, road construction and other development activities should strive to consider: 1. how water moves through the ground, 2. the types of dissolved substances these development activities may release, and 3. how to minimize the potential for these dissolved substances to reach this natural community.

Inventory Needs

Survey for occurrences statewide to advance documentation and classification of floodplain forests. A statewide review of floodplain forests is desirable, similar to the studies done in New Hampshire (Bechtel and Sperduto 1998, Nichols et al. 2000), Vermont (Sorenson et al. 1998), Massachusetts (Kearsley 1999), and Pennsylvania (Podniesinski and Wagner 2002). Continue searching for large sites in good condition especially those over 100 acres.

Research Needs

Research composition of floodplain forests statewide in order to characterize variations and how they correlate with flood regime and terrace elevation. Collect sufficient plot data to support the recognition of several distinct floodplain forest types based on composition, ecoregion, drainage, flood regime, and terrace elevation.

Rare Species

- *Ardea herodias* (Great Blue Heron) (guide)
- *Blera pictipes* (Painted Wood Fly) (guide)
- *Botrychium oneidense* (Blunt-lobed Grape Fern) (guide)
- *Bromus nottowayanus* (Satin Brome) (guide)
- *Cardamine douglassii* (Purple Spring Cress) (guide)
- *Carex abscondita* (Thicket Sedge) (guide)
- *Carex amphibola* (Ambiguous Sedge) (guide)
- *Carex arcta* (Northern Clustered Sedge) (guide)
- *Carex conjuncta* (Soft Fox Sedge) (guide)
- *Carex davisii* (Davis' Sedge) (guide)
- *Carex jamesii* (James' Sedge) (guide)
- *Carex lupuliformis* (False Hop Sedge) (guide)
- *Carex mitchelliana* (Mitchell's Sedge) (guide)
- *Carex styloflexa* (Bent Sedge) (guide)
- *Carex typhina* (Cat-tail Sedge) (guide)
- *Carya laciniosa* (Big Shellbark Hickory) (guide)
- *Chaerophyllum procumbens* (Spreading Chervil) (guide)
- *Cornus drummondii* (Rough-leaved Dogwood) (guide)
- *Crotalus horridus* (Timber Rattlesnake) (guide)
- *Diarrhena obovata* (Western Beakgrain) (guide)
- *Erigenia bulbosa* (Harbinger-of-spring) (guide)
- *Haliaeetus leucocephalus* (Bald Eagle) (guide)
- *Hydrastis canadensis* (Goldenseal) (guide)
- *Jeffersonia diphylla* (Twinleaf) (guide)
- *Lithobates kauffeldi* (Atlantic Coast Leopard Frog) (guide)
- *Melanerpes erythrocephalus* (Red-headed Woodpecker) (guide)
- *Monarda clinopodia* (Basilbalm) (guide)
- *Myotis sodalis* (Indiana Bat) (guide)
- *Neottia auriculata* (Auricled Twayblade) (guide)
- *Papaipema* sp. 2 nr. pterisii (Ostrich Fern Borer Moth) (guide)
- *Protonotaria citrea* (Prothonotary Warbler) (guide)
- *Quercus phellos* (Willow Oak) (guide)

- *Senecio suaveolens* (Sweet-scented Indian Plantain) (guide)
- *Tachopteryx thoreyi* (Gray Petaltail) (guide)
- *Veronicastrum virginicum* (Culver's Root) (guide)
- *Vitis vulpina* (Winter Grape) (guide)

Range

New York State Distribution

Large examples of this community are currently known from dozens of rivers and large streams across the state. Several high quality floodplain forests are known from the Upper Delaware Valley, the Central Hudson Valley, the Lake Champlain Valley, the Adirondack Mountains, the Mohawk Valley, the Lake Ontario Lake Plain, and across the High Allegheny Plateau.

Global Distribution

This physically and physiognomically broadly-defined community may be worldwide. Examples with the greatest biotic affinities to New York occurrences are suspected to span north to southern Canada, west to Minnesota, southwest to Indiana and Tennessee, southeast to Georgia and South Carolina, and northeast to Nova Scotia.

Best Places to See

- Neversink River Preserve (Orange County)
- East Bay Wildlife Management Area (Washington County)
- Schodack Island State Park (Greene, Rensselaer Counties)
- Conewango Swamp Wildlife Management Area
- Putts Creek Wildlife Management Area, Adirondack Park
- Jessup River Wild Forest, Adirondack Park (Hamilton County)
- Buttermilk Falls State Park (Tompkins County)

Identification Comments

General Description

A hardwood forest that occurs on mineral soils on low terraces of river floodplains and river deltas. These sites are characterized by their flood regime; low areas are annually flooded in spring and high areas are flooded irregularly. This is a broadly defined community; floodplain

forests are quite variable and may be very diverse. The composition of the forest apparently changes in relation to flood frequency and elevation of floodplain terraces along larger rivers.

Characters Most Useful for Identification

A hardwood forest that occurs on mineral soils on low terraces of river floodplains and river deltas. Species indicative of floodplains, such as bluejoint grass (Calamagrostis canadensis), jumpseed (Persicaria virginianum), smallspike false nettle (Boehmeria cylindrica), and nettles (Urtica spp.) should be more abundant than aquatic species. Other native species characteristic of floodplain forests include spotted jewelweed (Impatiens capensis), Canada goldenrod (Solidago canadensis), Virginia cutgrass (Leersia virginica), and possibly eastern cottonwood (Populus deltoides).

Elevation Range

Known examples of this community have been found at elevations between 6 feet and 1,657 feet.

Best Time to See

In the spring after a heavy rainstorm is an exciting time to witness the power and extent of a river at flood stage and how tolerant plants and animals inhabiting a floodplain must be.

Floodplain Forest Images

Floodplain forest at Saratoga National Historical Site (plot SBB1)

Gregory J. Edinger

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Red Maple - Black Cherry / Silky Dogwood Floodplain Forest (CEGL006503)
- Silver Maple / Sensitive Fern - Small-spike False Nettle Floodplain Forest (CEGL006176)
- Silver Maple - (Eastern Cottonwood) / Ostrich Fern - Canadian Woodnettle Floodplain Forest (CEGL006147)
- Sugar Maple - Ash species - American Basswood / Ostrich Fern - White Snakeroot Floodplain Forest (CEGL006114)
- River Birch - American Sycamore / Orange Jewelweed Floodplain Forest (CEGL006184)
- Pin Oak - Red Maple / Gray's Sedge - White Avens Wet Forest (CEGL006185)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Central Appalachian River Floodplain (CES202.608)
- Eastern Boreal Floodplain (CES103.588)
- Laurentian-Acadian Floodplain Forest (CES201.587)

Characteristic Species

Trees > 5m

Acer negundo var. *negundo* (box-elder, ash-leaved maple)
Acer rubrum var. *rubrum* (common red maple)
Acer saccharinum (silver maple)
Acer saccharum (sugar maple)
Betula nigra (river birch)
Carya cordiformis (bitternut hickory)
Carya laciniosa (kingnut hickory, big shellbark hickory)
Carya ovata var. *ovata* (shagbark hickory)
Celtis occidentalis (northern hackberry)
Fraxinus americana (white ash)
Fraxinus pennsylvanica (green ash)
Juglans cinerea (butternut)
Juglans nigra (black walnut)
Liriodendron tulipifera (tulip tree, tulip poplar, yellow poplar)
Platanus occidentalis (eastern sycamore)
Populus deltoides ssp. *deltoides* (eastern cottonwood)
Quercus bicolor (swamp white oak)
Quercus palustris (pin oak)
Tilia americana var. *americana* (American basswood)
Ulmus americana (American elm)
Ulmus rubra (slippery elm)

Shrubs 2 - 5m

Alnus incana ssp. *rugosa* (speckled alder)
Carpinus caroliniana ssp. *virginiana* (musclewood, ironwood, American hornbeam)

Cornus amomum ssp. *amomum* (silky dogwood)
Viburnum lentago (nannyberry)

Shrubs < 2m

Cornus amomum ssp. *amomum* (silky dogwood)
Cornus racemosa (gray dogwood, red-panicled dogwood)
Cornus sericea (red-osier dogwood)
Lindera benzoin (spicebush)
Staphylea trifolia (bladdernut)
Viburnum dentatum var. *lucidum* (smooth arrowwood)
Viburnum nudum var. *cassinoides* (northern wild-raisin)

Vines

Clematis virginiana (virgin's-bower)
Menispermum canadense (moonseed)
Parthenocissus quinquefolia (Virginia-creeper)
Toxicodendron radicans ssp. *radicans* (eastern poison-ivy)
Vitis riparia (river grape, frost grape)

Herbs

Ageratina altissima var. *altissima* (common white snakeroot)
Arisaema triphyllum ssp. *triphyllum* (common jack-in-the-pulpit)
Boehmeria cylindrica (false nettle)
Carex crinita var. *crinita* (common fringed sedge)
Carex intumescens (bladder sedge)
Carex lacustris (lake-bank sedge)
Carex lupulina (hop sedge)
Carex stricta (tussock sedge)
Carex tuckermanii (Tuckerman's sedge)
Circaea canadensis (eastern enchanter's-nightshade)
Geum canadense (white avens)
Impatiens capensis (spotted jewelweed, spotted touch-me-not)
Impatiens pallida (pale jewelweed, pale touch-me-not)
Laportea canadensis (wood-nettle)
Leersia oryzoides (rice cut grass)
Leersia virginica (white cut grass)
Lysimachia nummularia (moneywort, creeping-Jenny)
Matteuccia struthiopteris var. *pensylvanica* (ostrich fern)
Onoclea sensibilis (sensitive fern)
Persicaria virginiana (jumpseed)

Pilea pumila var. *pumila* (green-fruited clearweed)
Saururus cernuus (lizard's-tail)
Solidago canadensis var. *canadensis* (Canada goldenrod)
Solidago gigantea (swamp goldenrod)
Symplocarpus foetidus (skunk-cabbage)
Urtica gracilis ssp. *gracilis* (American stinging nettle)

Similar Ecological Communities

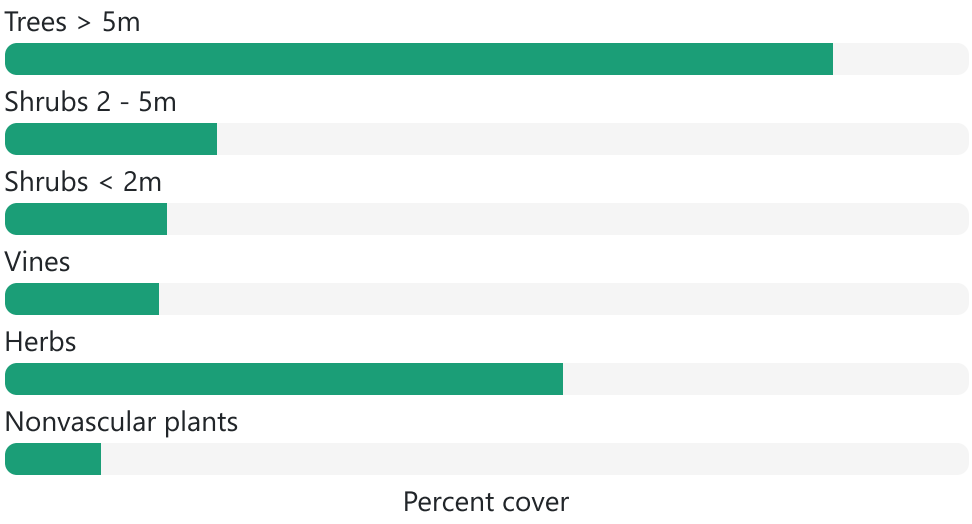
- Red maple-hardwood swamp (guide)

  Red maple-hardwood swamps occur in broad depressions and are not necessarily adjacent to streams or rivers. The soils of red maple-hardwood swamps are very poorly drained and thus when located along rivers, they hold water for longer durations than is typical for floodplain forests.

- Silver maple-ash swamp (guide)

  Silver maple-ash swamps occur in broad depressions and are not necessarily adjacent to streams or rivers. The soils of silver maple-ash swamps are very poorly drained and thus when located along rivers, they hold water for longer durations than is typical for floodplain forests.

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Floodplain Forest. Each bar represents the amount of "coverage" for all the

species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

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Links

- Emerald Ash Borer Fact Sheet (NYS DEC)
- Emerald Ash Borer (USDA APHIS)
- Plantation Island Wildlife Management Area (NYS DEC)
- Upper Delaware Scenic and Recreational River (NPS)

About This Guide

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NYNHP

Floodplain Grassland

Floodplain grassland community on the Delaware River
Gregory J. Edinger

System
Terrestrial

Subsystem
Open Uplands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S3

Vulnerable in New York - Vulnerable to disappearing from New York due to rarity or other factors (but not currently imperiled); typically 21 to 80 populations or locations in New York, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines.

Global Conservation Status Rank
G3G4

Vulnerable globally, or Apparently Secure - At moderate risk of extinction, with relatively few populations or locations in the world, few individuals, and/or restricted range; or uncommon but not rare globally; may be rare in some parts of its range; possibly some cause for long-term concern due to declines or other factors. More information is needed to assign either G3 or G4.

Contents

Summary

Did you know?

Floodplain grasslands have the "Big Four" grasses of the tallgrass prairie that once stretched from Minnesota to Texas: big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), switch grass (*Panicum virgatum*), and little bluestem (*Schizachyrium scoparium*). At almost 40,000 acres, the largest protected remenant of tallgrass prairie in world can be seen at the Joseph H. Williams Tallgrass Prairie Preserve in Oklahoma.

State Ranking Justification

There are an estimated 20 to 80 occurrences statewide. Very few documented occurrences have good viability and very few are protected on public land or private conservation land. This community is limited to the upper reaches of large rivers throughout upstate New York, north of the Coastal Lowland ecozone, and there are only a few good quality examples in New York. The current trend of this community is probably stable for occurrences on public land or private conservation land, or declining slightly elsewhere due to moderate threats that include shoreline development (especially roads and bridges) and invasive species.

Short-term Trends

The number and acreage of floodplain grasslands in New York have probably declined slightly in recent decades as a result of shoreline development, trampling by visitors, and invasive species.

Long-term Trends

The number and acreage of floodplain grasslands in New York have probably declined moderately from historical numbers likely correlated with past shoreline development, trampling by visitors, and invasive species.

Conservation and Management

Threats

Floodplain grasslands are threatened by development (e.g., residential, agricultural, industrial), either directly within the community or in the surrounding landscape. Structures built along the shoreline are a particular threat to this community (e.g., riprap, boat launches, cabins). Other threats include habitat alteration (e.g., road crossings, excessive logging in adjacent uplands, gravel mining in river channel), and relatively minor recreational overuse (e.g., boating, ATVs, trampling by visitors, campgrounds, picnic areas, fishing, trash dumping). Threats to the adjacent river may apply to the grasslands (e.g., pollution, nutrient loading, sedimentation, impoundments/flooding, water release for rafting). Several floodplain grassland are threatened by invasive species, such as purple loosestrife (Lythrum salicaria), reed canary grass (Phalaris

arundinacea), reedgrass (Phragmites australis ssp. australis), Canada bluegrass (Poa compressa), spotted knapweed (Centaurea biebersteinii), and Japanese knotweed (Fallopia japonica).

Conservation Strategies and Management Practices

Where practical, establish and maintain a natural forested buffer to reduce storm-water, pollution, and nutrient run-off, while simultaneously capturing sediments before they reach the grassland. Avoid habitat alteration along the shoreline and surrounding landscape. Restore floodplain grasslands that have been unnaturally disturbed (e.g., remove obsolete impoundments in order to restore the natural hydrology). Prevent the spread of invasive exotic species into the riverside ice meadow through appropriate direct management, and by minimizing potential dispersal corridors, such as roads and bridges.

Development and Mitigation Considerations

Where practical, establish and maintain a natural riparian buffer to filter storm-water, pollution, and nutrient run-off from surrounding uplands and to capture sediments before they reach the floodplain grassland. Avoid habitat alteration along the shoreline and in surrounding landscape. Minimize potential dispersal corridors for exotic species, such as roads and bridges. Maintain or restore the natural flood and ice scour regime.

Inventory Needs

Survey for occurrences statewide to advance documentation and classification of floodplain grasslands. Continue searching for large sites in good condition (A- to AB-ranked).

Research Needs

Research is needed to evaluate floodplains and shorelines dominated by shrubs and small trees as a potential new communuty tentatively called "floodplain shrubland" separate from floodplain grassland and floodplain forest. Research the role flood regime and ice scour pattern have on the succession and interelation of these floodplain communities.

Rare Species

- *Cistothorus stellaris* (Sedge Wren) (guide)

- *Lithobates kauffeldi* (Atlantic Coast Leopard Frog) (guide)

Range

New York State Distribution

Floodplain grasslands occur as discontinuous patches along the upper reaches of large rivers throughout upstate New York, north of the Coastal Lowland ecozone.

Global Distribution

This community is possibly limited to the northeastern U.S. and southern Canada, ranging from Pennsylvania to Quebec, but currently excluding Maine and New Bruswick.

Best Places to See

- Cherry Island Wildlife Management Area (Orange County)

Identification Comments

General Description

This community is somewhat densely vegetated, tall grassland that occurs on the floodplains along the upper reaches of larger confined rivers. This community occurs on relatively stable sand/gravel or cobble substrate that is often visible between the clump forming grasses. These floodplain shores and islands are typically broad and the soil is coarse and dry. These grasslands are subject to flooding and ice scour, but ice floes usually do not persist into spring as in riverside ice meadows.

Characters Most Useful for Identification

The dominant grasses are big bluestem (Andropogon gerardii), Indian grass (Sorghastrum nutans), and switch grass (Panicum virgatum). Other grasses with lower percent cover include little bluestem (Schizachyrium scoparium), reed canary grass (Phalaris arundinacea), deer tongue grass (Dichanthelium clandestinum), and freshwater cordgrass (Spartina pectinata). By late summer these grasses usually cover from 30% to ideally 50% or more of this community. Other characteristic herbs include goldenrods (Solidago juncea, S. gigantea, S. rugosa, S. canadensis, S. nemoralis, Euthamia graminifolia), false indigo (Baptisia

tinctoria), marsh fern (Thelypteris palustris), frostweed (Helianthemum canadense), bushclover (Lespedeza capitata), starry Solomon's-seal (Maianthemum stellatum), American germander (Teucrium canadense), spreading dogbane (Apocynum androsaemifolium), St. John's-wort (Hypericum mutilum), butterflyweed (Asclepias tuberosa), hairy-fruited sedge (Carex trichocarpa), giant St. John's-wort (Hypericum ascyron), and wool grass (Scirpus cyperinus).

Elevation Range

Known examples of this community have been found at elevations between 40 feet and 740 feet.

Best Time to See

Late summer (August-September) is an excellent time of year to canoe the Upper Delaware Scenic and Recreational River and see the tall grasses along the shoreline that are characteristic of this community.

Floodplain Grassland Images

Floodplain grassland community on the Delaware River

Gregory J. Edinger

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Sandcherry / Big Bluestem - Indiangrass Riverscour Wet Meadow (CEGL006518)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Central Appalachian River Floodplain (CES202.608)

Characteristic Species

Trees > 5m

Betula nigra (river birch)
Platanus occidentalis (eastern sycamore)
Populus deltoides ssp. *deltoides* (eastern cottonwood)

Shrubs 2 - 5m

Amorpha fruticosa (false indigo-bush)
Cornus racemosa (gray dogwood, red-panicled dogwood)
Crataegus sp.
Platanus occidentalis (eastern sycamore)
Quercus ilicifolia (scrub oak, bear oak)
Salix eriocephala (heart-leaved willow, Missouri willow)

Shrubs < 2m

Betula nigra (river birch)
Cornus racemosa (gray dogwood, red-panicled dogwood)
Elaeagnus umbellata (autumn-olive)

Gaylussacia baccata (black huckleberry)
Ilex verticillata (common winterberry)
Lyonia ligustrina var. *ligustrina* (maleberry)
Physocarpus opulifolius (ninebark)
Platanus occidentalis (eastern sycamore)
Prunus pumila var. *depressa* (dwarf cherry)
Quercus ilicifolia (scrub oak, bear oak)
Rhododendron periclymenoides (pinxter-flower)
Robinia pseudoacacia (black locust)
Rosa carolina ssp. *carolina* (eastern pasture rose)
Rosa multiflora (multiflora rose)
Rubus allegheniensis (common blackberry)
Rubus hispidus (swamp dewberry)
Rubus sp.
Salix sp.
Spiraea alba var. *latifolia* (broad-leaved meadow-sweet)
Vaccinium angustifolium (common lowbush blueberry)
Vaccinium pallidum (hillside blueberry)

Vines

Parthenocissus quinquefolia (Virginia-creeper)
Toxicodendron radicans ssp. *radicans* (eastern poison-ivy)

Herbs

Achillea millefolium (yarrow)
Agrostis sp.
Alliaria petiolata (garlic mustard)
Pycnanthemum sp.
Schizachyrium scoparium
Scirpus cyperinus (common wool-grass)
Solanum carolinense var. *carolinense* (horse-nettle)
Solidago gigantea (swamp goldenrod)
Solidago juncea (early goldenrod)
Solidago nemoralis ssp. *nemoralis* (gray goldenrod)
Solidago rugosa var. *rugosa* (common wrinkle-leaved goldenrod)
Sorghastrum nutans (Indian grass)
Spartina pectinata (prairie cord grass)
Teucrium canadense var. *canadense*
Thelypteris palustris var. *pubescens* (marsh fern)
Verbena hastata (blue vervain)

Similar Ecological Communities

- Cobble shore (guide)

  While both communities have a cobblestone substrate, floodplain grasslands are more densely vegetated and dominated by tall grasses, whereas cobble shores tend to be sparsely vegetated and are dominated by scattered low growing annuals, such as knotweeds (*Persicaria* sp.).

- Floodplain forest (guide)

  While both communities occur on river floodplains, floodplain grasslands are more frequently scoured and dominated by tall grasses, whereas floodplain forests have a closed canopy of large, multi-trunked trees that can tolerate seasonal flooding, such as silver maple and sycamore.

- Riverside ice meadow (guide)

  Riverside ice meadows tend to be more alkaline and have greater plant diversity compared to floodplain grasslands. Floodplain grasslands are more acidic and dominated by a few tall grasses. Riverside ice meadows develop in areas where frazil ice accummulates on the river shore and often persists into late spring, whereas floodplain grasslands are usually ice free at spring time in most years

- Riverside sand/gravel bar (guide)

  Riverside sand/gravel bars are usually unvegetated or very sparsely vegetated and more frequently flooded, compared to floodplain grasslands that are more densely vegetated by tall grasses and less frequently flooded.

- Shoreline outcrop (guide)

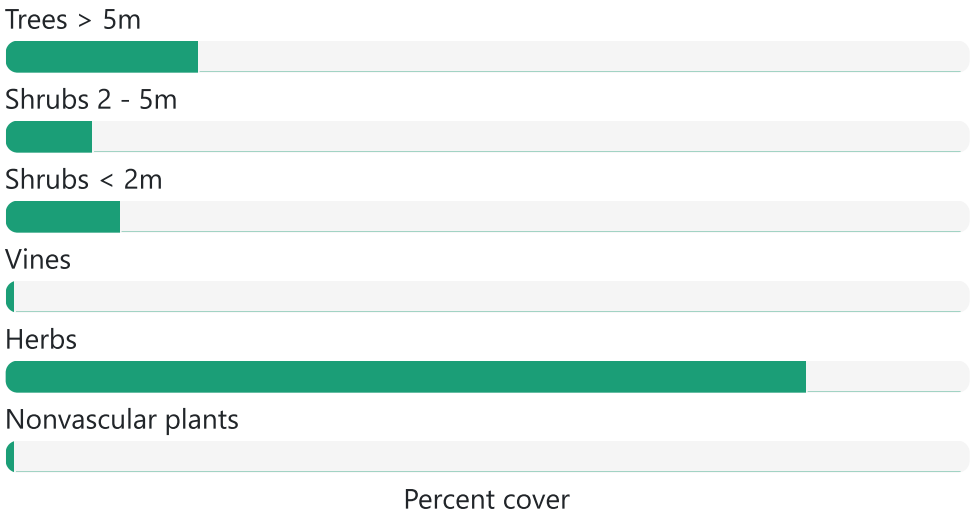
  While both communities occur along river shores and share several species, floodplain grasslands are more densely vegetated and dominated by tall grasses, whereas shoreline

outcops are sparsely vegetated with large areas of exposed bedrock.

- Successional northern sandplain grassland (guide)

  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (Schizachyrium scoparium), hairgrass (Avenella flexuosa), Pennsylvania sedge (Carex pensylvanica), poverty grass (Danthonia spicata), and panic grasses (Dichanthelium spp.). Floodplain grasslands occur on relatively stable sand/gravel or cobble substrate along rivers and are dominated by big bluestem (Andropogon gerardii), Indian grass (Sorghastrum nutans), and switch grass (Panicum virgatum).

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Floodplain Grassland. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

References

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Links

- Big Bluestem - Indian-grass Floodplain Grassland (Pennsylvania Natural Heritage Program)
- Joseph H. Williams Tallgrass Prairie Preserve, Oklahoma (TNC)
- Tallgrass Prairie National Preserve, Kansas Flint Hills (NPS)
- The "BIG FOUR" grasses of the tallgrass prairie ecosystem (NPS)
- Vegetation Mapping Inventory Project for Upper Delaware Scenic and Recreational River (NPS)

About This Guide

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NYNHP

Oak Openings

Oak openings
DJ Evans

System
Terrestrial

Subsystem
Barrens And Woodlands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S1

Critically Imperiled in New York - Especially vulnerable to disappearing from New York due to extreme rarity or other factors; typically 5 or fewer populations or locations in New York, very few individuals, very restricted range, very few remaining acres (or miles of stream), and/or very steep declines.

Global Conservation Status Rank

G2

Imperiled globally - At high risk of extinction due to rarity or other factors; typically 20 or fewer populations or locations in the world, very few individuals, very restricted range, few remaining acres (or miles of stream), and/or steep declines.

Contents

Summary

Did you know?

Oak openings, or grass-savanna openings within oak-hickory matrix forests, were never very common in New York. Far more common in the midwestern United States, this community type has declined dramatically throughout its range due to a combination of fire suppression, land development, and competition by invasive species. Widespread fire suppression has led to the succession of nearly all oak openings to mature forest. Historically, oak openings were created through the dynamics of natural fire disturbance; as openings succeeded to woody

vegetation, regular fires in the landscape prevented canopy closure and dominance by woody vegetation.

State Ranking Justification

This community has been degraded or destroyed throughout its range. New York State is at the edge of the range of the community. There are less than five occurrences statewide, and probably not many more historically given that its range is primarily restricted to the Monroe County portion of the Eastern Ontario Till Plain. Although two documented occurrences have good viability, there are no high quality examples known in the state (i.e., no A- to AB-ranked occurrences). Only two oak openings are protected on public land or private conservation land. The current trend of this community is declining moderately as a result of invasive species, development, and recreational overuse.

Short-term Trends

The number and acreage of oak openings in New York have declined in recent decades as a result of displacement by development and the spread of invasive species. At least two occurrences first documented in the mid-1980s have been lost. This loss has been offset somewhat by restoration efforts at Rush Oak Openings.

Long-term Trends

The number and acreage of oak openings in New York have probably declined moderately from historical numbers as a result of fire suppression, conversion to agriculture, and other development. Oak openings were probably always few in number and small in size in New York.

Conservation and Management

Threats

Invasive plants are the primary threat to all oak openings in New York. Various species of black swallow-wort (Cynanchum spp.) are having an alarming impact. Other invasive species include shrubby honeysuckle (Lonicera morrowii) and various pasture weeds. Suppression of the natural fire regime is the second greatest threat to this community. Oak openings are also threatened by development (e.g., residential, agricultural, roads, etc.) and recreational overuse (e.g., ATVs, mountain

bikers, and hikers). Logging and trash dumping are considered minor threats to a few examples of this community.

Conservation Strategies and Management Practices

This community needs to be kept open, either by mechanical means (e.g., brush-hogging) or prescribed burning to reduce woody plant invasion. Monitor and control invasive species, especially pale swallow-wort (*Cynanchum* spp.) and buckthorn (*Rhamnus cathartica*).

Development and Mitigation Considerations

Soils are very thin in and around this community, and the effects of clearing and construction on soil retention and erosion must be considered during any development activities. Similarly, these soils are acidic and nutrient-poor, and any soil enrichment (e.g., septic leach fields, fertilized lawns, etc.) activities have a high probability of altering community structure and function. The open structure of this community is maintained by fire and presents a fire hazard to existing and proposed development. Unprotected structures located within or near this community are more susceptible to damage from fire.

Inventory Needs

Inventory oak openings beyond Monroe County in order to resolve questionable identifications. Survey areas predicted by distribution modeling efforts (e.g., northeast Ontario County).

Research Needs

Compare New York sites with larger, more intact examples in the Midwest to confirm classification and rarity.

Rare Species

- *Carex meadii* (Mead's Sedge) (guide)
- *Carex mesochorea* (Midland Sedge) (guide)
- *Carex molesta* (Troublesome Sedge) (guide)
- *Carex richardsonii* (Richardson's Sedge) (guide)
- *Chordeiles minor* (Common Nighthawk) (guide)
- *Cyperus schweinitzii* (Schweinitz's Flat Sedge) (guide)
- *Desmodium ciliare* (Hairy Small-leaved Tick Trefoil) (guide)
- *Desmodium obtusum* (Rigid Tick Trefoil) (guide)

- *Draba arabisans* (Rock Whitlow Grass) (guide)
- *Lasiurus borealis* (Eastern Red Bat) (guide)
- *Lasiurus cinereus* (Hoary Bat) (guide)
- *Myotis lucifugus* (Little Brown Bat) (guide)
- *Valerianella chenopodiifolia* (Goosefoot Cornsalad) (guide)

Range

New York State Distribution

This community is currently known from the Erie and Ontario Lake Plain with most sites occurring within the Monroe County portion of the Eastern Ontario Till Plain. The historical range was probably restricted to the same area, and probably extended east into Wayne and Ontario counties, south into Livingston County, and west to Niagara and Erie counties.

Global Distribution

This community occurs in the upper midwestern United States and possibly adjacent Canada, particularly in south-central Michigan and western New York, and possibly southern Ontario.

Best Places to See

- Rush Oak Openings Unique Area (Monroe County)

Identification Comments

General Description

Oak openings are grass-oak savanna communities that occur on well-drained soils. In New York, these savannas originally occurred as openings within extensive oak-hickory forests. Historically they were restricted to exessively well-drained sites such as on knobs or hilltops with shallow soil over dolomite outrcrops, sandy to gravelly soils of kames and eskers, or gravelly glacial deltas and terraces. The best remnants can be found on dolomite knobs. Characteristic trees include Chinquapin oak (Quercus muehlenbergii), white oak (Q. alba), and black oak (Q. velutina). The oaks occur as open-grown trees with broadly spreading canopies and are sparsely distrubuted across a graminoid groundlayer dominated by warm-season grasses.

Characters Most Useful for Identification

Oak openings are a fire-dependent, savanna community type that is dominated by oaks that are typically scattered amongst a predominantly graminoid ground layer. Canopy cover in oak openings ranges from 0-60% cover, with or without a shrub layer. An abundance of fire dependent warm season grasses including Indian grass (Sorghastrum nutans), little bluestem (Schizachyrium scoparium), and big bluestem (Andropogon gerardii) can help identify oak openings, along with the presence of large, open grown oaks, especially Chinquapin oak, white oak, black oak, and possibly bur oak (Quercus macrocarpa).

Elevation Range

Known examples of this community have been found at elevations between 410 feet and 705 feet.

Best Time to See

The best time to experience oak openings is during the summer months, from June to August, when a variety of wildflowers, insects, and birds can be seen in and around the openings. The bright orange flower of butterfly milkweed (Asclepias tuberosa) is attractive to monarch butterflies, hummingbirds, and a number of other insects. Eastern bluebirds nest in cavity trees around the openings and the largest openings are used by a number of other openland bird species including savanna sparrow, eastern meadowlark, American kestral, and brown thrasher.

Oak Openings Images

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- White Oak - Bur Oak / Big Bluestem Open Woodland (CEGL005121)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- North-Central Interior Oak Savanna (CES202.698)

Characteristic Species

Trees > 5m

Carya ovata var. *ovata* (shagbark hickory)
Quercus alba (white oak)
Quercus muehlenbergii (yellow oak, chinquapin oak)

Shrubs 2 - 5m

Cornus racemosa (gray dogwood, red-panicled dogwood)
Viburnum dentatum var. *lucidum* (smooth arrowwood)

Shrubs < 2m

Cornus racemosa (gray dogwood, red-panicled dogwood)
Lonicera morrowii (Morrow's honeysuckle)
Rubus flagellaris (northern dewberry)
Viburnum dentatum var. *lucidum* (smooth arrowwood)

Herbs

Anemone canadensis (Canada anemone)
Antennaria neglecta (field pussy-toes)
Asclepias tuberosa (butterfly-weed)
Daucus carota (wild carrot)
Erigeron annuus (annual daisy fleabane)
Fragaria virginiana ssp. *virginiana* (common wild strawberry)
Hypericum perforatum ssp. *perforatum* (common St. John's-wort)
Leucanthemum vulgare (ox-eye daisy)
Lilium philadelphicum (wood lily)
Melilotus albus (white sweet-clover)
Monarda fistulosa var. *fistulosa* (common wild-bergamot)
Phleum pratense ssp. *pratense* (common Timothy)
Pilosella caespitosa (yellow hawkweed)
Plantago lanceolata (English plantain)
Prunella vulgaris ssp. *vulgaris* (Eurasian self-heal, Eurasian heal-all)
Rudbeckia hirta (common black-eyed Susan)
Schizachyrium scoparium var. *scoparium* (little bluestem)
Solidago gigantea (swamp goldenrod)
Solidago juncea (early goldenrod)
Solidago nemoralis ssp. *nemoralis* (gray goldenrod)
Sorghastrum nutans (Indian grass)

Symphyotrichum undulatum (wavy-leaved-aster)
Symphyotrichum urophyllum (arrow-leaved-aster)
Valeriana officinalis (common valerian, garden valerian, garden heliotrope)

Similar Ecological Communities

- Appalachian oak-hickory forest (guide)

  Appalachian oak hickory forest is a hardwood forest that is found on well-drained soils, usually on ridgetops and upper slopes of mountains, such as in the Hudson Highlands, or on rolling hills in the Finger Lakes region. This forest community is dominated by red oak (Quercus rubra), white oak, black oak, and hickory (Carya glabra, C. ovata). The overall canopy cover ranging, from 60-100%, distinguishes this from oak openings, as well as the high topographic position.

- Limestone woodland (guide)

  Limestone woodlands occur on thin soils over bedrock and are usually dominated by combinations of northern white cedar (Thuja occidentalis), hop hornbeam (Ostrya virginiana), sugar maple (Acer saccharum), shagbark hickory (Carya ovata), white oak, bur oak, and American basswood (Tilia americana). They typically have exposed bedrock pavement with some degree of fissuring, and the ground layer is usually dominated by sedges, ferns, and forbs that are characteristic of rich forests, including herb-robert (Geranium robertianium), black snake-root (Sanicula marilandica), rattlesnake fern (Botrychium virgianum), marginal wood fern (Dryopteris marginalis), canada mayflower (Maianthemum canadense), Solomon's plume (M. racemosum), early meadow-rue (Thalictrum dioicum), and trilliums (Trillium spp.).

- Successional northern sandplain grassland (guide)

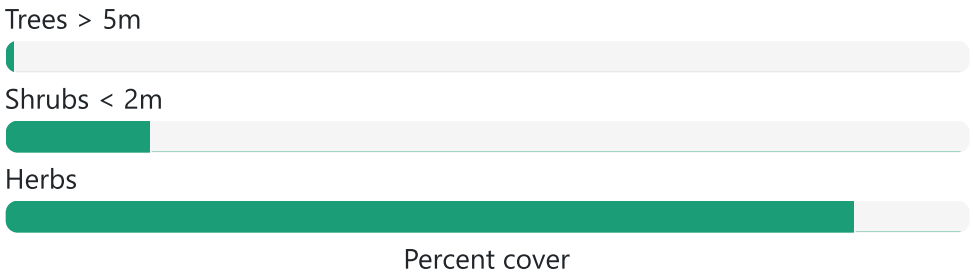
  While both communities share several dominant plants, such as little bluestem (Schizachyrium scoparium), successional northern sandplain grasslands lack the tall grasses such as Indian grass (Sorghastrum nutans), and big bluestem

(Andropogon gerardii). Successional northern sandplain grasslands are underlain by loamy sand instead of sandy loam or sandy clay loam of oak openings. Successional northern sandplain grasslands usually lack the scattered oak trees characteristic of oak openings.

- Successional old field

  Successional old fields are common statewide and occur on sites that have been cleared and plowed (for farming or development), and then abandoned. While both communities share several plants, such as little bluestem (Schizachyrium scoparium), successional old fields lack the tall grasses such as Indian grass (Sorghastrum nutans), and big bluestem (Andropogon gerardii).

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Oak Openings. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

References

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Links

- Rush Oak Openings Preserve (TNC)
- Rush Oak Openings Unique Area (NYS DEC)

About This Guide

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NYNHP

Red Maple-Hardwood Swamp

Troy Weldy at Grand Pond Swamp, red maple hardwood swamp
Timothy G. Howard

System
Palustrine

Subsystem
Forested Mineral Soil Wetlands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S3S4

Vulnerable in New York, or Apparently Secure - Vulnerable to disappearing from New York (but not currently imperiled), with relatively few populations or locations, few individuals, and/or restricted range; or uncommon but not rare in New York; may be rare in some parts of the state; possibly some cause for long-term concern due to declines or other factors. More information is needed to assign either S3 or S4.

Global Conservation Status Rank

G5

Secure globally - Common in the world; widespread and abundant (but may be rare in some parts of its range).

Contents

Summary

Did you know?

Jewelweed, or touch-me-not, is an herb found in red maple-hardwood swamps. Its name comes from the jewel-like silvery coating on its leaves that is only evident when the leaves are submerged in water. The silvery covering is actually a thin layer of air trapped in microscopic leaf hairs. The plant was nicknamed touch-me-not because of its seed capsules, which split and coil when triggered by the wind or a touch, expelling the seeds and dispersing them up to four feet away.

State Ranking Justification

There are several thousand occurrences statewide. Some documented occurrences have good viability and several are protected on public land or private conservation land. This community has statewide distribution, and includes a few large, high quality examples. The current trend of this community is probably stable for occurrences on public land, or declining slightly elsewhere due to moderate threats that include alteration of the natural hydrology and invasive species.

Short-term Trends

The number and acreage of red maple-hardwood swamps in New York have probably declined slightly to moderately in recent decades in areas with ash decline, and stable elsewhere as a result of wetland protection regulations. Since World War II, urbanization has emerged as the predominant force impacting wetlands in most parts of the region (Golet et al. 1993).

Long-term Trends

The number and acreage of red maple-hardwood swamps in New York have probably declined substantially (about 80%) from historical numbers likely correlated with agricultural and other development. The principal causes of wetland loss in the Northeast prior to mid-1800s include conversion of wetlands to agriculture, the construction of impoundments for hydropower and water supply, and the cutting of swamp timber for lumber, fence posts, and fuel wood (Golet et al. 1993).

Conservation and Management

Threats

Red maple-hardwood swamps are threatened by development (e.g., agriculture, residential, commercial, roads), habitat alteration (e.g., excessive logging, pollution), and recreational overuse (e.g., hiking trails, ATVs). Alteration to the natural hydrological regime is also a threat to this community (e.g., impoundments, blocked culverts, beaver). Several red maple-hardwood swamps are threatened by invasive species, such as common buckthorn (Rhamnus cathartica), glossy buckthorn (Frangula alnus), shrubby honeysuckle (Lonicera morrowii), multiflora rose (Rosa multiflora), and barberry (Berberis thunbergii). Conversion of wetlands for agriculture was a major cause of inland wetland loss in many areas of

the Northeast historically, and it is still an important factor today, most notably in New York (Golet et al. 1993). The emerald ash borer (Agrilus planipennis) is an Asian beetle that infests and kills North American ash trees. All native ash trees are susceptible, including white ash, green ash, and black ash. In New York, emerald ash borer has been found mostly south of the Adirondack Mountains, but in 2017 it was recorded in Franklin and St. Lawrence Counties. Natural communities dominated or co-dominated by ash trees would likely be most impacted by emerald ash borer invasion.

Conservation Strategies and Management Practices

Where practical, establish and maintain a natural wetland buffer to reduce storm-water, pollution, and nutrient run-off, while simultaneously capturing sediments before they reach the wetland. Buffer width should take into account the erodibility of the surrounding soils, slope steepness, and current land use. Wetlands protected under Article 24 are known as New York State "regulated" wetlands. The regulated area includes the wetlands themselves, as well as a protective buffer or "adjacent area" extending 100 feet landward of the wetland boundary (NYS DEC 1995). If possible, minimize the number and size of impervious surfaces in the surrounding landscape. Avoid habitat alteration within the wetland and surrounding landscape. For example, roads and trails should be routed around wetlands, and ideally not pass through the buffer area. If the wetland must be crossed, then bridges and boardwalks are preferred over filling. Restore past impacts, such as removing obsolete impoundments and ditches in order to restore the natural hydrology. Prevent the spread of invasive exotic species into the wetland through appropriate direct management, and by minimizing potential dispersal corridors, such as roads.

Development and Mitigation Considerations

When considering road construction and other development activities minimize actions that will change what water carries and how water travels to this community, both on the surface and underground. Water traveling over-the-ground as run-off usually carries an abundance of silt, clay, and other particulates during (and often after) a construction project. While still suspended in the water, these particulates make it difficult for aquatic animals to find food; after settling to the bottom of the wetland, these particulates bury small plants and animals and alter

the natural functions of the community in many other ways. Thus, road construction and development activities near this community type should strive to minimize particulate-laden run-off into this community. Water traveling on the ground or seeping through the ground also carries dissolved minerals and chemicals. Road salt, for example, is becoming an increasing problem both to natural communities and as a contaminant in household wells. Fertilizers, detergents, and other chemicals that increase the nutrient levels in wetlands cause algae blooms and eventually an oxygen-depleted environment where few animals can live. Herbicides and pesticides often travel far from where they are applied and have lasting effects on the quality of the natural community. So, road construction and other development activities should strive to consider: 1. how water moves through the ground, 2. the types of dissolved substances these development activities may release, and 3. how to minimize the potential for these dissolved substances to reach this natural community.

Inventory Needs

Survey for occurrences statewide to advance documentation and classification of red maple-hardwood swamps. A statewide review of red maple-hardwood swamps is desirable. Continue searching for large sites in good condition (A- to AB-ranked).

Research Needs

Research composition of red maple-hardwood swamps statewide in order to characterize variations reported by Golet et al. (1993). Collect sufficient plot data to support the recognition of several distinct red maple-hardwood swamp types based on composition and by ecoregion.

Rare Species

- *Ardea herodias* (Great Blue Heron) (guide)
- *Botrychium oneidense* (Blunt-lobed Grape Fern) (guide)
- *Callitriche terrestris* (Terrestrial Water Starwort) (guide)
- *Cardamine longii* (Long's Bittercress) (guide)
- *Carex haydenii* (Cloud Sedge) (guide)
- *Carex lupuliformis* (False Hop Sedge) (guide)
- *Carex mitchelliana* (Mitchell's Sedge) (guide)
- *Carex shortiana* (Short's Sedge) (guide)
- *Carex straminea* (Straw Sedge) (guide)
- *Carex styloflexa* (Bent Sedge) (guide)

- *Carex typhina* (Cat-tail Sedge) (guide)
- *Carex venusta* (Dark-green Sedge) (guide)
- *Diospyros virginiana* (Persimmon) (guide)
- *Equisetum palustre* (Marsh Horsetail) (guide)
- *Equisetum pratense* (Meadow Horsetail) (guide)
- *Euonymus americanus* (American Strawberry Bush) (guide)
- *Gentiana saponaria* (Soapwort Gentian) (guide)
- *Glyptemys muhlenbergii* (Bog Turtle) (guide)
- *Haliaeetus leucocephalus* (Bald Eagle) (guide)
- *Hypericum densiflorum* (Bushy St. John's Wort) (guide)
- *Juncus debilis* (Weak Rush) (guide)
- *Liparis liliifolia* (Lily-leaved Twayblade) (guide)
- *Lithobates kauffeldi* (Atlantic Coast Leopard Frog) (guide)
- *Magnolia virginiana* (Sweetbay Magnolia) (guide)
- *Melanerpes erythrocephalus* (Red-headed Woodpecker) (guide)
- *Nasiaeschna pentacantha* (Cyrano Darner) (guide)
- *Neottia auriculata* (Auricled Twayblade) (guide)
- *Neottia bifolia* (Southern Twayblade) (guide)
- *Pedicularis lanceolata* (Marsh Lousewort) (guide)
- *Persicaria setacea* (Bristly Smartweed) (guide)
- *Plantago cordata* (Heart-leaved Plantain) (guide)
- *Platanthera hookeri* (Hooker's Orchid) (guide)
- *Populus heterophylla* (Swamp Cottonwood) (guide)
- *Protonotaria citrea* (Prothonotary Warbler) (guide)
- *Quercus phellos* (Willow Oak) (guide)
- *Quercus shumardii* var. *shumardii* (Shumard Oak) (guide)
- *Setophaga cerulea* (Cerulean Warbler) (guide)
- *Sylvilagus transitionalis* (New England Cottontail) (guide)
- *Tipularia discolor* (Cranefly Orchid) (guide)
- *Vermivora chrysoptera* (Golden-winged Warbler) (guide)
- *Viola primulifolia* (Primrose-leaf Violet) (guide)

Range

New York State Distribution

This community is known throughout the state except perhaps at the southern portion of Staten Island, where the community is replaced by the related red maple-sweetgum swamp. Apparently also absent from the higher elevations of the central Adirondacks and adjacent foothills

(possible very small, scattered occurrences in the latter area). Different variants are concentrated in different ecoregions.

Global Distribution

The somewhat broadly-defined community may span much of the eastern United States and the southeastern fringe of Canada. Examples with the greatest biotic affinities to New York occurrences are suspected to be widespread throughout much of northeastern United States and the southeastern fringe of Canada. The range is estimated to span north to southern Ontario, west to Minnesota, southwest to Kentucky and Tennessee, southeast to North Carolina and Virginia, and northeast to Nova Scotia.

Best Places to See

- Perch River Wildlife Management Area (Jefferson County)
- Great Swamp Preserve (Putnam County)
- Connetquot River State Park Preserve (Suffolk County)
- Deer Mountain Nature Trail, Joralemon Town Park
- Wilson Hill Wildlife Management Area (St. Lawrence County)
- Franklin D. Roosevelt State Park (Westchester County)

Identification Comments

General Description

A hardwood swamp that occurs in poorly drained depressions, usually on inorganic soils with peat, if present, that is less than 20 cm deep. This is a broadly defined community with many variants. In any one stand red maple is either the only canopy dominant, or it is codominant with one or more hardwoods such as ash, elm, and birch. Blackgum (Nyssa sylvatica), sweetgum (Liquidambar styraciflua), and swamp white oak (Quercus bicolor) if present, are only minor associates. The shrub layer is usually well-developed and may be quite dense. The herbaceous layer may be diverse and is often dominated by ferns.

Characters Most Useful for Identification

A swamp dominated by red maple and hardwoods, such as ash, elm, and birch with little or no peat development. Blackgum, sweetgum, and swamp white oak if present, are only minor associates.

Elevation Range

Known examples of this community have been found at elevations between 10 feet and 1,710 feet.

Best Time to See

Because the characteristic plants of red maple-hardwood swamps are deciduous trees, it is easiest to identify the community during the growing season, from late May through summer. Striking seasonal leaf color can be enjoyed in the fall.

Red Maple-Hardwood Swamp Images

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Red Maple / Upright Sedge - Sensitive Fern Wet Woodland (CEGL006119)
- Red Maple - (Green Ash, White Ash) / Northern Spicebush / Skunk-cabbage Swamp Forest (CEGL006406)
- Red Maple / Catberry - Highbush Blueberry Swamp Forest (CEGL006220)
- Red Maple / Swamp Azalea - Coastal Sweet-pepperbush Swamp Forest (CEGL006156)
- Black Ash - Red Maple / Alderleaf Buckthorn / Bristly-stalked Sedge Swamp Forest (CEGL007441)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- North-Central Appalachian Acidic Swamp (CES202.604)
- North-Central Interior and Appalachian Rich Swamp (CES202.605)
- Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520)

Characteristic Species

Trees > 5m

Acer rubrum var. *rubrum* (common red maple)
Betula alleghaniensis (yellow birch)
Fraxinus pennsylvanica (green ash)
Ulmus americana (American elm)
Ulmus rubra (slippery elm)

Shrubs 2 - 5m

Alnus incana ssp. *rugosa* (speckled alder)
Ilex verticillata (common winterberry)
Vaccinium corymbosum (highbush blueberry)
Viburnum dentatum var. *lucidum* (smooth arrowwood)
Viburnum nudum var. *cassinoides* (northern wild-raisin)

Shrubs < 2m

Lindera benzoin (spicebush)
Vaccinium corymbosum (highbush blueberry)

Herbs

Boehmeria cylindrica (false nettle)
Carex stricta (tussock sedge)
Impatiens capensis (spotted jewelweed, spotted touch-me-not)
Onoclea sensibilis (sensitive fern)
Osmunda regalis var. *spectabilis* (royal fern)
Osmundastrum cinnamomeum var. *cinnamomeum* (cinnamon fern)
Symplocarpus foetidus (skunk-cabbage)
Thalictrum pubescens (tall meadow-rue)

Similar Ecological Communities

- Floodplain forest (guide)

  Red maple-hardwood swamps are basin swamps. Basin indicator species should be greater than floodplain indicators (e.g., Calamagrostis canadensis, Persicaria virginiana, Boehmeria cylindrica and Urtica spp.). Other native species characteristic of floodplain forests that may be used to distinguish this community from red maple-hardwood swamp include Impatiens capensis, Solidago canadensis, Leersia virginica, and possibly Populus deltoides.

- Perched swamp white oak swamp (guide)

  Red maple-hardwood swamps form in depressions, but they are not necessarily perched. The canopy is dominated by red maple and may include ash, elm, birch, and swamp white oak. Swamp white oak, if present, does not dominate the canopy. In addition, red maple-hardwood swamps have a denser understory than perched swamp white oak swamps.

- Red maple-blackgum swamp (guide)

  While there may be some blackgum in red maple-hardwood swamps, it is not codominant as in red maple-blackgum

swamps. Ash, elm, and birch are the characteristic codominants in red maple-hardwood swamps.

- Red maple-swamp white oak swamp (guide)

  Red maple-hardwood swamps may have some swamp white oak, but it is not codominant. Red maple-hardwood swamps are usually permanently saturated compared to red maple-swamp white oak swamps that draw down in most years.

- Red maple-sweetgum swamp (guide)

  Red maple-sweetgum swamps have red maple and sweetgum as canopy codominants, with other canopy species present in low densities. Also red maple-sweetgum swamps often occur on somewhat poorly-drained flats, rather than in basins.

- Red maple-tamarack peat swamp (guide)

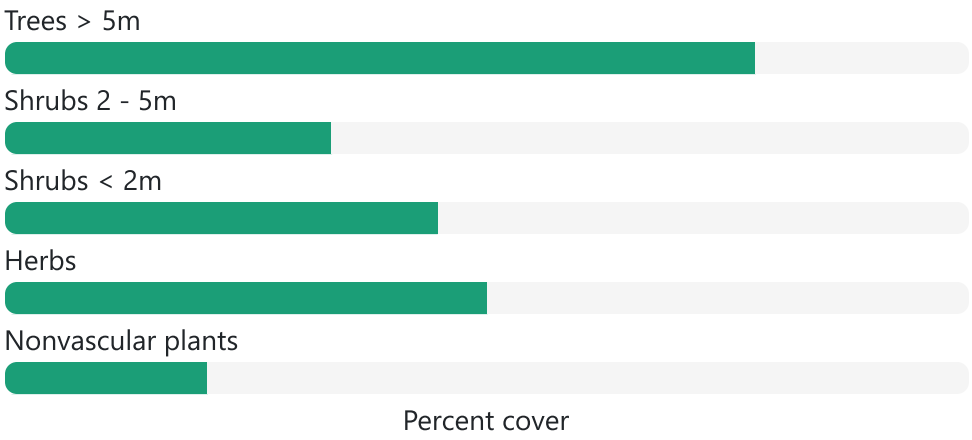
  Red maple-dominated swamps with deep peats (>20 cm) over calcium-rich soils may grade into forested peatlands such as red maple-tamarack peat swamp, which is co-dominated by tamarack.

- Silver maple-ash swamp (guide)

  The gradient between red maple-hardwood swamp and silver maple-ash swamp is difficult to identify. In red maple-hardwood swamps, Acer saccharinum typically occurs at less than 25% cover and is usually less abundant than Acer rubrum; otherwise the community may grade into silver maple-ash swamp. A hybrid between red maple and silver maple, Acer x freemanii, is more typical in silver maple-ash swamps. Combined cover of typical indicators of silver maple-ash swamp such as Acer saccharinum, Ribes spp., and Laportea canadensis are typically less than that of indicators of red maple-hardwood swamp such as Acer rubrum, Viburnum denatum, Viburnum nudum, and Vaccinium corymbosum. Additionally, presence of underlying acidic bedrock, low pH, and scarcity of other calciphilic species such as Rhamnus alnifolia and Thuja

occidentalis are more indicative of red maple-hardwood swamp than of silver maple-ash swamp.

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Red Maple-Hardwood Swamp. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

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Links

- Deer Creek Marsh Wildlife Management Area
- Emerald Ash Borer Fact Sheet (NYS DEC)
- Emerald Ash Borer (USDA APHIS)

- Great Swamp Wildlife Management Area
- Three Mile Bay Wildlife Management Area

About This Guide

This guide was authored by: Aissa Feldmann

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NYNHP

Rich Mesophytic Forest

Rich mesophytic forest at Rock City State Forest.
DJ Evans

System
Terrestrial

Subsystem
Forested Uplands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S2S3

Imperiled or Vulnerable in New York - Very vulnerable, or vulnerable, to disappearing from New York, due to rarity or other factors; typically 6 to 80 populations or locations in New York, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines. More information is needed to assign either S2 or S3.

Global Conservation Status Rank

G4

Apparently Secure globally - Uncommon in the world but not rare; usually widespread, but may be rare in some parts of its range; possibly some cause for long-term concern due to declines or other factors.

Contents

Summary

Did you know?

Black bugbane, or black cohosh (Cimicifuga racemosa), a common plant of rich mesophytic forests, has long been used as an herbal medicine to relieve inflammation, and for a variety of conditions that afflict women. Native tribes of eastern North America were known to use this plant in teas for soaking, or in a combination with other herbs as an oral medicine. Early settlers used black cohosh to treat menstrual symptoms, to relieve pain in childbirth, and as an anti-inflammatory agent against arthritis, rheumatism, and lung and nervous disorders. It is now commonly used in Europe to relieve symptoms associated with

menopause, and is considered to be an effective alternative to hormone-replacement therapy.

State Ranking Justification

There are probably a few hundred occurrences statewide. A few documented occurrences have good viability and a few are protected on public land or private conservation land. This community has a limited statewide distribution and includes a few large, high quality examples. The current trend of this community is probably stable for occurrences on public land, or declining slightly elsewhere due to moderate threats related to development pressure and logging.

Short-term Trends

The number and acreage of rich mesophytic forests in New York have probably declined in recent decades as result of clearing for agriculture and development.

Long-term Trends

The number and acreage of rich mesophytic forests in New York have probably declined substantially from historical numbers likely correlated with the onset of agricultural and development.

Conservation and Management

Threats

Threats to forests in general include changes in land use (e.g., clearing for development), forest fragmentation (e.g., roads), and invasive species (e.g., insects, diseases, and plants). Other threats may include over-browsing by deer, fire suppression, and air pollution (e.g., ozone and acidic deposition). When occurring in expansive forests, the largest threat to the integrity of rich mesophytic forests are activities that fragment the forest into smaller pieces. These activities, such as road building and other development, restrict the movement of species and seeds throughout the entire forest, an effect that often results in loss of those species that require larger blocks of habitat (e.g., black bear, bobcat, certain bird species). Additionally, fragmented forests provide decreased benefits to neighboring societies from services these societies often substantially depend on (e.g., clean water, mitigation of floods and droughts, pollination in agricultural fields, and pest control) (Daily et al.

1997). Rich mesophytic forests are threatened by development (e.g., residential, agricultural, industrial), either directly within the community or in the surrounding landscape. Other threats include habitat alteration (e.g., roads, excessive logging, mining, plantations, deer over-browsing), and recreational overuse (e.g., hiking trails, ATVs, trash dumping, camping). A few rich mesophytic forests are threatened by invasive species, such as garlic mustard (*Alliaria petiolata*) and Japanese barberry (*Berberis thunbergii*). American beech (*Fagus grandifolia*) trees in this community are threatened by the following diseases: 1) **Beech Bark Disease** causes significant mortality and defect in American beech. The disease results when bark, attacked and altered by the beech scale (*Cryptococcus fagisuga*), is invaded and killed by fungi, primarily *Nectria coccinea* var. *faginata* and sometimes *N. galligena* (Houston and O'Brien 1983). This disease is common across New York State (NYS DEC); 2) **Beech Leaf Disease** was first discovered in 2012 from northeastern Ohio (Ewing et al. 2019). The disease was first observed in New York in 2018 in Chautauqua County and was found in Suffolk and Nassau counties in 2019 (NYS DEC). It has since spread throughout western, central, and southern NY (NYS DEC). The foliar nematode *Litylenchus crenatae* ssp. *mcannii* is responsible for beech leaf disease and is believed to be non-native in North America (Carta et al. 2020, Reed et al. 2020). Beech leaf disease can kill beech trees of all ages though younger trees appear to die more quickly (NYS DEC). The **emerald ash borer** (*Agrilus planipennis*) is an Asian beetle that infests and kills North American ash trees. All native ash trees are susceptible, including white ash, green ash, and black ash. In New York, emerald ash borer has been found mostly south of the Adirondack Mountains, but in 2017 it was recorded in Franklin and St. Lawrence Counties. Natural communities dominated or co-dominated by ash trees would likely be most impacted by emerald ash borer invasion.

Conservation Strategies and Management Practices

Management should focus on activities that help maintain regeneration of the species associated with this community. Deer have been shown to have negative effects on forest understories (Miller et al. 1992, Augustine & French 1998, Knight 2003) and management efforts should strive to ensure that regenerating trees and shrubs are not so heavily browsed that they cannot replace overstory trees. Avoid cutting old-growth examples and encourage selective logging in areas that are under active forestry.

Development and Mitigation Considerations

Strive to minimize fragmentation of large forest blocks by focusing development on forest edges, minimizing the width of roads and road corridors extending into forests, and designing cluster developments that minimize the spatial extent of the development. Development projects with the least impact on large forests and all the plants and animals living within these forests are those built on brownfields or other previously developed land. These projects have the added benefit of matching sustainable development practices (for example, see: The President's Council on Sustainable Development 1999 final report, US Green Building Council's Leadership in Energy and Environmental Design certification process at http://www.usgbc.org/).

Inventory Needs

Inventory any remaining large and/or old-growth examples. Continue searching for large sites in good condition (A- to AB-ranked).

Research Needs

Research the composition of rich mesophytic forests in glaciated and unglaciated settings in order to characterize variations.

Rare Species

- *Agrimonia rostellata* (Woodland Agrimony) (guide)
- *Aplectrum hyemale* (Puttyroot) (guide)
- *Blera pictipes* (Painted Wood Fly) (guide)
- *Botrychium oneidense* (Blunt-lobed Grape Fern) (guide)
- *Cardamine douglassii* (Purple Spring Cress) (guide)
- *Carex careyana* (Carey's Sedge) (guide)
- *Carex jamesii* (James' Sedge) (guide)
- *Chamaelirium luteum* (Fairywand) (guide)
- *Cypripedium candidum* (Small White Lady's Slipper) (guide)
- *Cystopteris protrusa* (Lowland Fragile Fern) (guide)
- *Endodeca serpentaria* (Virginia Snakeroot) (guide)
- *Eurycea longicauda* (Longtail Salamander) (guide)
- *Haliaeetus leucocephalus* (Bald Eagle) (guide)
- *Hydrangea arborescens* (Wild Hydrangea) (guide)
- *Jeffersonia diphylla* (Twinleaf) (guide)
- *Lasiurus borealis* (Eastern Red Bat) (guide)
- *Lindbergia brachyptera* (Papillose Fine-branch Moss) (guide)

- *Monarda clinopodia* (Basilbalm) (guide)
- *Myotis lucifugus* (Little Brown Bat) (guide)
- *Myotis septentrionalis* (Northern Long-eared Bat) (guide)
- *Perimyotis subflavus* (Tri-colored Bat) (guide)
- *Pieris virginiensis* (West Virginia White) (guide)
- *Poa sylvestris* (Forest Blue Grass) (guide)
- *Protonotaria citrea* (Prothonotary Warbler) (guide)
- *Pseudotaxiphyllum distichaceum* (Two-ranked moss) (guide)
- *Setophaga cerulea* (Cerulean Warbler) (guide)
- *Symphyotrichum oolentangiense* (Sky-blue Aster) (guide)
- *Triphora trianthophora* (Nodding Pogonia) (guide)

Range

New York State Distribution

In New York, rich mesophytic forests are primarily restricted to the unglaciated portion of the Appalachian Plateau in Cattaraugus and Chautauqua counties. However, examples are also known from the Great Lakes Plain within the Eastern Ontario Till Plain in Monroe County, and within the Cattaraugus Finger Lakes Moraine and Hills in Tompkins County. New York is at the northern extreme of the range that extends south along the Appalachians to approximately North Carolina and Tennessee where the richer southern type is known as a "cove hardwood forest."

Global Distribution

This forest is found in the High Alleghenies, Western Allegheny Plateau, Central Appalachians, and Cumberlands from New York and New Jersey south to West Virginia, Virginia, and eastern Kentucky.

Best Places to See

- Zoar Valley Multiple Use Area
- Allegany State Park

Identification Comments

General Description

Rich mesophytic forest communities are hardwood or mixed forests that resemble the mixed mesophytic forests of the Allegheny Plateau south of New York, but are slightly less diverse. This community occurs on rich, fine-textured soils that are favorable for the dominance of a wide variety of tree species. Canopy codominants of at least five species, a well developed, diverse shrub layer, and a relatively rich herbaceous layer are characteristic of rich mesophytic forests. In New York, rich mesophytic forests are best developed in the unglaciated portions of the Allegheny Plateau. In Cattaraugus County, New York this forest typically occurs at mid to upper elevations (Edinger et al. 2002).

Characters Most Useful for Identification

A canopy with a large number of codominant species helps identify this forest. Cucumber magnolia (Magnolia acuminata) is characteristic of this community type and is sometimes codominant in the canopy. Canopy codominants include five or more of the following species: red oak (Quercus rubra) red maple (Acer rubrum), white ash (Fraxinus americana), American beech (Fagus grandifolia), sugar maple (Acer saccharum), black cherry (Prunus serotina), cucumber tree (Magnolia acuminata), and black birch (Betula lenta). The shrub layer is well developed, and the herb layer is rich and includes some southern Appalachian species such as yellow mandarin (Disporum lanuginosum), running strawberry bush (Euonymus obovatus), and black bugbane (Cimicifuga racemosa).

Elevation Range

Known examples of this community have been found at elevations between 300 feet and 2,362 feet.

Best Time to See

Because the key to distinguishing a rich mesophytic forest from related types is its vascular plant composition and diversity, it is easiest to identify the community during the growing season, from late May through summer. Striking seasonal leaf color can be enjoyed in the fall.

Rich Mesophytic Forest Images

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Sugar Maple - White Ash - American Basswood - Tuliptree / Black Baneberry Forest (CEGL006237)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Southern and Central Appalachian Cove Forest (CES202.373)

Characteristic Species

Trees > 5m

Acer rubrum var. *rubrum* (common red maple)
Acer saccharum (sugar maple)
Betula lenta (black birch)
Fagus grandifolia (American beech)
Fraxinus americana (white ash)
Magnolia acuminata (cucumber tree, cucumber magnolia)
Prunus serotina var. *serotina* (wild black cherry)
Quercus rubra (northern red oak)

Shrubs 2 - 5m

Acer pensylvanicum (striped maple)
Acer spicatum (mountain maple)
Carpinus caroliniana ssp. *virginiana* (musclewood, ironwood, American hornbeam)
Castanea dentata (American chestnut)
Corylus cornuta ssp. *cornuta* (beaked hazelnut)
Hamamelis virginiana (witch-hazel)
Sambucus racemosa (red elderberry)

Shrubs < 2m

Euonymus obovatus (running strawberry-bush)
Rubus allegheniensis (common blackberry)

Herbs

Actaea pachypoda (white baneberry, doll's-eyes)
Actaea racemosa (black cohosh, black snakeroot, bug-bane)
Ageratina altissima var. *altissima* (common white snakeroot)
Allium tricoccum var. *tricoccum* (common wild leek)
Brachyelytrum erectum (southern shorthusk)
Carex appalachica (Appalachian sedge)
Carex debilis var. *rudgei* (Rudge's sedge)
Carex leptonervia (northern woodland sedge)
Carex pensylvanica (Pennsylvania sedge)
Carex rosea (common upland star sedge)
Caulophyllum thalictroides (blue cohosh, late blue cohosh)
Cinna latifolia (drooping wood-reed)

Clintonia borealis (blue bead-lily)
Dendrolycopodium obscurum (flat-branched tree-clubmoss)
Dennstaedtia punctilobula (hay-scented fern)
Dryopteris intermedia (evergreen wood fern, fancy wood fern, common wood fern)
Eurybia divaricata (white wood-aster)
Hepatica acutiloba (sharp-lobed hepatica)
Huperzia lucidula (shining firmoss)
Lysimachia borealis (starflower)
Milium effusum var. *cisatlanticum* (millet grass)
Monotropa uniflora (Indian-pipe)
Polygonatum biflorum var. *biflorum* (small Solomon's-seal)
Polystichum acrostichoides (Christmas fern)
Prosartes lanuginosa (yellow mandarin)
Uvularia sessilifolia (wild-oats, sessile-leaved bellwort)
Viola rotundifolia (early yellow violet)

Similar Ecological Communities

- Allegheny oak forest (guide)

  Allegheny oak forest is also restricted to western New York and best developed in the unglaciated Allegheny Plateau region of the state. Allegheny oak forest is a summit and south-facing, upper slope community type. Rich mesophytic forest can be distinguished from Allegheny oak by the lack of chestnut oak (Quercus montana) and the lack of, or very low density of, black oak (Quercus velutina). The short shrub layer of Allegheny oak forest is typically dominated by heaths such as blueberry (Vaccinium pallidum), whereas the shrub layer of rich mesophytic forest is a mix of tree seedlings, saplings, and tall shrub species.

- Beech-maple mesic forest (guide)

  Rich mesophytic forest can be distinguished from beech-maple mesic forest by the predominance of rich herbs that include some southern species (yellow mandrin, running strawberry bush, black bugbane), and by the circumneutral fine textured

soils. Beech-maple mesic forest communities, in contrast, generally occur on more acidic soils.

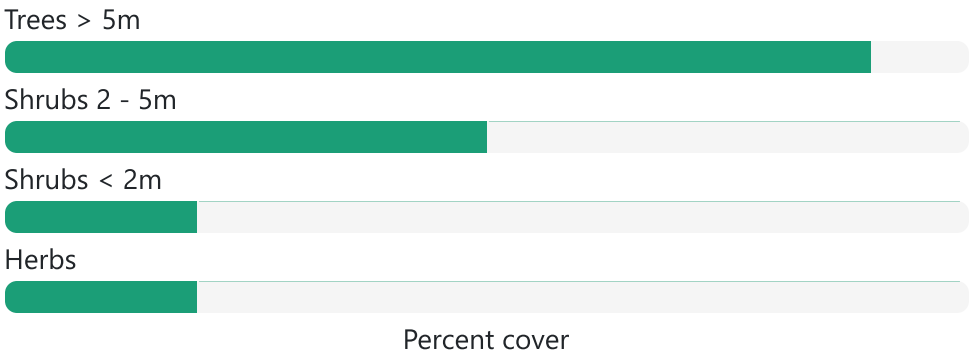
- Maple-basswood rich mesic forest (guide)

  Rich mesophytic forest can be distinguished from maple-basswood rich mesic forest by the presence of trees such as cucumber magnolia (Magnolia acuminata) and rich herbs including some southern Appalachian species, such as yellow mandarin (Disporum lanuginosum), running strawberry bush (Euonymus obovatus), and black bugbane (Cimicifuga racemosa).

- Oak-tulip tree forest (guide)

  Oak-tulip tree forests are found on moist, well drained sites in southeastern New York and have not been documented in western New York. Tulip tree (Liriodendron tulipifera) is typically codominant in oak-tulip tree forests and only rarely occurs in rich mesophytic forests in New York.

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Rich Mesophytic Forest. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

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Links

- Allegany State Park
- Beech Bark Disease (Ohio State University Extension)
- Beech Bark Disease (UMass Amherst, UMass Extension)
- Beech Leaf Disease (NYS DEC)
- Beech Leaf Disease (UMass Amherst, UMass Extension)
- Nine Mile State Forest
- Zoar Valley Multiple Use Area

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NYNHP

Rich Sloping Fen

Rich sloping fen at Malloryville Fen
F.R. Wesley

System
Palustrine

Subsystem
Open Peatlands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S1?

Critically Imperiled in New York (most likely) - Conservation status is uncertain, but most likely especially vulnerable to

disappearing from New York due to extreme rarity or other factors; typically 5 or fewer populations or locations in New York, very few individuals, very restricted range, very few remaining acres (or miles of stream), and/or very steep declines. More information is needed to assign a firm conservation status.

Global Conservation Status Rank

G3

Vulnerable globally - At moderate risk of extinction due to rarity or other factors; typically 80 or fewer populations or locations in the world, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines.

Contents

Summary

Did you know?

Fens influenced by calcareous bedrock can harbor an interesting group of green algae. Stoneworts (such as Chara vulgaris), are highly evolved algae that are often mistaken for vascular plants. They appear to have stems and branches, and are similar in appearance to submerged aquatic plants such as milfoil (Myriophyllum spp.), but they lack the internal water and nutrient transport structures common to all vascular plants. Stoneworts are thought to be closely related to non-vascular plants (mosses and liverworts), because the two groups have many evolutionary cytological and biochemical homologies.

State Ranking Justification

There are less than one hundred occurrences statewide. Some documented occurrences have good viability and several are protected on public land or private conservation land. This community is limited to the calcareous areas of the state and is restricted to wetlands that gain most of their moisture from underground sources that flow through calcareous substrates. There are few high quality examples. Most sites are small and some are very disturbed. The current trend of this community is probably stable for occurrences on public land, or declining slightly elsewhere due to moderate threats related to development pressure or alteration to the natural hydrology. Total acreage is very limited and many sites are too small to be protected by New York State freshwater wetland regulations.

Short-term Trends

The number and acres of rich sloping fens in New York have probably stabilized in recent decades as a result of wetland protection regulations.

Long-term Trends

The number acreage of rich sloping fens in New York probably declined moderately to substantially from their historical numbers likely correlated with the onset of agricultural and residential development.

Conservation and Management

Threats

Rich sloping fens are threatened by development and its associated run-off (e.g., agriculture, residential, roads) and habitat alteration in the adjacent landscape (e.g., clearing, logging, mowing, pollution, dumping, mining, utility ROWs). Alteration to the natural hydrology is also a threat to this community (e.g., ditching, blocked culverts, beaver). Nearly all examples of rich sloping fen are threatened by invasive species, such as purple loosestrife (Lythrum salicaria), reed grass (Phragmites australis ssp. australis), and dozens of non-native plants typical of successional old fields and pastures.

Conservation Strategies and Management Practices

Consider how water flows around and into this wetland. As most of the water inputs are from underground, management for the prevention of altered water quality and quantity is particularly difficult for this natural community, but also should be of utmost priority. Projects that occur near this community must consider the proximity of the development to this wetland and the potential for changing how water flows, both aboveground and belowground, into this wetland. Terrestrial buffers provide nesting habitat for resident salamanders, frogs, and turtles, and additional food sources for locally nesting birds, and thus they should be retained. Consultation with a hydrologist is important to determine patterns of run-off and underground water sources for the wetland; the construction of impervious surfaces, which rapidly deliver water to the wetland, should be avoided. Rapid influxes of surface water dilute the limey, mineral rich waters, decrease the robustness of the native fen species, and increase the likelihood of invasion by non-native species.

Development and Mitigation Considerations

Avoid or minimize the disruption of the groundwater hydrology in and around rich sloping fens. The presence of seeps and small streams within these fens means that typically the ground is saturated year-round and often does not freeze solid, making them very sensitive to compaction even in winter. New or modified inputs of surface water may modify the chemical composition of the substrate within the fen and the water feeding it. A change in chemistry in the fen may favor the increase of non-native invasive species over the persistence of alkaline-loving native fen species.

Inventory Needs

Additional inventory efforts in regions with calcareous bedrock and promising wetlands will likely turn up a few additional sites. Re-inventories of known sites will provide important information to help assess short- and long-term changes. Survey fens that provide habitat for rare species. For example, extant bog turtle sites should be surveyed to determine the type and quality of the natural community if it is unknown.

Research Needs

Research better ways to accurately and efficiently measure and understand the groundwater hydrology of fens. Further research into determining the proportion of fen water inputs is needed (e.g., groundwater vs. surface). If a fen is strongly groundwater influenced, traditional wetland buffers aimed at reducing surface water run-off may not sufficiently protect the fen hydrology.

Rare Species

- *Calephelis borealis* (Northern Metalmark) (guide)
- *Carex buxbaumii* (Brown Bog Sedge) (guide)
- *Carex capillaris* (Hair-like Sedge) (guide)
- *Carex emoryi* (Emory's Sedge) (guide)
- *Carex garberi* (Elk Sedge) (guide)
- *Carex livida* (Livid Sedge) (guide)
- *Carex meadii* (Mead's Sedge) (guide)
- *Carex sartwellii* (Sartwell's Sedge) (guide)
- *Carex schweinitzii* (Schweinitz's Sedge) (guide)
- *Chamaelirium luteum* (Fairywand) (guide)
- *Cirriphyllum piliferum* (Hair-pointed Moss) (guide)
- *Cistothorus stellaris* (Sedge Wren) (guide)
- *Cypripedium candidum* (Small White Lady's Slipper) (guide)
- *Gentianopsis virgata* (Lesser Fringed Gentian) (guide)
- *Glyptemys muhlenbergii* (Bog Turtle) (guide)
- *Juniperus horizontalis* (Creeping Juniper) (guide)
- *Poa paludigena* (Slender Marsh Blue Grass) (guide)
- *Pseudocalliergon turgescens* (Curving Feather Moss) (guide)
- *Pycnanthemum verticillatum* var. *verticillatum* (Whorled Mountain Mint) (guide)
- *Solidago ohioensis* (Ohio Goldenrod) (guide)
- *Tachopteryx thoreyi* (Gray Petaltail) (guide)
- *Triglochin palustris* (Marsh Arrow Grass) (guide)
- *Trollius laxus* (Spreading Globeflower) (guide)
- *Viola nephrophylla* (Northern Bog Violet) (guide)

Range

New York State Distribution

Extant sites cluster into three large elliptical shaped areas: 1) eastern New York centered around Dutchess and Putnam counties, 2) central New York centered around Tompkins and Cortland counties, and 3) western New York centered around Wyoming County. The historical range is unknown, but this community probably occurred all across upstate New York south of the Adirondacks.

Global Distribution

This physically broadly-defined community may be widespread in areas of the United States and worldwide with calcareous seepage. Examples with the greatest biotic affinities to New York occurrences are suspected to extend north into Ontario, south to the central Appalachians of North Carolina and Tennessee, west to Wisconsin, Illinois and Iowa, east to western New England, and northeast to New Brunswick. Few examples are suspected east of the Appalachian Divide, where the bedrock is mostly acidic.

Best Places to See

- Letchworth State Park (Livingston, Wyoming Counties)
- Tioughnioga Wildlife Management Area (Madison County)
- Malloryville Swamp Preserve (Tompkins County)
- Black Creek Bog Preserve, Adirondack Park (Herkimer County)

Identification Comments

General Description

A small, gently sloping, minerotrophic wetland, with shallow peat deposits (usually at least 20 cm), that occurs in a shallow depression on a slope (1° or greater) composed of calcareous glacial deposits. Sloping fens are fed by small springs or groundwater seepage. Like other rich fens, their water sources have high concentrations of minerals and high pH values, generally from 6.0 to 7.8. Rich sloping fens are headwater wetlands with cold water constantly moving through them. They often have water flowing at the surface in small channels or rivulets. Rich sloping fens are often surrounded by upland forest and grade into other palustrine communities such as hemlock-hardwood swamp, shrub swamp, or shallow emergent marsh downslope. This community shares many species with other rich fens, but can be separated by having a

measurable slope (e.g., 1° to >5°) and its position in the landscape. The structure of rich sloping fens is variable; usually there are scattered trees and shrubs and a nearly continuous groundlayer of herbs and bryophytes. They may be shrub-dominated or herb-dominated. Species diversity is usually very high and may include species from the surrounding forest.

Characters Most Useful for Identification

Characteristic shrubs and small trees include red osier dogwood (Cornus sericea), willows (Salix discolor, S. sericea, S. bebbiana) dwarf raspberry (Rubus pubescens), northern gooseberry (Ribes hirtellum), alder-leaf buckthorn (Rhamnus alnifolia), arrowwood (Viburnum dentatum var. lucidum), highbush blueberry (Vaccinium corymbosum), red maple (Acer rubrum), eastern red cedar (Juniperus virginiana), and eastern hemlock (Tsuga canadensis). Characteristic herbs include skunk-cabbage (Symplocarpus foetidus), marsh fern (Thelypteris palustris), spotted joe-pye-weed (Eutrochium maculatum), spreading goldenrod (Solidago patula), sedges (Carex leptalea, C. flava, C. hystericina, C. interior, C. sterilis, C. stricta), golden ragwort (Packera aurea), purple-stemmed aster (Symphyotrichum puniceum var. puniceum), cat-tails (Typha latifolia and T. angustifolia), swamp goldenrod (Solidago uliginosa), cotton-grass (Eriophorum viridi-carinatum), boneset (Eupatorium perfoliatum), flat-topped white aster (Doellingeria umbellata var. umbellata), purple avens (Geum rivale), tall meadow-rue (Thalictrum pubescens), common horsetail (Equisetum arvense), fowl mannagrass (Glyceria striata), field mint (Mentha arvensis), sundew (Drosera rotundifolia), water-horehound (Lycopus americanus), cinnamon fern (Osmunda cinnamomea), bulrush (Scirpus atrovirens), wild strawberry (Fragaria virginiana), water-horehound (Lycopus uniflorus), and grass-leaved goldenrod (Euthamia graminifolia). Characteric bryophytes include the mosses Calliergonella lindbergii, Hamatocaulis vernicosus, Helodium blandowii, Philonotis fontana, several peat mosses (Sphagnum centrale, S. fimbriatum, S. teres), and the thalloid liverwort Marchantia polymorpha. Mosses that can become characteristically abundant in rich sloping fens include Calliergonella cuspidata, Cratoneuron filicinum, the peat moss Sphagnum warnstorfii, and the rare golden moss (Tomentypnum nitens). Additional rich sloping fen bryophytes common to other rich fen types include the mosses Aulacomnium palustre, Bryum pseudotriquetrum, Calliergonella lindbergii, Campylium stellatum, Fissidens adianthoides, Scorpidium revolvens and the thalloid liverwort Aneura pinguis.

Odonates, such as the brush-tipped emerald (Somatochlora walshii) and clamp-tipped emerald (Somatochlora tenebrosa), are characteristic of some rich sloping fens.

Elevation Range

Known examples of this community have been found at elevations between 116 feet and 1,760 feet.

Best Time to See

One of the best times to visit this community is when the showy yellow flowers of shrubby cinquefoil are in full bloom, usually from mid July to mid August. Rich sloping fens are also scenic during late summer, when plant species of the aster family come into bloom.

Rich Sloping Fen Images

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- (Inland Sedge, Bottlebrush Sedge, Yellow Sedge) - Alpine Bulrush / Star Campylium Moss Fen (CEGL006331)
- Gray Dogwood / (Dioecious Sedge, Water Sedge, Lake Sedge) Fen (CEGL006123)
- Red-osier Dogwood - Silky Dogwood - Black Chokeberry - Nannyberry Fen (CEGL005088)
- Shrubby-cinquefoil / Inland Sedge - Yellow Sedge - Fen Grass-of-Parnassus Fen (CEGL005140)
- Shrubby-cinquefoil / (Dioecious Sedge, Bottlebrush Sedge, Yellow Sedge) Fen (CEGL006326)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Laurentian-Acadian Alkaline Fen (CES201.585)
- North-Central Appalachian Seepage Fen (CES202.607)

Characteristic Species

Trees > 5m

Acer rubrum var. *rubrum* (common red maple)
Juniperus virginiana var. *virginiana* (eastern red cedar)

Shrubs 2 - 5m

Fraxinus nigra (black ash)
Toxicodendron vernix (poison-sumac)

Shrubs < 2m

Cornus sericea (red-osier dogwood)
Dasiphora fruticosa (shrubby-cinquefoil)
Rhamnus alnifolia (alder-leaved buckthorn)
Ribes hirtellum (northern gooseberry)
Salix discolor (pussy willow)

Vines

Clematis virginiana (virgin's-bower)

Herbs

Carex flava (yellow sedge)
Carex hystericina (porcupine sedge)
Carex lacustris (lake-bank sedge)
Carex leptalea (bristle-stalked sedge)
Carex sterilis (dioecious sedge)
Carex stricta (tussock sedge)
Drosera rotundifolia (round-leaved sundew)
Eriophorum viridicarinatum (green-keeled cotton-grass)
Eupatorium perfoliatum (boneset)
Eutrochium maculatum var. *maculatum* (spotted Joe-Pye-weed)
Lycopus americanus (American bugleweed, American water-horehound)
Muhlenbergia glomerata (spike muhly)
Scirpus atrovirens (dark-green bulrush)
Solidago patula (rough-leaved goldenrod)
Symphyotrichum puniceum var. *puniceum* (purple-stemmed-aster)
Symplocarpus foetidus (skunk-cabbage)
Thelypteris palustris var. *pubescens* (marsh fern)
Typha latifolia (wide-leaved cat-tail)

Nonvascular plants

Calliergonella cuspidata
Campylium stellatum
Sphagnum warnstorfii

Submerged aquatics

Chara vulgaris

Similar Ecological Communities

- Rich graminoid fen (guide)

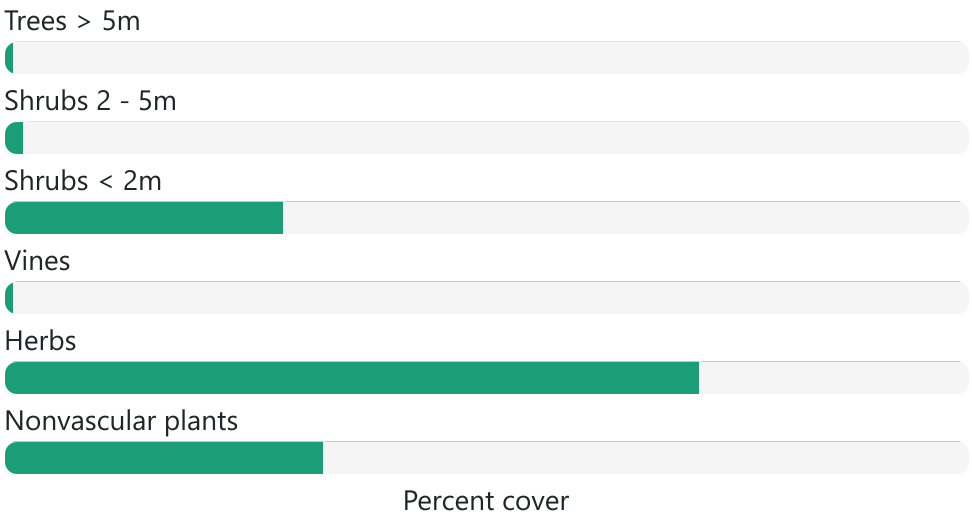
  Rich graminoid fens are open wetlands with less than 50% shrub cover, which occur on strongly mineral enriched peat soils, with bedrock generally at a depth of 90 cm or greater from the surface. They are situated in basins or at sites with less than one degree slope, often adjacent to a river, pond, or lake.

Standing surface water may be present but it is not flowing in small channels or rivulets.

- Rich shrub fen (guide)

  Rich shrub fens are open wetlands with greater than 50% shrub cover, which occur on strongly mineral enriched peat soils, with bedrock generally at a depth of 90 cm or greater from the surface. They are situated in basins or low lying areas with less than one degree slope, often adjacent to a river, pond, or lake. Standing surface water may be present but it is not flowing in small channels or rivulets.

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Rich Sloping Fen. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

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Links

- Bear's Den Preserve
- O.D. von Engeln Preserve at Malloryville

About This Guide

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NYNHP

Sedge Meadow

NY Natural Heritage director DJ Evans in kayak viewing tussock sedge (Carex stricta) dominated sedge meadow at Glen Lake Fen.
Gregory J. Edinger

System
Palustrine

Subsystem
Open Peatlands

State Protection
Not Listed

Not listed or protected by New York State.

Federal Protection
Not Listed

State Conservation Status Rank
S3

Vulnerable in New York - Vulnerable to disappearing from New York due to rarity or other factors (but not currently imperiled); typically 21 to 80 populations or locations in New York, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines.

Global Conservation Status Rank
G5

Secure globally - Common in the world; widespread and abundant (but may be rare in some parts of its range).

Contents

Summary

Did you know?

The dominant plant of sedge meadows is tussock sedge (Carex stricta). Stands of this sedge provide excellent nesting habitat for rails and snipe. They, along with other sedges, form "hummocks" in sedge meadows. Hummocks are small mounds in the meadow composed of undecayed fibrous roots and rhizomes.

State Ranking Justification

There are several hundred occurrences statewide. A few documented occurrences have good viability and several are protected on public land or private conservation land. This community is sparsely scattered but widespread throughout the state. There are a few large, high quality examples. The current trend of this community is probably stable for

occurences on public land and private conservation land, or declining slightly elsewhere due to moderate threats related to development pressure or alteration to the natural hydrology.

Short-term Trends

The number and acreage of sedge meadows in New York have probably remained stable in recent decades as a result of wetland protection regulations.

Long-term Trends

The number and acreage of sedge meadows in New York have probably declined substantially from historical numbers likely correlated to the alteration of natural hydrology (e.g., draining, impoundments) and agricultural activity, such as overgrazing or hay cutting.

Conservation and Management

Threats

Sedge meadows are threatened by adjacent development and its associated run-off (e.g., from agriculture, residential developments, mining, roads) and habitat alteration in the surrounding landscape (e.g., clearing, logging). In addition, alteration to the natural hydrological regime and the introduction of invasive species such as purple loosestrife (Lythrum salicaria), reedgrass (Phragmites australis ssp. australis), Japanese knotweed (Reynoutria japonica), and reed canary grass (Phalaris arundinacea) also pose significant threats to this community.

Conservation Strategies and Management Practices

Consider how water flows around and into this wetland. Projects that occur near this community must consider the proximity of the development to this wetland and the potential for changing how water flows, both above ground and below ground, into this wetland. Terrestrial buffers provide nesting habitat for resident salamanders, frogs, and turtles, and additional food sources for locally nesting birds, and thus should be retained. Impervious surfaces that rapidly divert water to the wetland should be avoided.

Development and Mitigation Considerations

When considering road construction and other development activities, minimize actions that will change what water carries and how water travels to this community, both on the surface and underground. Water traveling over-the-ground as run-off usually carries an abundance of silt, clay, and other particulates during (and often after) a construction project. While still suspended in the water, these particulates make it difficult for aquatic animals to find food; after settling to the bottom of the wetland, these particulates bury small plants and animals and alter the natural functions of the community in many other ways. Thus, road construction and development activities near this community type should strive to minimize particulate-laden run-off into this community. Water traveling on the ground or seeping through the ground also carries dissolved minerals and chemicals. Road salt, for example, is becoming an increasing problem both to natural communities and as a contaminant in household wells. Fertilizers, detergents, and other chemicals that increase the nutrient levels in wetlands cause algae blooms and eventually an oxygen-depleted environment where few animals can live. Herbicides and pesticides often travel far from where they are applied and have lasting effects on the quality of the natural community. So, road construction and other development activities should strive to consider: 1. how water moves through the ground, 2. the types of dissolved substances these development activities may release, and 3. how to minimize the potential for these dissolved substances to reach this natural community.

Inventory Needs

Additional inventory efforts in regions with calcareous bedrock and wetlands along slow moving streams will likely turn up a few additional sites. Re-inventories of known sites will provide important information to help assess short and long-term changes.

Research Needs

Research better ways to accurately and efficiently measure and understand groundwater hydrology of sedge meadows. Further research into determining the proportion of the sedge meadow water inputs is needed (e.g., groundwater vs. surface). If a wetland is strongly groundwater influenced, traditional wetland buffers aimed at reducing

surface water run-off may not sufficiently protect the groundwater hydrology.

Rare Species

- *Ammodramus henslowii* (Henslow's Sparrow) (guide)
- *Asclepias purpurascens* (Purple Milkweed) (guide)
- *Cardamine rotundifolia* (Round-leaved Water Cress) (guide)
- *Carex bullata* (Button Sedge) (guide)
- *Carex buxbaumii* (Brown Bog Sedge) (guide)
- *Carex haydenii* (Cloud Sedge) (guide)
- *Carex lupuliformis* (False Hop Sedge) (guide)
- *Carex mitchelliana* (Mitchell's Sedge) (guide)
- *Carex sartwellii* (Sartwell's Sedge) (guide)
- *Carex schweinitzii* (Schweinitz's Sedge) (guide)
- *Castilleja coccinea* (Indian Paintbrush) (guide)
- *Cistothorus stellaris* (Sedge Wren) (guide)
- *Cuscuta polygonorum* (Smartweed Dodder) (guide)
- *Dichanthelium leibergii* (Leiberg's Rosette Grass) (guide)
- *Eleocharis tenuis* var. *pseudoptera* (Sharp-angled Spike Rush) (guide)
- *Fagitana littera* (Marsh Fern Moth) (guide)
- *Glyptemys muhlenbergii* (Bog Turtle) (guide)
- *Iris virginica* (Southern Blue Flag) (guide)
- *Lysimachia hybrida* (Lowland Loosestrife) (guide)
- *Paspalum laeve* (Field Bead Grass) (guide)
- *Phlox maculata* ssp. *maculata* (Wild Sweet William) (guide)
- *Polemonium vanbruntiae* (Jacob's Ladder) (guide)
- *Scirpus ancistrochaetus* (Northeastern Bulrush) (guide)
- *Scutellaria integrifolia* (Hyssop Skullcap) (guide)
- *Sylvilagus transitionalis* (New England Cottontail) (guide)
- *Symphyotrichum boreale* (Northern Bog Aster) (guide)
- *Tripsacum dactyloides* (Northern Gama Grass) (guide)
- *Viola primulifolia* (Primrose-leaf Violet) (guide)

Range

New York State Distribution

This community is sparsely scattered but widespread throughout upstate New York. It is moderately common in the Northern Appalachians

Ecoregion and relatively uncommon in the North Atlantic Coast Ecoregion.

Global Distribution

This broadly-defined community may be worldwide. Examples with the greatest biotic affinities to New York occurrences are suspected to span north to southern Canada, west to Minnesota, southwest to Indiana and Tennessee, southeast to Georgia, and northeast to Nova Scotia.

Best Places to See

- Claryville-Sundown Sholam Wild Forest, Catskill Park (Ulster County)
- Boreal Heritage Preserve, Adirondack Park (St. Lawrence County)
- Adirondack Park, Ferris Lake Wild Forest, Silver Lake Wildlife Management Area (Hamilton County)

Identification Comments

General Description

A wet meadow community that has organic soils (muck or fibrous peat) that are permanently saturated and seasonally flooded; there is usually limited peat accumulation in the substrate, but it is deep enough (usually at least 20 cm) to be treated as a peatland; otherwise it would be classified as a mineral soil wetland such as shallow emergent marsh. The peat of this community is usually fibrous, rather than sphagnous, and is usually underlain by deep muck. The dominant herbs are tussock-forming sedge species, such as tussock sedge (Carex stricta) (Edinger et al. 2002).

Characters Most Useful for Identification

Sedge meadows are open wetlands dominated by fibrous peat (at least 20 cm deep) and tussock-forming sedges such as tussock sedge, which has at least 50% cover. The most common associate is bluejoint grass (Calamagrostis canadensis), which has less than 50% cover. Other associates include other sedges (Scirpus spp., Carex spp., Eleocharis spp., Dulichium arundinaceum), sensitive fern (Onoclea sensibilis), manna grasses (Glyceria spp.), and sparsely distributed shrubs (Alnus spp., Spiraea spp.).

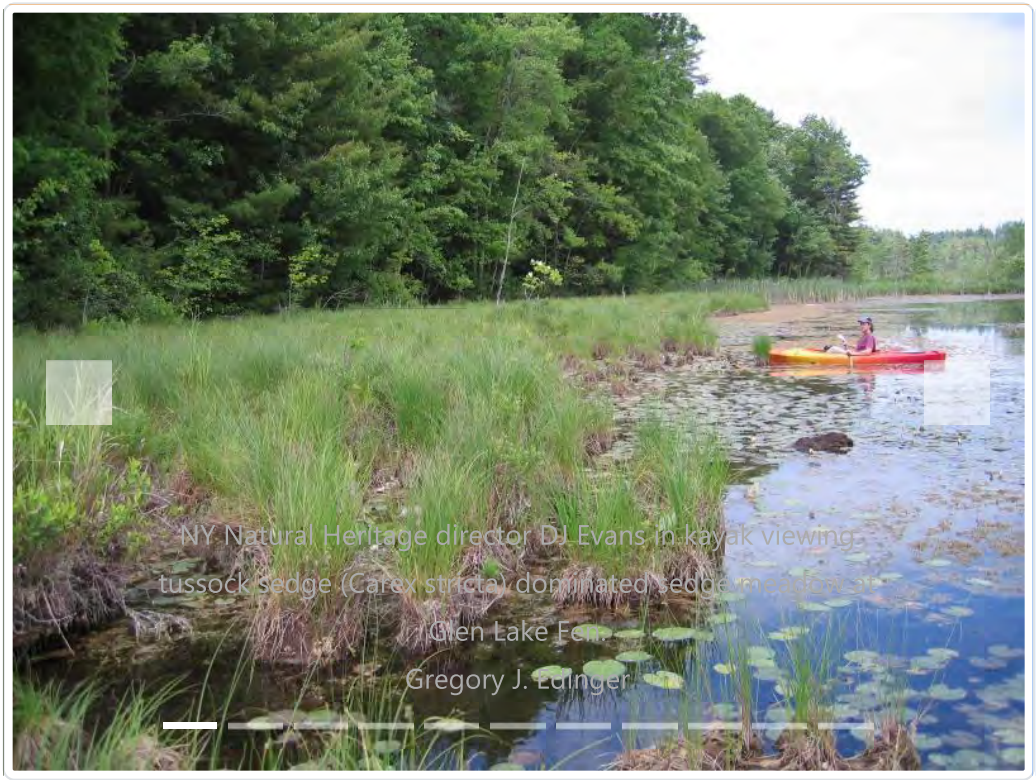
Elevation Range

Known examples of this community have been found at elevations between 399 feet and 2,067 feet.

Best Time to See

Meadowsweet and hardhack (Spiraea spp.), when present, come into full bloom during midsummer. Many of the characteristic sedges and grasses are best identified during late summer, when they flower and fruit.

Sedge Meadow Images



Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Upright Sedge - Blister Sedge Wet Meadow (CEGL006412)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

Characteristic Species

Shrubs 2 - 5m

Alnus incana ssp. *rugosa* (speckled alder)

Shrubs < 2m

Spiraea alba var. *latifolia* (broad-leaved meadow-sweet)
Spiraea tomentosa (steeplebush)

Herbs

Calamagrostis canadensis var. *canadensis* (Canada bluejoint grass)
Carex stricta (tussock sedge)
Carex utriculata (bottle-shaped sedge)
Carex vesicaria (lesser bladder sedge)
Comarum palustre (marsh-cinquefoil)
Equisetum fluviatile (river horsetail)
Eutrochium maculatum var. *maculatum* (spotted Joe-Pye-weed)
Glyceria canadensis (rattlesnake manna grass)
Impatiens capensis (spotted jewelweed, spotted touch-me-not)
Lysimachia terrestris (swamp-candles)
Onoclea sensibilis (sensitive fern)
Scirpus atrovirens (dark-green bulrush)
Scirpus cyperinus (common wool-grass)
Thelypteris palustris var. *pubescens* (marsh fern)

Similar Ecological Communities

- Inland poor fen (guide)

  Sedge meadows are open wetlands dominated by tussock sedge (Carex stricta) with bluejoint grass (Calamagrostis

canadensis) as a common codominant. Tussock sedge may be present in inland poor fens, but it usually makes up less than 50% cover.

- Medium fen (guide)

  Medium fens are usually dominated, or co-dominated, by woolly-fruited sedge (Carex lasiocarpa ssp. americana) and sweet-gale (Myrica gale) in the bayberry family (Myricaceae) with lesser amounts of the heath shrubs. **Sedge meadows** are open wetlands dominated by fibrous peat (at least 20 cm deep) and tussock-forming sedges, such as tussock sedge (Carex stricta), which has at least 50% cover. The most common associate is bluejoint grass (Calamagrostis canadensis). Other associates include other sedges (Scirpus spp., Carex spp., Eleocharis spp., Dulichium arundinaceum), sensitive fern (Onoclea sensibilis), manna grasses (Glyceria spp.), and sparsely distributed shrubs (Alnus spp., Spiraea spp.).

- Rich graminoid fen (guide)

  Rich graminoid fens are strongly minerotrophic (pH 6.0 to 7.8), have deeper peat, and are usually more floristically diverse than sedge meadows. Rich graminoid fens may have tussock sedge (Carex stricta), but it usually makes up less than 50% of the herbaceous cover.

- Shallow emergent marsh (guide)

  Shallow emergent marshes have organic soils over mineral soils, and lack significant peat accumulation. Sedge meadows are dominated by tussock sedge (Carex stricta), whereas shallow emergent marshes have a variety of possible dominant species.

Vegetation

Trees > 5m

Shrubs 2 - 5m

This figure helps visualize the structure and "look" or "feel" of a typical Sedge Meadow. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

References

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Links

- Tussock Sedge (Carex stricta)
- Tussock Sedge Marsh (Pennsylvania Natural Heritage Program)

About This Guide

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NYNHP

Shrub Swamp

Shrub swamp at Ludlow Creek Marsh

Stephen M. Young

System

Palustrine

Subsystem

Open Mineral Soil Wetlands

State Protection

Not Listed

Not listed or protected by New York State.

Federal Protection

Not Listed

State Conservation Status Rank

S3S4

Vulnerable in New York, or Apparently Secure - Vulnerable to disappearing from New York (but not currently imperiled), with relatively few populations or locations, few individuals, and/or restricted range; or uncommon but not rare in New York; may be rare in some parts of the state; possibly some cause for long-term concern due to declines or other factors. More information is needed to assign either S3 or S4.

Global Conservation Status Rank

G5

Secure globally - Common in the world; widespread and abundant (but may be rare in some parts of its range).

Contents

Summary

Did you know?

Speckled alder (*Alnus incana* ssp. *rugosa*) is a nitrogen-fixing shrub that has been found to increase the concentration of inorganic nitrogen in the surface waters of the Adirondacks. Native Americans used speckled alder in combination with bloodroot, wild plum, and red osier dogwood (*Cornus sericea*) to make a scarlet dye for porcupine quill embroidery. Inuit people and settlers extracted a dark dye from the bark for tanning and staining hides. The bark was boiled to make medicinal teas for treating rheumatism and was also applied to wounds as a poultice to reducing bleeding and swelling.

State Ranking Justification

There are several thousand shrub swamps statewide. Some documented occurrences have good viability and many are protected on public land or private conservation land. This community has statewide distribution, and includes a few large, high quality examples. The current trend of this community is probably stable for occurrences on public land and private conservation land, or declining slightly elsewhere due to moderate threats that include alteration of the natural hydrology and invasive species.

Short-term Trends

The number and acreage of shrub swamps in New York have probably remained stable in recent decades as a result of wetland protection regulations. There may be a few cases where this community has increased as a result of abandoned agriculture land.

Long-term Trends

The number and acreage of shrub swamps in New York have substantially declined (50-75%) from historical numbers likely correlated to the alteration to the natural hydrology and to direct destruction, especially near urban areas.

Conservation and Management

Threats

Shrub swamps are threatened by development and its associated run-off (e.g., agriculture, residential, roads/bridges), habitat alteration (e.g., pollution, nutrient loading, excessive logging in adjacent uplands), and recreational overuse (e.g., trash dumping, motor boating). Alteration to the natural hydrological regime is also a threat to this community (e.g., impoundments, blocked culverts, beaver). Several shrub swamps are threatened by invasive species, such as purple loosestrife (Lythrum salicaria), reedgrass (Phragmites australis), non-native shrub honeysuckles (Lonicera spp.), European buckthorn (Rhamnus cathartica), autumn olive/Russian olive (Elaeagnus umbellata, E. angustifolia), multiflora rose (Rosa multiflora), glossy buckthorn (Frangula alnus), and frog-bit (Hydrocharis morsus-ranae).

Conservation Strategies and Management Practices

Where practical, establish and maintain a natural wetland buffer to reduce storm-water, pollution, and nutrient run-off, while simultaneously capturing sediments before they reach the wetland. Buffer width should take into account the erodibility of the surrounding soils, slope steepness, and current land use. Wetlands protected under Article 24 are known as New York State "regulated" wetlands. The regulated area includes the wetlands themselves, as well as a protective buffer or "adjacent area" extending 100 feet landward of the wetland boundary (NYS DEC 1995). If possible, minimize the number and size of impervious surfaces in the surrounding landscape. Avoid habitat alteration within the wetland and surrounding landscape. For example, roads and trails should be routed around wetlands, and ideally not pass through the buffer area. If the wetland must be crossed, then bridges and boardwalks are preferred over filling. Restore past impacts, such as removing obsolete impoundments and ditches in order to restore the natural hydrology. Prevent the spread of invasive exotic species into the wetland through appropriate direct management, and by minimizing potential dispersal corridors, such as roads.

Development and Mitigation Considerations

When considering road construction and other development activities, minimize actions that will change what water carries and how water travels to this community, both on the surface and underground. Water traveling over-the-ground as runoff usually carries an abundance of silt, clay, and other particulates during (and often after) a construction project. While still suspended in the water, these particulates make it difficult for aquatic animals to find food; after settling to the bottom of the system, they bury small plants and animals and alter the natural functions of the community in many other ways. Thus, road construction and development activities near this community type should strive to minimize particulate-laden run-off into this community. Water traveling on the ground or seeping through the ground also carries dissolved minerals and chemicals. Road salt, for example, is becoming an increasing problem both to natural communities and as a contaminant in household wells. Fertilizers, detergents, and other chemicals that increase the nutrient levels in wetlands cause algal blooms and eventually an oxygen-depleted environment in which few animals can live. Herbicides

and pesticides often travel far from where they are applied and have lasting effects on the quality of the natural community. So, road construction and other development activities should strive to consider: 1. how water moves through the ground, 2. the types of dissolved substances these development activities may release, and 3. how to minimize the potential for these dissolved substances to reach this natural community.

Inventory Needs

Survey for occurrences statewide to advance documentation and classification of shrub swamps. A statewide review of shrub swamps is desirable. Continue searching for large sites in good condition (A- to AB-ranked).

Research Needs

Research composition of shrub swamps statewide in order to characterize variations. Collect sufficient plot data to support the recognition of several distinct shrub swamp types based on composition and by ecoregion (e.g., Alnus spp. dominant, Cephalanthus occidentalis dominant, Cornus spp. dominant, Salix spp. dominant, etc.).

Rare Species

- *Betula pumila* (Swamp Birch) (guide)
- *Callophrys henrici* (Henry's Elfin) (guide)
- *Cardamine rotundifolia* (Round-leaved Water Cress) (guide)
- *Carex atherodes* (Wheat Sedge) (guide)
- *Carex conjuncta* (Soft Fox Sedge) (guide)
- *Carex cumulata* (Clustered Sedge) (guide)
- *Carex decomposita* (Large-panicled Sedge) (guide)
- *Carex lupuliformis* (False Hop Sedge) (guide)
- *Carex mitchelliana* (Mitchell's Sedge) (guide)
- *Carex straminea* (Straw Sedge) (guide)
- *Carex tenuiflora* (Sparse-flowered Sedge) (guide)
- *Circus hudsonius* (Northern Harrier) (guide)
- *Crotalus horridus* (Timber Rattlesnake) (guide)
- *Cuscuta cephalanthi* (Buttonbush Dodder) (guide)
- *Emydoidea blandingii* (Blanding's Turtle) (guide)
- *Fagitana littera* (Marsh Fern Moth) (guide)
- *Hottonia inflata* (American Featherfoil) (guide)
- *Liparis liliifolia* (Lily-leaved Twayblade) (guide)

- *Lithophane viridipallens* (Pale Green Pinion Moth) (guide)
- *Monarda clinopodia* (Basilbalm) (guide)
- *Neottia auriculata* (Auricled Twayblade) (guide)
- *Pedicularis lanceolata* (Marsh Lousewort) (guide)
- *Phlox maculata* ssp. *maculata* (Wild Sweet William) (guide)
- *Podilymbus podiceps* (Pied-billed Grebe) (guide)
- *Polemonium vanbruntiae* (Jacob's Ladder) (guide)
- *Rhododendron canadense* (Rhodora) (guide)
- *Rorippa aquatica* (Lake Water Cress) (guide)
- *Salix pyrifolia* (Balsam Willow) (guide)
- *Senecio suaveolens* (Sweet-scented Indian Plantain) (guide)
- *Sparganium natans* (Small Bur-reed) (guide)
- *Sylvilagus transitionalis* (New England Cottontail) (guide)
- *Vermivora chrysoptera* (Golden-winged Warbler) (guide)

Range

New York State Distribution

Widespread throughout the state, including the coastal areas and represented by different regional variants. Alder-dominated swamps are widespread throughout the northern Appalachian portion of the northern third of New York and probably extend south as small patches in the lower New England and Great Lakes areas.

Global Distribution

This physiognomically broadly-defined community is likely to be widespread worldwide. Examples with the greatest biotic affinities to New York occurrences are suspected to span north to southern Canada, west to Minnesota, southwest to Indiana and Tennessee, southeast to Georgia, and northeast to Nova Scotia.

Best Places to See

- West Branch Sacandaga River (Hamilton County)
- Conewango Creek Forest
- South Branch Grass River Colton (St. Lawrence County)
- Harris Bay Marsh (Warren County)
- East Mud Lake
- Jordan River
- Cattaraugus Creek Balsam (Wyoming County)

- Shingle Shanty Brook (Hamilton County)
- West Branch Oswegatchie River Diana (Lewis County)
- Mad River Swamp (Lewis County)
- East Branch Fish Creek (Lewis County)

Identification Comments

General Description

A shrub swamp is 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. This is a very broadly defined type that includes several distinct communities and many intermediates. In northern New York many shrub swamps are dominated by alder (Alnus incana ssp. rugosa); these swamps are sometimes called alder thickets. A swamp dominated by red osier dogwood (Cornus sericea), silky dogwood (C. amomum), and willows (Salix spp.) may be called a shrub carr. Along the shores of some lakes and ponds there is a distinct zone dominated by waterwillows (Decodon verticillatus) and/or buttonbush (Cephalanthus occidentalis) which can sometimes fill a shallow basin. Birds that may be found in shrub swamps include both common species such as common yellowthroat (Geothlypis trichas) and swamp sparrow (Melospiza georgiana) and rare species such as the American bittern (Botaurus lentiginosus).

Characters Most Useful for Identification

Shrub swamps are very common and quite variable. They may be codominated by a mixture of species or be a near-monoculture of a single dominant shrub species. Characteristic shrubs include meadowsweet (Spiraea alba var. latifolia), steeplebush (Spiraea tomentosa), gray dogwood (Cornus racemosa), swamp azalea (Rhododendron viscosum), highbush blueberry (Vaccinium corymbosum), maleberry (Lyonia ligustrina), smooth alder (Alnus serrulata), spicebush (Lindera benzoin), willows (Salix bebbiana, S. discolor, S. lucida, S. petiolaris), wild raisin (Viburnum nudum var. cassinoides), and arrowwood (Viburnum dentatum var. lucidum).

Elevation Range

Known examples of this community have been found at elevations between 10 feet and 1,900 feet.

Best Time to See

The best time to view the diversity of plants in a shrub swamp is in the summer, from June to August. Many dogwood species (Cornus spp.) begin to bloom as early as May, but most other characteristic shrubs, including meadowsweet (Spiraea alba), buttonbush (Cephalanthus occidentalis), and sweet pepperbush (Clethra alnifolia) bloom from June or July through August.

Shrub Swamp Images

Shrub swamp at Ludlow Creek Marsh

Stephen M. Young

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Gray Alder - Dogwood species / Devil's Darning-Needles Alluvial Shrub Swamp (CEGL006062)
- Speckled Alder - Catberry / Peatmoss species Acidic Peatland (CEGL006158)
- Common Buttonbush / Sedge species Midwest Shrub Swamp (CEGL002190)
- Common Buttonbush - Swamp-loosestrife Shrub Swamp (CEGL006069)
- Red-osier Dogwood - Willow species - (Swamp Rose) Shrub Swamp (CEGL002186)
- Swamp-loosestrife Shrub Swamp (CEGL005089)
- Sweetgale - Northern Bayberry Wet Shrubland (CEGL006339)
- American Sycamore - River Birch - (Coastal Plain Willow, Black Willow) Floodplain Forest (CEGL003896)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Central Appalachian River Floodplain (CES202.608)
- Central Appalachian Stream and Riparian (CES202.609)
- Eastern Boreal-Sub-boreal Bog (CES103.581)
- Laurentian-Acadian Floodplain Forest (CES201.587)
- Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)
- Northern Atlantic Coastal Plain Pond (CES203.518)

Characteristic Species

Trees > 5m

Alnus serrulata (smooth alder)
Salix spp.

Shrubs 2 - 5m

Alnus incana ssp. *rugosa* (speckled alder)
Cephalanthus occidentalis (buttonbush)
Clethra alnifolia (coastal sweet-pepperbush)

Cornus sericea (red-osier dogwood)
Spiraea alba var. *latifolia* (broad-leaved meadow-sweet)

Shrubs < 2m

Alnus incana ssp. *rugosa* (speckled alder)
Cephalanthus occidentalis (buttonbush)
Ilex laevigata (smooth winterberry)
Salix spp.

Vines

Vitis aestivalis (summer grape)

Herbs

Bidens cernua (nodding beggar-ticks)
Carex torta (twisted sedge)
Decodon verticillatus (water-willow)
Osmundastrum cinnamomeum var. *cinnamomeum* (cinnamon fern)
Persicaria amphibia ssp. *laevimarginata* (American water smartweed)
Persicaria arifolia (halberd-leaved tear-thumb)
Phalaris arundinacea (reed canary grass)
Typha angustifolia (narrow-leaved cat-tail)

Nonvascular plants

Sphagnum spp.

Floating-leaved aquatics

Lemna minor (common duckweed)

Similar Ecological Communities

- Dwarf shrub bog (guide)

  Dwarf shrub bogs are underlain by a layer of peat that is typically deeper than 20 cm; shrub swamps have only shallow peat or, more commonly, mineral soils.

- Highbush blueberry bog thicket (guide)

Highbush blueberry bog thicket are underlain by a layer of peat that is typically deeper than 20 cm; shrub swamps have only shallow peat or, more commonly, mineral soils.

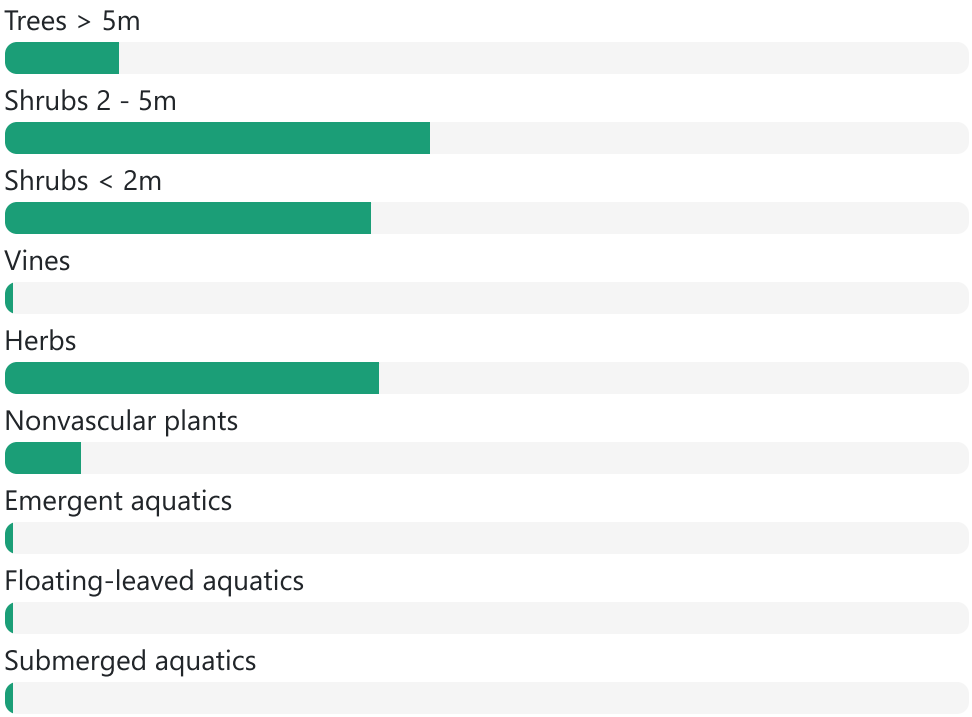
- Pine barrens shrub swamp (guide)

  A pine barrens shrub swamp occurs in shallow depressions on the Coastal Plain, often as a linear transition zone between a coastal plain pondshore and an upland pitch pine-dominated community. They are embedded within fire-prone communities.

- Shallow emergent marsh (guide)

  Shallow emergent marshes are dominated by herbaceous species; shrubs are typically present at significantly less than 50% cover.

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Shrub Swamp. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

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Links

- Perch River Wildlife Management Area
- Speckled Alder (Alnus incana ssp. rugosa) - USDA Plants
- Tug Hill Wildlife Management Area (NYS DEC)

About This Guide

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NYNHP

Successional Northern Sandplain Grassland

Successional northern sandplains grassland at Fort Drum Training Area 5D

Gregory J. Edinger

System

Terrestrial

Subsystem

Open Uplands

State Protection

Not Listed

Not listed or protected by New York State.

Federal Protection

Not Listed

State Conservation Status Rank

S3

Vulnerable in New York - Vulnerable to disappearing from New York due to rarity or other factors (but not currently imperiled); typically 21 to 80 populations or locations in New York, few individuals, restricted range, few remaining acres (or miles of stream), and/or recent and widespread declines.

Global Conservation Status Rank

G4?

Apparently Secure globally (most likely) - Conservation status is uncertain, but most likely uncommon in the world but not rare; usually widespread, but may be rare in some parts of its range; possibly some cause for long-term concern due to declines or other factors. More information is needed to assign a firm conservation status.

Contents

Summary

Did you know?

The Karner blue butterfly (*Lycaeides melissa samuelisis*) is an endangered species and its caterpillars feed only on the leaves of wild lupine (*Lupinus perennis* ssp. *perennis*) which is sometimes found in successional northern sandplain grasslands in eastern New York (e.g., Albany Pine Bush and Wilton Wildlife Preserve and Park).

State Ranking Justification

This community is widespread throughout New York State, where the substrate is sand. There are an estimated 500 to 2,000 extant occurrences statewide and there are only a few good quality examples in New York. Successional northern sandplain grasslands are threatened by fire suppression, invasive species, and fragmenting development.

Short-term Trends

The number and acreage of successional northern sandplain grasslands in New York have probably declined slightly in recent decades due to fire suppression, disturbance by off-road vehicles, trash dumping, and development.

Long-term Trends

The number and acreage of successional northern sandplain grasslands in New York have probably had very large declines from historical numbers due to fire suppression, fragmentation, disturbance by off-road vehicles, trash dumping, and development.

Conservation and Management

Threats

As a fire-dependent natural community, the primary threat to successional northern sandplain grasslands is the suppression of fire. Lack of fire will likely result in the invasion of woody species from the surrounding woodlands that may convert the grasslands to shrublands and eventually to successional hardwoods. Other threats to this community include fragmenting development (e.g., residential, agricultural, commercial, roads, utility ROWs) and recreational overuse (e.g., ATV use, off-trail trampling, trash dumping). Nearly all examples of successional northern sandplain grasslands are threatened by invasive species: including invasive woody plants, such as black locust (Robinia pseudoacacia), shrubby honeysuckles (Lonicera tatarica, L. morrowii), and multiflora rose (Rosa multiflora), and garlic mustard (Alliara petiolata); and invasive herbaceous plants, such as spotted knapweed (Centaurea stoebe. ssp. micranthos), cypress spurge (Euphorbia cyparissias), and bird's-foot trefoil (Lotus corniculatus).

Conservation Strategies and Management Practices

Develop and implement prescribed burn plans at appropriate sites. Reduce or minimize fragmenting features, such as residential and commercial development, roads, abandoned clearings, unnecessary trails, etc. Restrict mountain bikes and ATVs to designated trails and least sensitive areas, and prevent dumping of trash. Remove or control invasive species where appropriate.

Development and Mitigation Considerations

This community is best protected as part of a pine barrens ecosystem, encompassing patches grasslands, scrub oak shrublands, and pitch pine-oak forests. Development should avoid fragmentation of such systems to allow for nutrient flow, seed dispersal, and seasonal animal migrations within them. Bisecting trails, roads, and developments can also allow exotic plant and animal species to invade.

Inventory Needs

Survey for occurrences statewide to advance documentation and classification of successional northern sandplain grassland. Continue searching for large sites in good condition (A- to AB-ranked).

Research Needs

Determine the optimal fire regime for this community.

Rare Species

- *Aletris farinosa* (White Colicroot) (guide)
- *Asio flammeus* (Short-eared Owl) (guide)
- *Carex houghtoniana* (Houghton's Sedge) (guide)
- *Carex tincta* (Tinged Sedge) (guide)
- *Circus hudsonius* (Northern Harrier) (guide)
- *Hedeoma hispida* (Rough Pennyroyal) (guide)
- *Houstonia purpurea* var. *calycosa* (Midwestern Purple Bluets) (guide)
- *Houstonia purpurea* var. *purpurea* (Large Purple Bluets) (guide)
- *Lactuca hirsuta* (Tall Hairy Lettuce) (guide)
- *Lithospermum canescens* (Hoary Puccoon) (guide)
- *Piptatheropsis canadensis* (Canada Rice Grass) (guide)
- *Plebejus melissa samuelis* (Karner Blue) (guide)

- *Rumex hastatulus* (Heart Sorrel) (guide)
- *Scleria triglomerata* (Whip Nut Sedge) (guide)

Range

New York State Distribution

This community is widespread throughout New York State, where the substrate is sand, but somehat restricted to sites where the substrate is moist sand and kept open through prescribed burning or infrequent mowing. It is probably represented by different regional variants. It is typically a small patch community with very few large patch occurrences known from the Great Lakes Plains.

Global Distribution

This broadly-defined community may be widespread at northern latitudes where the substrate is sand. Examples with the greatest biotic affinities to New York occurrences are suspected to span north to southern Canada, west to Minnesota, southwest to Indiana and Tennessee, southeast to Georgia, and northeast to Nova Scotia.

Best Places to See

- Brandon Burn (Franklin County)
- Wilton Wildlife Preserve and Park (Saratoga County)
- Fort Drum (Training Areas 4 and 5) (Jefferson County)
- Albany Pine Bush (Albany County)

Identification Comments

General Description

A meadow community that occurs on open sandplains that have been cleared and plowed (for farming or development), and then abandoned. This community is usually dominated by a low, dry turf of sedges and grasses less than 30 cm (12 inches) tall, and includes patches of open sand and patches of soil covered with mosses and lichens.

Characters Most Useful for Identification

These grasslands are dominated grasses and sedges, such as little bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*),

Pennsylvania sedge (*Carex pensylvanica*), common poverty grass (*Danthonia spicata*), panicgrasses (*Dichanthelium acuminatum* ssp. *columbianum*, *D. linearifolium*, *D. depauperatum*), and other sedges (*Carex rugosperma*, *C. lucorum*). Characteristic herbs with low percent cover include bracken fern (*Pteridium aquilinum* var. *latiusculum*), stiff leaf aster (*Ionactis linariifolius*), butterflyweed (*Asclepias tuberosa*), round-head bushclover (*Lespedeza capitata*), whorled loosestrife (*Lysimachia quadrifolia*), and pale bluets (*Houstonia longifolia*).

Elevation Range

Known examples of this community have been found at elevations between 250 feet and 1,740 feet.

Best Time to See

Late summer (August-September) is an excellent time of year to see little bluestem (*Schizachyrium scoparium*) blowing in the breeze.

Successional Northern Sandplain Grassland Images

Classification

International Vegetation Classification Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

- Little Bluestem - (Broomsedge Bluestem) - Goldenrod species Ruderal Meadow (CEGL006333)

NatureServe Ecological Systems

This New York natural community falls into the following ecological system(s). Ecological systems are often described at a coarser resolution than New York's natural communities and tend to represent clusters of associations found in similar environments. The ecological systems project is developed and maintained by NatureServe.

- Northeastern Interior Pine Barrens (CES202.590)

Characteristic Species

Trees > 5m

Betula populifolia (gray birch)
Pinus rigida (pitch pine)
Quercus alba (white oak)
Quercus rubra (northern red oak)
Quercus velutina (black oak)

Shrubs 2 - 5m

Corylus americana (American hazelnut)
Pinus rigida (pitch pine)
Populus tremuloides (trembling aspen, quaking aspen)
Prunus serotina var. *serotina* (wild black cherry)
Quercus ilicifolia (scrub oak, bear oak)
Robinia pseudoacacia (black locust)
Rubus flagellaris (northern dewberry)

Shrubs < 2m

Betula populifolia (gray birch)
Ceanothus americanus (New Jersey-tea)
Comptonia peregrina (sweet-fern)
Lonicera tatarica (Tartarian honeysuckle)
Pinus rigida (pitch pine)
Pinus strobus (white pine)
Populus deltoides ssp. *deltoides* (eastern cottonwood)
Populus grandidentata (big-toothed aspen)
Populus tremuloides (trembling aspen, quaking aspen)
Prunus serotina var. *serotina* (wild black cherry)
Quercus ilicifolia (scrub oak, bear oak)
Quercus velutina (black oak)
Rubus allegheniensis (common blackberry)
Rubus flagellaris (northern dewberry)
Spiraea alba var. *latifolia* (broad-leaved meadow-sweet)

Herbs

Asclepias syriaca (common milkweed)
Asclepias tuberosa (butterfly-weed)
Avenella flexuosa (common hair grass)
Carex lucorum (long-beaked carpet sedge)
Carex pensylvanica (Pennsylvania sedge)
Carex rugosperma (wrinkle-seeded sedge)
Centaurea stoebe ssp. *micranthos* (spotted knapweed)
Comandra umbellata ssp. *umbellata* (bastard-toadflax)
Cyperus houghtonii (Houghton's flat sedge)
Cyperus lupulinus ssp. *macilentus* (eastern flat sedge)
Danthonia spicata (poverty grass)
Dichanthelium clandestinum (deer-tongue rosette grass)
Dichanthelium columbianum (District of Columbia rosette grass)
Dichanthelium depauperatum (poverty rosette grass)
Dichanthelium linearifolium (linear-leaved rosette grass)
Dichanthelium xanthophysum (strict rosette grass)
Euthamia graminifolia (common flat-topped-goldenrod)
Fragaria virginiana ssp. *virginiana* (common wild strawberry)
Hieracium sp.
Houstonia longifolia (long-leaved bluets)
Hypericum perforatum ssp. *perforatum* (common St. John's-wort)

Ionactis linariifolia (stiff-leaved-aster)
Lespedeza capitata (round-headed bush-clover)
Lupinus perennis ssp. *perennis* (wild lupine, sundial lupine)
Lysimachia quadrifolia (whorled-loosestrife)
Monarda punctata var. *punctata* (dotted horse-mint)
Panicum virgatum (switch grass)
Poa pratensis ssp. *pratensis* (common Kentucky blue grass)
Polygala polygama (bitter milkwort)
Polygonum articulatum (northern jointweed)
Potentilla simplex (old-field cinquefoil)
Pteridium aquilinum ssp. *latiusculum* (eastern bracken fern)
Rumex acetosella ssp. *pyrenaicus* (sheep-sorrel)
Schizachyrium scoparium var. *scoparium* (little bluestem)
Solidago canadensis var. *canadensis* (Canada goldenrod)
Solidago juncea (early goldenrod)
Sorghastrum nutans (Indian grass)
Verbascum thapsus (common mullein)

Nonvascular plants

Cladonia arbuscula ssp. *mitis*
Cladonia cristatella
Cladonia rangiferina
Polytrichum juniperinum
Polytrichum piliferum

Similar Ecological Communities

- Alvar pavement grassland (guide)

  Successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.). Alvar pavement grasslands occur on Chaumont limestone (Galoo-Rock outcrop complex) and are dominated by small rush grass (*Sporobolus neglectus*), sheathed rush grass (*S. vaginiflorus*), Philadelphia panic grass (*Panicum philadelphicum*), Canada bluegrass (*Poa compressa*), upland white aster (*Oligoneuron album*), poverty grass (*Danthonia spicata*), false pennyroyal (*Trichostema brachiatum*), balsam

ragwort (*Packera paupercula*), Crawe's sedge (*Carex crawei*), and wiry panic grass (*Panicum flexile*).

- Dry alvar grassland (guide)

  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.). Whereas, dry alvar grasslands occur on Chaumont limestone (Galoo-Rock outcrop complex) and are dominated by poverty grass (*Danthonia spicata*), Canada bluegrass (*Poa compressa*), and sometimes little bluestem (*Schizachyrium scoparium*).

- Floodplain grassland (guide)

  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.) Floodplain grasslands occur on relatively stable sand/gravel or cobble substrate and are dominated by big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and switch grass (*Panicum virgatum*).

- Hempstead Plains grassland (guide)

  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.) Hempstead Plains grasslands are a tall grassland community that occurs on rolling outwash plains in west-central Long Island and are dominated by little bluestem (*Schizachyrium scoparium*), rush (*Juncus greenei*), and hyssop-leaved boneset (*Eupatorium hyssopifolium*).

- Maritime grassland (guide)

  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.). Maritime grasslands occur on rolling outwash plains of the glaciated portion of the coastal plain, near the ocean and within the influence of offshore winds and salt spray. They are dominated by little bluestem (*Schizachyrium scoparium*), common hairgrass (*Avenella flexuosa*), and poverty-grass (*Danthonia spicata*).

- Rocky summit grassland (guide)

  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (Dichanthelium spp.). Rocky summit grasslands occur on rocky summits and exposed rocky slopes of hills and are dominated by bluestem (*Schizachyrium scoparium*), tufted hairgrass (*Avenella flexuosa*), poverty-grass (*Danthonia spicata*, D. compressa), and Indian grass (Sorghastrum nutans).

- Successional old field

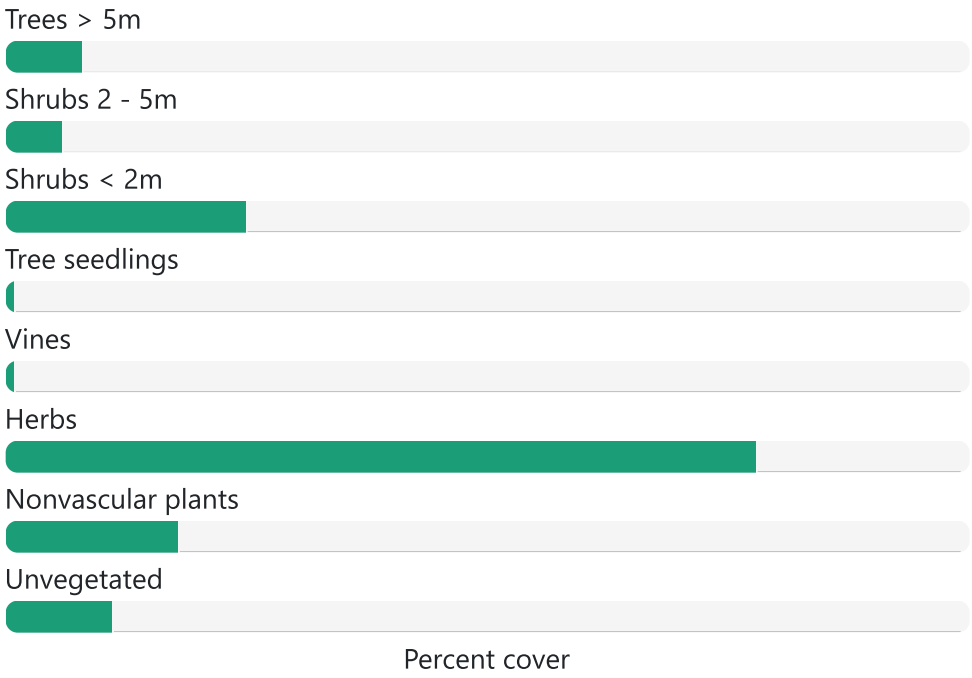
  While these communities may share similar species, successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.). Successional old fields are meadows dominated by forbs and grasses that occurs on sites that have been cleared and plowed (for farming or development), and then abandoned. They are dominated by goldenrods (*Solidago* spp.), and various pasture grasses, such as bluegrasses (*Poa* spp.), timothy (*Phleum pratense*), quackgrass (*Elymus repens*), smooth brome (*Bromus inermis*), sweet vernal

grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*).

- Wet alvar grassland (guide)

  Successional northern sandplain grasslands occur on sandy soil and are dominated by bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), and panic grasses (*Dichanthelium* spp.). Whereas, wet alvar grasslands occur on Chaumont limestone (Galoo-Rock outcrop complex) and are dominated by tufted hairgrass (*Deschampsia cespitosa*), Crawe's sedge (*Carex crawei*), prairie dropseed (*Sporobolus heterolepis*), and flat-stemmed spikerush (*Eleocharis elliptica* var. elliptica).

Vegetation



This figure helps visualize the structure and "look" or "feel" of a typical Successional Northern Sandplain Grassland. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

Additional Resources

References

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Links

- Albany Pine Bush Preserve
- Albany Pine Bush Preserve (NYS DEC)
- Fort Drum restores grassland for threatened bird species
- Wilton Wildlife Preserve & Park

About This Guide

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Appendix F

Riparian Buffer Guidance

Riparian Buffer

Recommended buffer standards are adapted from Chapter 5.1.2 of the DEC Stormwater Design Manual with suggested modifications that reflect local urban and agricultural land uses, unique resources and site conditions specific to Smokes Creek. Riparian buffer functions include mitigation of stormwater discharges, floodplain protection, groundwater-surface water interaction, wetland protection, instream habitat, and terrestrial habitat protection and connectivity. A three-zone buffer approach is recommended as shown in Figure 1.

Figure 1 – Three-Zone Stream Buffer
DEC Stormwater Design Manual, 2015

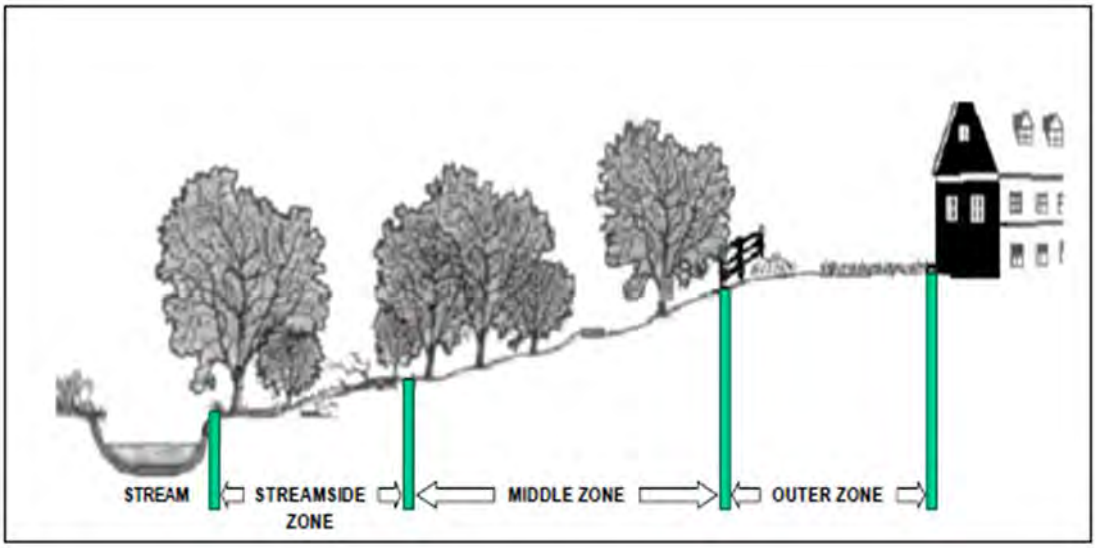

Table 1 summarizes buffer zone criteria. The Streamside Zone should be measured landward from the meander belt to accommodate lateral movement of the channel. The Middle Zone should extend landward from the Streamside Zone at least 50 feet and/or the extent of the 100-year floodplain. The Outer Zone should extend landward of the Middle Zone to within 25 feet of structures, impervious surfaces or intensive agricultural uses (e.g., row cropping, pasture with frequent grazing, etc.). Where constrained by existing development, roads and other features, buffer averaging along the same side of the stream corridor or increases to buffer width on the opposite bank should be explored so that the total acreage of buffer within the immediate area is maintained.

The vegetation target describes what types of vegetation should be established or enhanced and recommended uses provides guidance on recommended levels of activity within each zone. Where city-owned land, public drainage easements and other instruments are in place within the Streamside Zone and Middle Zone, land conservation measures are not required; however, where Smokes Creek flows across private land conservation tools should be considered.

Table 1 Riparian Buffer Zone Criteria

Criteria	Streamside Zone	Middle Zone	Outer Zone
Width	Minimum of 25 feet from meander belt and contiguous wetlands, bluffs and groundwater seepage areas and other critical habitat	Minimum of 50 feet from streamside zone, plus 100-year floodplain	25-foot setback from structures, impervious cover, or other intensive urban or agricultural land uses

Vegetation Target	Undisturbed mature forest or unmaintained prairie in rural/agricultural areas	Managed forest with retention of native herbaceous, shrub and tree canopy strata; or sustainably managed grassland in rural/agricultural areas	Native grassland, woodland or forest encouraged
Recommended Uses	Low impact uses that do not encroach on stream or forest habitat	Low impact residential and agricultural uses, recreational trails, stormwater practices that protect streamside zone	Low impact urban and agricultural uses are encouraged. Stormwater controls that mitigate impacts of residential development.
Land Conservation Tools	Protective easements/fee title	Protective easements/fee title; landowner education	Landowner education

Riparian Buffer Enhancement

Riparian buffers may be negatively impacted by current and historic land use, invasive species, dumping, all terrain motor vehicles, mountain bikes, agricultural practices, and grazing to name just a few. These impacts reduce the capacity of the buffer to protect Smokes Creek and provide broader ecological functions. Key elements of riparian buffer enhancement include:

- Control invasive species (especially glossy buckthorn, common buckthorn and multiflora rose)
- Remove yard waste, debris and fill material.
- Control/manage access of motorized vehicles/mountain bikes
- Stabilize erosion hot spots on streambanks and bluffs
- Reroute stormwater outfalls to level spreaders, infiltration ponds and other facilities that attenuate discharge, improve water quality and promote infiltration.
- Supplement existing plant communities with tree, shrub and herbaceous planting, consistent with species composition of locally occurring natural communities (See Attachment A).

Riparian Buffer Creation

Where the Streamside, Middle or Outer Zone is lacking or does not meet minimum width requirements, the riparian buffer can be expanded to protect Smokes Creek and adjacent sensitive resources more fully. Site hydrology, soils, and comparable areas (same elevation, landform) should be evaluated to determine historic natural community. Tree, shrub and herbaceous plantings consistent with locally occurring natural communities (See Attachment A) should be planted within applicable riparian zones.


GHD