Native Plant Community Data in the City of Duluth, Minnesota

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Executive Summary

The Minnesota Land Trust and the City of Duluth partnered to conduct a comprehensive assessment of native plant communities (NPCs) across approximately 10,000 acres of publicly owned, undeveloped land within the City of Duluth. GEI Consultants, Inc. (GEI) was tasked with mapping NPCs, updating existing NPC mapping, evaluating ecological condition, and documenting invasive species and rare plants to support citywide natural resource planning, management, and restoration efforts.

The primary objective of this project was to characterize the current condition and distribution of Duluth's NPCs to identify high-quality resources warranting protection, areas impacted by disturbance that are candidates for restoration, and landscape-scale trends influencing long-term ecological resilience.

GEI completed a citywide classification of NPCs on previously unmapped lands and an update of existing mapping using a phased approach that combined desktop analysis with targeted field verification. Desktop analysis incorporated color infrared imagery, LiDAR-derived elevation and terrain data, historic aerial photography, soils data, and previously completed NPC and natural resource inventories to delineate preliminary plant community boundaries and identify developed and disturbed lands. Public lands were organized into discrete survey areas, with survey priorities established in coordination with the City of Duluth and Minnesota Land Trust. Areas with recent or comprehensive inventories were evaluated using desktop methods alone, while high-priority sites including Hawk Ridge, Mission Forest, and Brewer Park received more intensive field verification.

Field surveys were completed during the 2025 growing season and focused on confirming NPC classifications and boundaries, evaluating ecological condition, and documenting invasive species and rare plant occurrences. Meander surveys were conducted using best professional judgment to account for natural variability and transitional communities. Condition rankings were assigned following the DNR's Natural Heritage Element Occurrence Ranking Guidelines, which consider species composition, vegetation structure, ecological processes, and disturbance history.

Across the city, Duluth's public lands support a diverse mosaic of plant communities, including mesic hardwood forests, fire-dependent forests and woodlands, floodplain and wet forest systems, open wetlands, cliff and talus communities, and bedrock outcrops. Most NPCs were ranked as having fair to good ecological integrity (Condition C - B), indicating they retain core ecological characteristics but would benefit from targeted management actions. Importantly, numerous high-quality plant communities (Condition A - B) were documented throughout the city, including intact mesic hardwood forests, rare wet forest systems, and sensitive rock outcrop and cliff communities that remain ecologically significant at both local and regional scales.

Invasive species were identified as the most widespread stressor affecting NPCs citywide. Common buckthorn (*Rhamnus cathartica)* was the most pervasive invasive species and was documented across upland forests, rock outcrops, wetlands, and disturbed areas. Glossy buckthorn was more common within forested wetlands and shrub swamps, while invasive honeysuckle species, ornamental escapes, and emerging threats (e.g., cotoneaster and Japanese barberry) were observed in more localized distributions. Invasive species pressure was generally highest near roads, trails, residential edges, and areas with evidence of historic land clearing or fragmentation.

In addition to invasive plants, several broad-scale ecological drivers were found to be shaping plant community condition across Duluth. Emerald ash borer has been causing widespread mortality of black ash in wet forest and floodplain communities, initiating transitions toward shrub-dominated wetlands or open wet meadows. Heavy white-tailed deer browse has been consistently observed and is limiting tree regeneration across many forested systems, particularly in high-quality mesic and wet-mesic hardwood forests. Legacy disturbances including historic agriculture, logging, homesteading, trail development, and the 1918 Cloquet Fire continue to influence vegetation structure and species composition in many areas.

Despite these stressors, numerous rare and sensitive ecological features were documented across the city. Several state-listed plant species were identified, along with new and expanded populations of regionally significant species. Multiple imperiled (S2) and critically imperiled (S1) NPC types were documented, underscoring Duluth's importance as a conservation stronghold within northeastern Minnesota. In addition, north-facing slopes, ravines, riparian corridors, and groundwater-influenced wetlands were identified as potential climate refugia that may support long-term resilience under changing climate conditions.

Based on these findings, GEI developed management recommendations focused on protecting high-quality plant communities, slowing the spread of invasive species, and maintaining ecological function across the landscape. Priority actions include preserving Condition A - B communities; limiting new fragmentation and trail impacts; implementing targeted invasive species control beginning with seed-producing individuals; restoring forest structure through underplanting of desired native tree species, particularly in areas affected by emerald ash borer; and maintaining habitat corridors that connect large forest blocks and smaller natural areas across the city.

Longer-term opportunities include expanded mapping and monitoring of vernal pools, rare species, invasive species priorities, and climate refugia to support adaptive management. By using this citywide dataset as a baseline, the City of Duluth and its partners can track ecological change, prioritize restoration investments, and proactively manage one of the most extensive and ecologically diverse urban forest systems in Minnesota.

Introduction

This report presents the methods and results of a project focused on classifying native plant communities (NPCs) across approximately 10,000 acres within the City of Duluth (Figure 1). The primary objectives were to systematically classify NPCs, document occurrences of rare and invasive species, and integrate this information into the city's natural resources management plan. The NPC classification supports the identification of areas with high ecological integrity that warrant protection, highlight regions impacted by invasive species or other anthropogenic activities that are candidates for restoration, and establish restoration targets for affected areas.

The city's undeveloped land was divided into survey areas, with priorities set in collaboration with the City of Duluth and the Minnesota Land Trust. Areas such as Hartley Natural Area, St. Louis River Natural Area, and Park Point were not surveyed due to recent or prior comprehensive assessments. Their NPC descriptions and ecological conditions are not included in this report, but they are summarized in other reports and memos (Delaney 2014; Reschke et al. 2019; SEH 2018; SEH 2021; Santec 2024*)* and included in the ArcGIS Online web map (web map). In contrast, Hawk Ridge, Mission Forest, and Brewer were resurveyed as high-priority sites for further evaluation.

GEI conducted a desktop review to classify and delineate NPC polygons and identify disturbed or developed non-NPC polygons. This step utilized a range of resources, including color-infrared (CIR) imagery, LiDAR, historic photographs, soil maps, and previous field surveys, to accurately classify NPCs and determine the historic NPC of disturbed polygons.

Following the desktop analysis, high priority areas received extensive field surveys, while lower-priority areas were evaluated based on desktop results alone. GEI conducted meander surveys to confirm NPC classifications and boundaries, assess ecological conditions, and document rare plant occurrences and invasive species populations. Field data were then processed, and NPC boundaries and classifications were refined, as necessary.

This report describes the methods employed and presents findings by survey area, including NPCs, rare plant occurrences, and invasive species documented across the City of Duluth. Results are organized to summarize ecological conditions by location and to support the identification of management needs based on NPC type, ecological condition, and other relevant considerations. Management recommendations are provided in a subsequent section of the report.

Native Plant Community Survey Methods

GEI compiled available data to create a comprehensive basemap, then interpreted this information to delineate and classify NPCs. The workflow included two primary steps: 1) Data preprocessing and 2) NPC classification. Following classification, GEI conducted field verification surveys and assessed ecological condition for a subset of NPC polygons.

Data Preprocessing

A foundational basemap was created using the following data sources:

- **St. Louis County – Parcel Data:** The St. Louis County parcel database was downloaded and spatial analysis tools were implemented to define the project's survey area based on public lands within the City of Duluth.
- **Duluth 1-Meter Land Cover Classification:** A multitemporal composite of aerial imagery from the summer of 2015, fall of 2009-2011, and lidar data from 2011 and 2012 were classified to produce a land cover raster. This layer is helpful for identifying developed and disturbed areas.
- **United States Geological Survey National Land Cover Database (2001-2021):** A multitemporal database of land cover rasters for the contiguous United States. This dataset is useful for classifying developed and disturbed areas and for broadly classifying plant communities. However, the 30x30 meter raster resolution does not support fine scale evaluation.
- **U.S. Department of Agriculture (USDA) Farm Service Agency (FSA) – National Agriculture Imagery Program (NAIP) Color Infrared Orthophotography:** Useful for discerning features such as vegetation that gives off a distinct signature in the infrared spectrum (e.g., intense bright red = vigorously growing dense vegetation). The 2023 NAIP imagery was used for evaluation.
- **MnGEO WMS service (aerial photography):** The MnGEO WMS service was used to analyze the USDA FSA Color and color-infrared (CIR) imagery from the NAIP for 1991 to 2021. The 2019 and 2017 CIR imagery served as the primary sources for classifying native plant communities, as these years provided the best differentiation among dominant tree groups and species. In the imagery, dark red typically indicated conifers, orange or yellow represented maple or oak, pinkish hues corresponded to aspen, and bright white signified paper birch or bigtooth aspen.
- **Previously Delineated Native Plant Community Mapping**: Previous NPC mapping completed by the Minnesota Biological survey, the Natural Resources Research Institute, and Short Elliot Hendrickson (SEH) was incorporated into the project evaluation area. As needed, the boundaries and native plant community classifications were updated.
- **Historic Aerial Imagery:** St. Louis County Historic Aerial Imagery (1939-2023) and the Statewide NAIP Aerial Imagery (1991-2023) were used to evaluate land cover change and to infer NPCs that likely existed in areas that have since been disturbed or developed.

- **National Wetland Inventory:** Location and attribute information of the USFWS National Wetland Inventory. The wetland boundaries within this database were delineated predominantly using desktop methods and are therefore approximate. This database is useful for comparison against hydric-affiliated native plant communities.
- **National Hydrography Database:** Waterbody and waterway locations provided by the United States Geological Survey. Associated attribute information provides estimates for flow regime. This database is helpful for desktop delineation of thin linear waterway associated communities.
- **U.S. Department of Agriculture Natural Resources Conservation Service – Soil Survey Geographic Database (SSURO):** SSURGO Soils data were incorporated into the GIS basemap and symbolized to show hydric soil classification polygons and drainage classification polygons. The SSURGO information is beneficial to understand underlying soil characteristics influencing plant community locations.
- **St. Louis County - Public Lands:** St. Louis County-hosted server layer displaying location and type of publicly owned land within the county boundary. This layer was used to evaluate the results of spatial analysis completed using the county parcel layer to exclude private lands and small, noncontiguous segments of public land when defining the project survey area.
- **Digital Elevation Model Hillshade:** St. Louis County 1-meter resolution digital elevation hillshade was used for visualizing topography, slope and aspect, and assessing plant community positions within the landscape.

Desktop NPC Classification

The initial phase of this effort focused on identifying publicly owned land within the city and determining areas where NPCs had been previously mapped. Public land was identified primarily using St. Louis County Parcel data and verified with the Public Land server layer hosted by St. Louis County. GEI coordinated with the Minnesota Land Trust and the City of Duluth to finalize the project investigation area and to exclude small, noncontiguous public land parcels. The City provided existing NPC mapping for city natural areas and parks, and the DNR also provided additional mapping. Remaining unmapped public lands were then classified as developed, disturbed, or NPC.

Developed

Developed land is altered by construction and maintained for human use, including pavement, buildings, gravel, dog parks, golf courses, and sports fields. Developed land was identified using the Duluth 1-Meter Land Cover Classification data. Developed land not captured through this dataset was manually classified using aerial imagery.

Disturbed

Disturbed land is impacted by human activity and exists in a semi-natural or non-native state. Disturbed land was identified in CIR and historic imagery. Disturbed areas were further categorized by disturbance type:

- Conifer plantation – conifer trees planted in rows. Often red pine or jack pine.

- Non-native wetland – open or forested wetland dominated by non-native species.
- Non-native upland – open or forested upland dominated by non-native species.
- Old field – formerly cultivated land dominated by non-native species.
- Maintained Right-of-Way (ROW) - vegetation cleared for utility corridors and road shoulders with high cover of non-natives.
- Maintained/Manicured – other mowed, mostly non-native vegetation.

Native Plant Community

NPCs are groups of native plants that interact with each other and their environment in ways not significantly altered by modern human activity or introduced organisms. Initial NPC classifications were based primarily on multiple years of CIR imagery, LiDAR derived data, and existing NPC mapping. Historic aerial imagery was also reviewed to identify past land use practices that may have influenced NPCs or resulted in disturbed or non-native areas. Existing plant community classification datasets, including the NRCS Ecological Plant Community Classification, the National Wetland Inventory, and previous natural area mapping, were cross-referenced with newly generated classifications to support verification and identify any discrepancies. For a description of attributes assessed for the NPC polygons see Appendix A.

NPC determinations followed Minnesota's Native Plant Community Classification (Version 2.0), a hierarchical system with six levels ranging from system groups to native plant community subtypes (MN DNR, n.d.). Each level is defined by distinct characteristics (Table 1).

Table 1. Native Plant Community (NPC) Classification Hierarchy. Adapted from Minnesota Department of Natural Resources (MN DNR), Native Plant Community Classification

Classification Level	Dominant Factors	Example
System Group	Vegetation structure and hydrology	Upland Forest and Woodland Systems
Ecological System	Ecological processes	Mesic Hardwood (MH)
Floristic Region	Climate and paleohistory	North (MHn)
NPC Class	Local environmental conditions	Northern Rich Mesic Hardwood Forest (MHn47)
NPC Type	Canopy dominants, substrate, or finer environmental conditions	Sugar Maple – Basswood – (Bluebead Lily) Forest (MHn47a)
NPC Subtype	Finer distinctions in canopy dominants, substrate, or environmental conditions	No subtypes exist for this example

Plant communities were generally classified to class level during the desktop review. When field verification was conducted, efforts were made to identify communities to the type or subtype level. For field-verified polygons that remained at the class level, this was typically due to the presence of a mix of types that were difficult to separate, or the absence of field indicators needed for more specific classification.

NPC Classification Field Verification

GEI carried out field verification during the 2025 growing season, with the goal of verifying at least 20 percent of mapped polygons citywide. The level of field verification varied by survey priority, with polygons in the highest priority areas field verified and polygons in the lowest priority areas not field verified.

Meander surveys were used to confirm NPC classifications and boundaries. Best professional judgment was used to discern normal variation in vegetation composition and structure, identify transitional areas between communities, and account for inclusions of NPCs too small to map during delineation. For each NPC type within high priority survey areas, a Survey123 form was completed documenting species composition, invasive species cover, buckthorn abundance and priority for control, assessment of forest structure and regeneration, and overall ecological condition. Ecological condition assessments were based on the DNR's Natural Heritage Element Occurrence Ranking Guidelines. Condition ranks are assigned by considering species composition, vegetation structure, ecological processes and functions, level of human disturbance, presence of non-native species, and other factors. Condition ranks are assigned on a scale of A to D with an NA ranking for non-NPCs (Table 2).

Table 2. Department of Natural Resource's Natural Heritage Element Occurrence Ranking Guidelines

Condition Rank	Condition Rank Description
A	occurrences have excellent ecological integrity. They have species composition, structure, and ecological processes typical of the natural or historic range of the community and have been little disturbed by recent human activity or invasive species.
B	occurrences have good ecological integrity. They include lightly disturbed plant communities and communities that were disturbed in the past but have recovered and now have relatively natural composition and structure. B-rank occurrences normally will return to A-rank condition with protection or appropriate management.
C	occurrences have fair ecological integrity. They show strong evidence of human disturbance but retain some characteristic species and have some potential for recovery with protection and management.
D	occurrences have poor ecological integrity. The original composition and structure of the community have been severely altered by human disturbances or invasion by exotic species. They have little chance of recovery to their natural or historic condition.
NA	Non-NPC cover types that are not assigned a condition rank.

During meander surveys, invasive species occurrences were recorded as polygons for larger populations and as points for smaller, isolated occurrences. Although this effort was not a comprehensive invasive species survey and not all occurrences were mapped, the data collected provided a representative understanding of invasive species distribution and cover within the survey areas.

Rare plant occurrences were also documented during fieldwork. While these efforts were not exhaustive, surveys focused on habitats known to be suitable for rare species when possible, contributing valuable information on their presence and distribution within the survey areas.

While not all polygons underwent comprehensive surveys, notes, observations, and photos on NPC type, condition, and invasive species cover were documented throughout the survey areas to support NPC classification and condition assessments.

Data Processing

Following field verification, all Survey123 points and other recorded field observations were systematically reviewed. Based on this data, updates were made to NPC classifications and boundaries where warranted. In some cases, small NPC inclusions within larger mapped NPCs were identified and incorporated. Condition rankings were added or updated as appropriate to reflect the most current field assessments. Field data were then integrated into the NPC polygon attribute table, including detailed information such as invasive species cover, buckthorn abundance, and priority for control.

Results

ArcGIS Online Webmap

All data collected during the desktop review and field verification are available in a web map hosted on ArcGIS Online. The map includes a Native Plant Community polygon layer, which houses most project data, along with layers for invasive species (points and polygons) and georeferenced field photos. Additional reference layers, including a map of the 1918 fire, are also provided. See Appendix A for a description of attributes assessed for the NPC polygons. The web map and associated geodatabase were provided to MLT and the City of Duluth.

Priority Levels and Survey Effort

GEI collaborated with the City of Duluth and the Minnesota Land Trust to establish survey areas and priority levels. Highest priority areas, including those that had already been mapped, were field verified to update condition rankings and confirm NPC determinations. Lowest priority areas were reviewed through desktop analysis only, unless time allowed for additional field surveys. Several areas that were recently surveyed and were not considered high priority were not included in field surveys for this project (Table 3).

Table 3. Priority Levels, Previous NPC Mapping, and 2025 Survey Efforts by Survey Area

Survey Area Name	Priority	Previous NPC Data	2025 Survey Effort
Airport	Medium	None	Partial
Bagley	Medium	None	Thorough
Brewer	Medium	Mapped in 2021	Thorough
Chester Park	Medium	None	Thorough
Congdon	Medium	None	Thorough
Dog park	Low	None	Partial
Enger	Low	None	Partial
Forest Hill Cemetery	Medium	Partially mapped 2024	Thorough
Hartley	None	Mapped in 2019	None
Hawk Ridge	High	Mapped in 2014	Confirmed/Updated
Janette Pollay	Medium	None	Thorough
Kohls	Low	None	Partial
Lester	High	None	Thorough
LSC	Low	None	Desktop only
Magney Snively	None	Mapped in 2024	None
Mission	High	Mapped in 1999-2010	Thorough
Moose Mountain	Low	Partially mapped in 2004	Partial
Park Point	None	Mapped in 2000-2003	None
SLC Public Safety	Low	None	Desktop only
SLRNA	None	Mapped in 2018	None
St. Scholastica	Medium	None	Thorough
Tischer Headwaters	Low	None	Partial

Within each survey area, developed features such as roads and parking lots were present, along with disturbed lands including non-native uplands, non-native wetlands, old fields, and conifer plantations. Undeveloped lands throughout the City of Duluth were systematically classified into NPCs with community subtypes identified wherever possible.

Native Plant Communities Across Duluth

Table 4 summarizes all NPCs identified across the survey areas and the total acreage of each community within Duluth. The landscape is dominated by forested NPCs, particularly Northern Mesic Hardwood Forest (MHn35), which is the most extensive community, accounting for over 3,000 acres. Other widespread forest types include Aspen–Birch Forest (FDn43b), Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a), Black Ash–Basswood Forest (MHn46b), and various wet-mesic hardwood–conifer forests. Wetland and swamp communities are also well represented, including Black Ash–Aspen–Balsam Poplar Swamp (WFn55a), Black Ash - Alder Swamp (Northern) (WFn64c), Northern Wet Meadow/Carr Willow-Dogwood Shrub Swamp (WMn82a), and multiple alder and sedge-dominated systems. In contrast, rare or spatially limited communities such as cliffs, talus, bogs, fens, marshes, bedrock

outcrops, and river shore systems occur in relatively small acreages. Areas classified as Disturbed and Developed, where NPC classification does not apply, together represented a substantial portion of the mapped area, indicating a significant degree of landscape modification within the city.

Table 4. Summary of Native Plant Communities Identified Across All Survey Areas in Duluth, Showing NPC Codes, Community Names, and Total Acreage

Native Plant Community Code	Native Plant Community Name	Total Acres
APn80a	Black Spruce Bog	17.15
CTn11	Northern Dry Cliff	0.03
CTn11e	Dry Sandstone Cliff	1.09
CTn24	Northern Scrub Talus	19.30
Developed	Not applicable	447.86
Disturbed	Not applicable	1146.91
FDn32	Northern Poor Dry-Mesic Mixed Woodland	1.03
FDn33a1	Red- Pine – White Pine Balsam Fir Subtype	5.48
FDn33b	Aspen - Birch Woodland	120.78
FDn43a	White Pine - Red Pine Forest	56.11
FDn43b	Aspen - Birch Forest	764.15
FDn43b1	Balsam Fir Subtype	42.84
FDn43b2	Hardwood Subtype	414.33
FDn43c	Upland White Cedar Forest	24.83
FFn57a	Black Ash - Silver Maple Terrace Forest	124.73
FPn73a	Alder - (Maple - Loosestrife) Swamp	130.60
FPn82a	Northern Rich Tamarack Swamp (Western Basin)	1.04
MHn35	Northern Mesic Hardwood Forest	60.30
MHn35b	Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	3055.18
MHn44	Northern Wet-Mesic Boreal Hardwood-Conifer Forest	101.10
MHn44a	Aspen - Birch - Red Maple Forest	188.44
MHn44b	White Pine - White Spruce - Paper Birch Forest	212.52
MHn44c	Aspen - Fir Forest	196.27

Native Plant Community Code	Native Plant Community Name	Total Acres
MHn45b	White Cedar - Yellow Birch Forest	13.60
MHn46	Northern Wet-Mesic Hardwood Forest	10.12
MHn46b	Black Ash - Basswood Forest	619.83
MHn47a	Sugar Maple - Basswood - (Bluebead Lily) Forest	756.06
MRn83a	Cattail - Sedge Marsh (Northern)	7.74
MRn93b	Spikerush - Bur Reed Marsh (Northern)	0.07
OPn92b	Graminoid Sphagnum Rich Fen (Basin)	2.43
OW	Open Water	3.94
ROn12b	Crystalline Bedrock Outcrop (Northern)	4.63
ROn23a	Bedrock Shrubland (Inland)	99.83
ROn23b	Bedrock Shrubland (Lake Superior)	130.28
RV	River Shore System	3.19
RVx32	Sand/Gravel/Cobble River Shore	28.50
RVx43a2	Permanent Stream Subtype	36.48
RVx54a	Slumping Clay/Mud Slope (River)	71.59
WFn53a	Lowland White Cedar Forest (North Shore)	12.84
WFn55a	Black Ash - Aspen - Balsam Poplar Swamp (Northeastern)	458.65
WFn64	Northern Very Wet Ash Swamp	16.29
WFn64a	Black Ash - Conifer Swamp (Northeastern)	14.53
WFn64c	Black Ash - Alder Swamp (Northern)	262.06
WFn74a	Alder - (Red Currant - Meadow-Rue) Swamp	84.30
WMn82a	Northern Wet Meadow/Carr Willow-Dogwood Shrub Swamp	170.60
WMn82b	Sedge Meadow	31.48
WMn82b1	Sedge Meadow Bluejoint Subtype	14.91
Total Acreage		**9,971.11**

Overall Ecological Condition

The ecological condition of NPCs varied both within and among survey areas. Most communities were ranked as condition B or C, indicating that while they retain core ecological characteristics, they would benefit from targeted management actions (see Recommendations). Historical land clearing and forest fragmentation have allowed invasive species to colonize and spread in these NPCs.

Despite these impacts, Duluth's public lands contain many intact NPCs ranked A or B. These higher-quality sites were characterized by representative species assemblages and largely intact ecological function, with limited evidence of significant past or ongoing disturbance. Community types that more frequently exhibited higher condition rankings included Northern Mesic Hardwood Forest (e.g., MHn35), rich hardwood systems, and certain wet forest types such as Black Ash – Aspen – Balsam Poplar Swamp (WFn55a), although conditions varied across the landscape.

Primary Stressors and Drivers of Change

Invasive Species

Invasive species were documented across the city and represent the most widespread and significant threat to ecological health. Common buckthorn is the most pervasive invasive species, while emerging species such as Japanese barberry (*Berberis thunbergii*) and cotoneaster (*Cotoneaster lucida*) present additional risks. Invasive pests, particularly emerald ash borer *(Agrilus planipennis*), are also driving substantial ecological change. A complete list of invasive species documented, along with their State of Minnesota Noxious Weeds Designation, can be found in Table 5.

Prohibited – eradicate Noxious Weed

Includes noxious weeds that must be eradicated on all lands in the state. Transportation of propagating parts of prohibited-eradicate noxious weeds is prohibited, except as allowed under Minnesota Statutes section 18.82. Prohibited-eradicate noxious weeds may not be sold or propagated in Minnesota. Noxious weeds designated as prohibited-eradicate and placed on the prohibited-eradicate noxious weeds list are plants that are not currently known to be present in Minnesota, or that are not widely established in the state.

Prohibited – control Noxious Weed

Includes noxious weeds that must be controlled on all lands in the state. Transportation of propagating parts is prohibited, except as allowed under Minnesota Statutes section 18.82. Prohibited-control noxious weeds may not be propagated or sold in Minnesota. Noxious weeds that are designated as prohibited-control and placed on the prohibited-control noxious weeds list are plants that are already established in Minnesota. At a minimum, these species must be controlled in a way that prevents their spread by seed or vegetative means.

Restricted Noxious Weed

Includes noxious weeds and their propagating parts that may not be imported, sold, or transported in Minnesota, except by permit under Minnesota Statutes section 18.82. Noxious weeds that are

designated as restricted may be plants that are widely distributed in Minnesota and eradication or control would not be possible on a statewide basis using existing practices.

Specially Regulated Noxious Weed

Includes noxious weeds that may be native species or non-native species that have demonstrated economic value but could cause harm in non-controlled environments. Plants designated as specially regulated have ecological, economic, or human or animal health concerns. Specially regulated plants have species-specific management plans or rules that define the use and management requirements for these plants. The plans must minimize the potential harm caused by these plants.

Table 5. Non-native Species Documented Across Duluth and Their State of Minnesota Noxious Weeds Designation

Scientific name	Common name	State of Minnesota Noxious Weeds Designation
Acer ginnala	Amur maple	Specially Regulated
Aegopodium podagraria	Goutweed	Not Regulated
Alliaria petiolata	Garlic mustard	Restricted
Arctium minus	Common burdock	Not Regulated
Berberis thunbergii	Japanese barberry	Restricted
Caragana arborescens	Siberian peashrub	Restricted
Cirsium arvense	Canada thistle	Prohibited – Control
Cirsium vulgare	Bull thistle	Not Regulated
Convallaria majalis	European lily-of-the-valley	Not Regulated
Cotoneaster lucida	Cotoneaster	Not Regulated
Epipactis helleborine	Broad-leaved helleborine	Not Regulated
Euphorbia esula	Leafy spurge	Prohibited – control
Filipendula ulmaria	Queen of the meadow	Not Regulated
Frangula alnus	Glossy buckthorn	Restricted
Galeopsis tetrahit	Brittlestem hemp-nettle	Not Regulated
Hieracium aurantiacum	Orange hawkweed	Not Regulated
Hieracium caespitosum	Meadow hawkweed	Not Regulated
Lamium galeobdolon	Yellow archangel	Not Regulated
Leucantheumum vulgare	Oxeye daisy	Not Regulated

Scientific name	Common name	State of Minnesota Noxious Weeds Designation
Lonicera morowii	Morrow's honeysuckle	Restricted
Lonicera tatarica	Tartarian honeysuckle	Restricted
Lonicera x bella	Showy honeysuckle	Restricted
Lotus corniculatus	Bird's foot trefoil	Not Regulated
Lythrum salicaria	Purple loosestrife	Prohibited – Control
Melilotus officinalis	Yellow sweet clover	Not Regulated
Phedimus kamtschaticus	Orange stonecrop	Not Regulated
Pinus sylvestris	Scots pine	Not Regulated
Poa pratensis	Kentucky bluegrass	Not Regulated
Phalaris arundinacea	Reed canary grass	Not Regulated
Ranunculus acris	Tall buttercup	Not Regulated
Reynoutria japonica	Japanese knotweed	Prohibited – Control
Rhamnus cathartica	Common buckthorn	Restricted
Robinia hispida or pseudoacacia	Bristly or black locust	Restricted
Salix X fragilis	Crack willow	Not Regulated
Sorbaria sorbifolia	False spiraea	Not Regulated
Sorbus aucuparia	Rowan mountain-ash	Specially Regulated
Syringa vulgaris	Lilac	Not Regulated
Tanacetum vulgare	Tansy	Prohibited – Control
Taraxicum officinale	Dandelion	Not Regulated
Valeriana officinalis	Common valerian	Not Regulated
Viburnum opulus var opulus	Guelder-rose	Not Regulated

Browse

White-tailed deer (*Odocoileus virginianus*) were consistently observed and are a major ecological driver across many plant communities. Heavy browsing pressure limits regeneration of tree, shrub, and herbaceous species altering forest structure and slowing or preventing natural succession.

Ash Decline and Forest Transition

Wet forests, some mesic forests, stream corridors, and vernal pool systems frequently contain black ash (*Fraxinus nigra*) as a dominant or co-dominant canopy species. Due to emerald ash borer, these systems are currently experiencing widespread ash mortality.

As ash declines, these communities are expected to undergo significant structural and compositional changes, including increased light availability, shifts in species composition, and potential conversion to different NPC types. These transitional systems are particularly vulnerable to invasive species establishment and declines in native biodiversity. While long-term outcomes remain uncertain, management recommendations include promoting species adapted to similar hydrologic and site conditions to help maintain ecosystem function.

Legacy Impacts and Landscape Context

Historical disturbances have had lasting effects on present-day plant communities. Review of 1939 aerial imagery indicates that many NPCs difficult-to-classify in the field were previously cleared for homesteads, agricultural land, or subject to repeat clearcutting. Now these areas often contain mature invasive species and lack clear indicators of original community composition.

The Cloquet Fire of 1918 burned across large portions of Duluth. Long-term ecological effects of the fire remain poorly documented. Preliminary comparisons between field observations and the fire perimeter suggest some overlap between burned areas and altered plant community composition, though further study is needed to better understand these relationships.

Trail density across Duluth contributes to forest fragmentation, though impacts vary depending on trail characteristics. Narrow trails that remain within the forest canopy generally have minimal ecological impact. In contrast, wider trails or those involving significant earthwork (e.g., benching) can create canopy openings, facilitate the spread of invasive species, and increase access for large herbivores, like white-tailed deer. These factors can amplify ecological disturbance in otherwise intact areas.

Rare Features and High-Value Communities

Numerous notable ecological features were documented across survey areas, including populations of regionally rare or uncommon plant species such as soapberry (*Shepherdia canadensis*), pale sedge (C*arex pallescens*), eastern rough sedge (*Carex scabrata*), floating marsh marigold (*Caltha natans*), eastern hemlock (*Tsuga canadensis*), barren strawberry (W*aldsteinia fragarioides*), and a potential occurrence of false mountain willow (*Salix pseudomonticola*) (Table 6).

Table 6. Rare or Uncommon Plant Species Found Across All Survey Areas

Latin Name	Common Name	Status	Survey Area(s)
Caltha natans	Floating marsh marigold	State Endangered	Airport
Carex pallescens	Pale sedge	State Endangered	Lester, Mission, Spirit
Carex scabrata	Eastern rough sedge	No status rank	Enger
Salix pseudomonticola	False mountain willow	Special Concern	Brewer
Shepherdia canadensis	Soapberry	State Special Concern	Lester, Hawk Ridge
Tsuga canadensis	Eastern hemlock	State Endangered	Lester, Congdon
Waldsteinia fragarioides	Barren Strawberry	State Special Concern	Lester, Mission

Minnesota NPC types and subtypes have been assigned conservation status ranks (S-ranks) to indicate their level of risk of being lost from the state. These ranks range from S1 to S5 and represent increasing levels of security. Communities ranked S1 are considered critically imperiled, while S2 communities are imperiled. An S3 ranking indicates vulnerability to extirpation. Communities with an S4 rank are generally stable and uncommon but not rare. Those designated S5 are secure, abundant, and widespread across Minnesota (MNDNR, n.d.).

Four imperiled (S2) NPCs were identified within the city, including:

- White Pine – Red Pine Forest (FDn43a)
- White Pine – White Spruce – Paper Birch Forest (MHn44b)
- White Cedar – Yellow Birch Forest (MHn45b)
- Slumping Clay/Mud Slope (River) (RVx54a)

Two critically imperiled (S1) NPCs were documented within the city, including:

- Dry Sandstone Cliff (CTn11e)
- Wet Sandstone Cliff (CTn42d)

These communities represent important conservation priorities due to their rarity within Minnesota and ecological sensitivity.

Climate Refugia and Landscape Significance

Duluth's proximity to Lake Superior, combined with its complex topography, creates a range of microclimatic conditions that may serve as refugia for climate-sensitive species. Features such as north-facing slopes, steep ravines with cold-water streams, and areas influenced by Lake Superior's moderating effects provide localized environments that may support boreal species as regional climate conditions change.

Native Plant Communities within Survey Areas

The following section provides descriptions of the NPCs identified within each survey area. Survey areas were assessed using a combination of desktop analysis and field verification, with the intensity of fieldwork determined by the priority assigned to each area. These descriptions highlight the unique features of each NPC, including forest structure, age classes, and successional phases. Characteristic species found within specific NPCs are noted, drawing on data compiled from Survey123 outputs. Factors influencing the general condition of each community, such as historical events like the 1918 fire, development pressures, proximity to housing, fragmentation, and deer browse, are also discussed. A summary of invasive species and rare species is provided for each survey area.

Airport

Table 7. Native Plant Communities, Condition Ranks, and Acres at Airport Survey Area

Airport Native Plant Communities	Condition Rank	Acres
APn80a	Not assessed	17.15
Developed	NA	121.60
Disturbed	NA	237.31
FDn43b	B, C	206.36
FPn73a	B	99.90
FPn82a	Not assessed	1.04
MHn35b	B	234.95
MHn46b	B, C	53.25
OPn92b	B	2.43
OW	Not assessed	2.20
WFn55a	B, C	56.66
WFn64c	A, B	149.66
WFn74a	B	15.93
WMn82a	B	140.66
WMn82b	B	4.70

APn80a Black Spruce Bog

A Black Spruce Bog was identified during the desktop review; however, this area was not field verified as access was limited due to restrictions around airport property. Historical imagery from 1939 shows the

area as non-forested, suggesting it was previously clearcut. By 1991, the next available year of imagery, the area had returned to a forested condition and remained forested in all subsequent imagery, indicating that no clearcutting has occurred since at least 1991. In the most recent imagery, the trees appear tall, particularly along the edge of the bog, which may indicate higher nutrient availability and suggests the area could be classified as Poor Conifer Swamp (APn81). Confirmation of the NPC type would require data on the species composition of the area.

Developed

Much of the developed land associated with the airport was excluded from the survey area. Developed areas that were included in the survey primarily consist of roads and small sections adjacent to the airport, which were incorporated because they connect natural, undeveloped areas.

Disturbed

Disturbed land primarily occurred along the borders of developed areas both within and outside the survey area, likely because of adjacent development and airport activities. Additional disturbed land was identified near the waste management facility, where disturbance appeared to result from direct impacts associated with facility operations or from former waste disposal activities, as evidenced by the presence of garbage and other indicators of past disturbance.

FDn43b Aspen – Birch Forest

Aspen – Birch Forest appeared in areas that had been logged or cleared. In recently logged areas, the forests' evidence of more mesic soils was observed in the herbaceous species on the forest floor, including leatherwood (*Dirca palustris*). Other Aspen – Birch Forests (FDn43b) occasionally contained vernal pools, which were more typical in rich mesic hardwood forests. When looking back at early 1939 aerial imagery, those upland forests had been cleared.

FPn73a Alder Swamp

There were both expansive Alder Swamps and smaller inclusions of Alder Swamp within the fire-dependent forests. Larger Alder Swamps occurred adjacent to the Black Spruce Bog (APn80a) and within a matrix of open wetland NPCs, including shrub and graminoid dominated communities. Alder Swamp was distinguished from other shrubby NPC types by the dominance of alder, high sphagnum moss cover, and indicator forb species such as crested wood fern (*Dryopteris cristata*), cinnamon fern (*Osmunda cinnamomea*), and marsh cinquefoil (*Potentilla palustris*).

FPn82a Rich Tamarack - (Alder) Swamp

A small Rich Tamarack–(Alder) Swamp was identified within an Alder Swamp (FPn73a) during the desktop review but was not field verified due to limited access. Color-infrared imagery revealed a signature consistent with tamarack trees growing in a cluster within the swamp. Historic imagery also indicates additional potential Rich Tamarack–(Alder) Swamp areas within present-day Alder Swamp (FPn73a) that were either cleared or have since died.

MHn35b Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest

Northern Mesic Hardwood Forest was intermixed with Fire Dependent Aspen – Birch Forest (FDn43b) and was primarily identified by the presence of hardwood species such as sugar maple (*Acer saccharum*) and red maple (*Acer rubrum*). Indicator forb species, including Canada mayflower (*Maianthemum canadense*) and Pennsylvania sedge (*Carex pensylvanica*), were also used to support classification. The absence of rich indicator species distinguished this community from Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a).

Patches of forest surrounding the mature sugar maple – basswood forest had been logged and regenerated as young Aspen - Birch Forest (FDn43b). The 1918 fire appeared to have burned the entire area, including this sugar maple – basswood forest. Early 1939 aerial imagery showed young forests across much of the area, excluding the cleared forests.

MHn46b Black Ash – Basswood Forest

A band of Northern Wet-Mesic Hardwood Forest separated the Black Ash - Alder Swamp (Northern) (WFn64c) from the Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn35b) in the southern part of the survey area. This forest was dominated by quaking aspen (*Populus tremuloides*) and black ash, with the ash canopy declining due to emerald ash borer. This community type was identified by a species composition characteristic of both drier and wetter forests.

OPn92b Graminoid – Sphagnum Rich Fen (Basin)

Between Alder Swamp (FPn73a) and Black Ash - Alder Swamp (Northern) (WFn64c) was a rich fen with nearly 100% ground cover of various sphagnum moss species. Many species characteristic of rich fens were present, including tufted loosestrife (*Lysimachia thyrsiflora*), three-way sedge (*Dulichium arundinaceum*), and marsh St. John's wort (*Triadenum fraseri*). Low growing shrubs including labrador tea (*Rhododendron groenlandicum*), willow species (Salix spp.) and speckled alder (*Alnus incana*) were also present.

OW Open Water

Some human-made ponds were observed near the center of the forested region and likely draw water from Miller Creek tributaries.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

A few Black Ash–Aspen–Balsam Poplar Swamps were identified bordering uplands and Black Ash - Alder Swamp (Northern) (WFn64c), but not adjacent to Miller Creek or its tributaries. These communities were similar to Black Ash - Alder Swamp (Northern) (WFn64c) but were primarily distinguished by the absence of pooled water and generally drier conditions, resulting in a slightly different species composition.

WFn64c Black Ash – Alder Swamp (Northern)

Extensive Black Ash –Alder Swamps surrounded the main channel and smaller tributaries. Miller Creek appears to have been ditched in the upper reaches. Black ash were the predominant canopy species and were all showing signs of decline from the emerald ash borer. Where black ash has completely died,

open meadow and emergent marsh habitats were observed with Canada bluejoint (*Calamagrostis canadensis*) dominating the wet meadows and cattail species (*Typha sp.*) dominating the emergent marsh communities. Unique species in these very wet ash swamps include winterberry *(Ilex verticellata*), native buckthorn (*Rhamnus alnifolia*), and bristle-stalked sedge (*Carex leptalea*).

Another unique species found within the creek bed and the deep wet pockets beside Miller Creek was the state endangered floating marsh marigold. This small plant is typically found rooted in soft sediment in shallow waters of small streams with access to sunlight. These individuals were frequent along the creek where it flowed west into a pool beside the road where it was no longer found. On the east side of the Northern Very Wet Ash Swamp (WFn64) and in the Black Ash – Aspen – Balsam Poplar Swamp (WFn55a) along a tributary near Rice Lake Road, several more floating marsh marigold were found in scattered standing water pockets, again under the shade of the ash canopy.

WFn74a Alder - (Red Currant - Meadow-Rue) Swamp

Alder - (Red Currant –Meadow-Rue) Swamp was dominated by speckled alder, with 50–75% cover and has similar species composition and structure to the Alder Swamp community FPn73a. Typically, it occurred adjacent to or surrounded by Northern Very Wet Ash Swamp (WFn64) or near streams. Indicator species such as ostrich fern (*Matteuccia struthiopteris*), tall meadow rue (*Thalictrum dasycarpum*), and balsam poplar (*Populus balsamifera*) helped distinguish this community from Alder Swamp (FPn73a). The presence of mesic hardwood forest species, including Canada mayflower and large-leaved aster (*Eurybia macrophylla*), also contributed to differentiating this community from Alder Swamp (FPn73a).

WMn82a Northern Wet Meadow/Carr Willow-Dogwood Shrub Swamp

Expansive wet meadows were observed in various parts of the survey area, with shrub species cover ranging from 25 to 75 percent. The most common shrubs included willow species (*Salix* spp.), white meadowsweet (*Spiraea alba*), red osier dogwood (*Cornus sericea*), and speckled alder, occurring either in mixed stands or with one species dominating. Graminoid diversity was high, with Canada bluejoint, tussock sedge (*Carex stricta*), and lake sedge (*Carex lacustris*) being the primary species present. Numerous forbs characteristic of wet meadow communities were also observed, including spotted Joe-Pye weed (*Eutrochium maculatum*) and marsh skullcap (*Scutellaria galericulata*).

WMn82b Sedge Meadow

Many of the polygons classified as Sedge Meadow (WMn82b) represented a mosaic of shrub and graminoid-dominated areas. The graminoid patches within these polygons were not expansive enough to be mapped separately and were considered a natural feature of the shrubby community type. One small Sedge Meadow (WMn82b) was field verified and was located at the border of a Black Ash - Conifer Swamp (Northeastern) (WFn64a) and an Alder - (Red Currant - Meadow-Rue) Swamp (WFn74a).

Rare Plant Occurrences

Floating marsh marigold

The state endangered floating marsh marigold was observed in the Black Ash - Alder Swamp (Northern) (WFn64c) and the Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a) along Miller Creek and the small pools that feed into it under the black ash canopy. These occurrences were found as individuals rooted into the soft, mucky sediment in shallow water, or as small colonies where water moved slowly in the creek, or in small pools adjacent to the creek. These populations of floating marsh marigold will be susceptible to more competition as the black ash canopy dies and native, likely more aggressive species will take advantage of the increased sunlight.

Invasive species

Glossy buckthorn (*Frangula alnus*) was prevalent in wetlands, ranging from scattered individuals to areas with significant cover. Common buckthorn was also observed in wetlands, though it was less common and more frequently found in upland areas, with cover varying by location. Some disturbed areas exhibited very high cover of tansy (*Tanacetum vulgare*) and other invasive species that have the potential to spread into adjacent plant communities.

Bagley

Table 8. Native Plant Communities, Condition Ranks, and Acres at Bagley Survey Area

Bagley Native Plant Communities	Condition Rank	Acres
Developed	NA	5.11
Disturbed	NA	14.35
FDn43a	C	1.57
MHn46b	B	4.20
MHn47a	A, B, C, D	40.24
OW	Not applicable	1.75

Developed

Developed areas remain within the Bagley Nature Area and include old remnant homesteads that are now maintained as a ball field and picnic and tent pad area. These are mowed throughout the summer months and contain a mix of grass species.

Disturbed

The Bagley Nature Area has a long history of human use, primarily land clearing, ornamental tree planting, and trail construction. A ski hill with a tow rope powerhouse cut through the Northern Rich Mesic Hardwood Forest (MHn35), and the break in the canopy remains to this day as a meadow of grass and tansy that slopes steeply down to Rock Pond. Small pockets of red pine (*Pinus resinosa*) plantations

were planted within the mesic forest as well as ornamental species not native to this area such as eastern red cedar (*Juniperus virginiana*) and black locust (*Robinia pseudocacia*) in the manicured plantings around Rock Pond.

Another small polygon on the northwest side of Bagley is an impacted wetland adjacent to residential homes. It has been heavily impacted by emerald ash borer with high black ash tree mortality and a low diversity herbaceous layer consisting primarily of Canada bluejoint. This wetland could improve if new canopy tree or shrub species replace the black ash or are intentionally planted to replace the ash, but they would have to be protected from deer.

FDn43a White Pine – Red Pine Forest

Just north of Arrowhead, there is a section of public land that serves as a connection between Bagley and Hartley, though it is not clearly part of either area. For this project, it was included as part of Bagley. This section contains one disturbed polygon adjacent to the road and one White Pine – Red Pine Forest (FDn43a) polygon that is contiguous with an FDn43a polygon in Hartley. The FDn43a polygon was not field verified during this survey, but it was classified as FDn43a because it is directly connected to a polygon that was field verified as FDn43a in 2019. The photo signature for this area indicates a similar composition, making it reasonable to classify it as the same community type.

MHn46b Black Ash – Basswood Forest

The black ash – basswood forest in Bagley follows the stream corridor of a tributary to the West Branch of Tischer Creek. The black ash shows indications of emerald ash borer and woodpecker damage, and many have died from the damage. The canopy is in transition due to the black ash mortality, but important codominant species were present in the canopy and subcanopy like yellow birch (*Betula alleghaniensis*) and northern white cedar (*Thuja occidentalis*). Occasional young yellow birch and cedar were observed growing above the deer browse reach, despite a high density of deer in Bagley as evidenced elsewhere by heavy browse of desirable seedlings.

Diverse herbaceous species were found on the forest floor due to the occasional flooding from spring melt and heavy rain events and the gradual transition to the northern rich hardwood forest (MHn47) adjacent to this wet – mesic hardwood forest.

Bagley has a high density of trails, including cross-country skiing, mountain biking, and hiking trails; however, all trails cross this Black Ash – Basswood Forest (MHn46b) plant community via bridges that keep traffic out of the wet soils and tributary. The tributary enters Bagley through a concrete culvert into a catchment and receives inputs from the north end of Rock Pond. Several herbaceous invasive species were identified, including forget-me-not (*Myosotis scorpioides*) and yellow archangel (*Lamium galeobdolon*). Yellow archangel was originally observed in the Sugar Maple - Basswood - (Bluebead Lily)

Forest (MHn47a) behind residential housing but has since crossed the mountain biking trail and entered the wet – mesic hardwood forest. The 1918 fire did not appear to have reached Bagley.

MHn47a Sugar Maple – Basswood - (Bluebead Lily) Forest

The Sugar Maple – Basswood - (Bluebead Lily) Forest is the primary forest type throughout the nature area. Sugar maple dominates the canopy in most areas with lesser codominant like yellow birch and red oak (*Quercus rubrum*). Pockets of quaking aspen and paper birch (*Betula papyrifera*) are found where past disturbances opened the sugar maple canopy. Quaking aspen and paper birch suffered intense damage during the 2016 blowdown event with numerous mature quaking aspen falling or breaking in half from the strong wind. Very occasional super canopy white pine are found in the maple forest, potentially being old enough to be considered old growth. Common subcanopy species include young sugar maple and ironwood (*Ostrya virginiana*).

Small to medium vernal pools with dying black ash were scattered throughout the maple forest which prefer the glacial till soils found in the northern rich hardwood forests. Additional indicator species of the Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a) include leatherwood found on the southwestern edge of the nature area, white baneberry (*Actaea pachypoda*), and long beach fern (*Phegopteris connectilis*).

Some clearing of the forest occurred, primarily around Rock Pond and adjacent to present-day housing, as indicated by 1939 aerial photographs. However, sufficient portions of the Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a) were left intact to maintain indicator species of this northern rich hardwood forest. Intact rich hardwood forests often maintain higher humidity levels and moist soils, conditions that are not conducive to wildfire. Although Bagley was near the leading edge of the 1918 fire, it did not burn.

OW Open Water

Rock Pond was constructed in 1968 and is relatively shallow. 1939 aerial imagery shows that the footprint of the pond had once been a large, shrub dominant wetland. Groundwater inputs are visible in the southwest corner of the pond, and the pond drains from the north end through a pipe into a tributary that feeds into the West Branch of Tischer Creek. Native plantings surround the pond along with some non-endemic planted specimen tree species like eastern red cedar and river birch *(Betula nigra)*.

Rare Plant Occurrences

No rare plants were observed.

Invasive Species

The primary invasive species of concern in Bagley Nature Area is common buckthorn, but historic removal has maintained a very low density of buckthorn throughout the forest. The locations with the highest infestations were adjacent to residential areas and disturbed or developed spaces within the park. Other concerning species that were observed in rare to occasional occurrences include yellow archangel, forget-me-not, and Japanese barberry. These species were marked with a point when

observed apart from forget-me-not which was consistent along the tributary to the West Branch of Tischer Creek.

Brewer

NPCs at Brewer were classified and mapped in 2021, but their ecological condition was not assessed at that time. The 2025 survey aimed to confirm those classifications, evaluate condition rankings, and document occurrences of rare plants and invasive species. Minor updates to NPC classifications were made as needed and recorded in the attribute table of the NPC layer available on the web map. Additional field observations on NPCs and ecological condition were also documented in the attribute table and are not repeated here, as the communities were described in the 2021 survey (SEH 2021).

Table 9. Native Plant Communities, Condition Ranks, and Acres at Brewer Survey Area

Brewer Native Plant Communities	Condition Rank	Acres
CTn24	B, C, D	19.30
Developed	NA	190.71
Disturbed	NA	248.45
FDn32	C	1.03
FDn33b	C, D	64.72
FDn43a	D	0.57
FDn43b	B, C	13.08
FDn43b2	B, C, D	178.52
FDn43c	B	11.16
FPn73a	C	22.95
MHn35b	A, B, C, D	736.19
MHn44	A	21.85
MHn44a	B	37.34
MHn44b	B, C	15.62
MHn45b	B	1.50
MHn46	C	7.64
MHn46b	B, C, D	117.97
MHn47a	A, B, C	138.53
MRn83a	Not assessed	6.45

Brewer Native Plant Communities	Condition Rank	Acres
ROn12b	Not assessed	4.63
ROn23a	D	0.55
ROn23b	C, D	130.28
RVx43a2	Not assessed	8.48
WFn55a	B, C, D	181.89
WMn82a	D	4.50
WMn82b	B	0.33

Rare Plant Occurrences

False mountain willow

False mountain willow (*Salix pseudomonticola)* was potentially located off Skyline Drive on the north side of the road near the intersection with 40th Ave West but still west of a parking lot. There was one individual willow shrub growing in full sun on the edge of a mow line. The shrub had multiple stems that became red near the end of the new growth. Two paired stipules grew beneath the leaves, and leaves were oval with toothed edges. The upper leaf surfaces were glossy and dark green. Other older leaves and twigs had less defined characteristics, and without those newer growth features from the current growing season, the shrub would have been identified as pussy or Bebb's willow (*Salix discolor* and *S. bebbiana*).

Invasive Species

Common buckthorn was common throughout Brewer Park and Piedmont. The presence of buckthorn was degrading the overall condition of many of the plant communities throughout the park. Bedrock shrubland (ROn23) and crystalline open bedrock (ROn12) were both significantly impacted by buckthorn.

Another invasive species, cotoneaster, was documented in exposed bedroom communities in Magney-Snively Park and Hawk Ridge, where it has been degrading NPCs. If this species becomes established in Piedmont or Brewer Park, it could rapidly spread and displace the unique native vegetation on the rocky outcrops and shrublands.

Chester

Table 10. Native Plant Communities, Condition Ranks, and Acres at Chester Survey Area

Chester Native Plant Communities	Condition Rank	Acres
Developed	NA	7.29
Disturbed	NA	40.66

Chester Native Plant Communities	Condition Rank	Acres
FDn43a	B, C, D	27.31
MHn35b	B, C, D	34.02
MHn44a	C	2.04
MHn44c	C	0.97
RVx	Not assessed	3.19
RVx32	C, D	4.70
RVx43a2	B	2.06

Developed

Developed areas include the parking lot, playground, ski area, and roads. Developed areas were excluded when not connecting undeveloped parts of the survey area.

Disturbed

Disturbed land was primarily located above Skyline Parkway near Chester Bowl infrastructure and other developed areas. Most of the disturbed land was formerly mesic hardwood forest.

FDn43a White Pine – Red Pine Forest

On steep slopes along Chester Creek was a fire-dependent forest dominated by white pine and white cedar. This community shared characteristics with Upland White Cedar Forest (FDn43c), particularly in the understory, but was best classified as White Pine – Red Pine Forest (FDn43a) due to the strong presence of white pine and certain understory species, such as pipsissewa (*Chimaphila umbellata*). Ecological condition varied primarily based on proximity to roads and the creek, with the highest quality areas located furthest from these features.

MHn35b Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest

Mesic hardwood forest occurred throughout the survey area and was identified primarily by the abundance of sugar maple. Distinguishing Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest (MHn35b) from Sugar Maple – Basswood - (Bluebead Lily) Forest (MHn47a) was challenging due to limited diversity and a lack of indicator species in the understory. As a result, it is possible that some areas classified as Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest (MHn35b) may actually be lower quality Sugar Maple – Basswood - (Bluebead Lily) Forest (MHn47a).

MHn44a Aspen – Birch – Red Maple Forest

Along the upper part of the slope, transitioning to White Pine - Red Pine Forest (FDn43a) below, was an Aspen – Birch – Red Maple Forest (MHn44a) that differed slightly in composition from the adjacent White Pine – Red Pine Forest (FDn43a). Although there was some overlap in species composition, the

area classified as Aspen – Birch – Red Maple Forest (MHn44a) exhibited a higher cover of deciduous trees, including sugar maple and black ash, as well as other characteristic shrub and forb indicator species.

MHn44c Aspen - Fir Forest

Adjacent to a road and a large, disturbed area was a small pocket of Aspen–Fir Forest (MHn44c) situated on a steep slope. Indicator species in the shrub layer included mountain maple (*Acer spicatum*) and low bush honeysuckle (*Diervilla lonicera*) along with forbs such as thimbleberry (*Rubus parviflorus*). The community also supported forbs typical of wetter environments, including jewelweed (*Impatiens capensis*) and flat-topped aster (*Doellingeria umbellata*). While this area shared some characteristics with Northern Wet-Mesic Hardwood Forest (MHn46), it was more accurately classified as Aspen – First Forest (MHn44c).

RV

The lower part of Chester Creek was not field verified. This area is likely a mix of Sand/Gravel/Cobble River Shore types (RVx32), with the possibility of sections containing boulders that would be classified as Bedrock/Boulder Shore, Permanent Stream Subtype (RVx43a2).

RVx32 Sand/Gravel/Cobble River Shore

A mix of Sand/Gravel/Cobble River Shore (RVx32) types was present throughout the area. These types were not differentiated in mapping because they frequently intermingled, and when distinct, occurred only in small patches. It is also likely that there are small inclusions of Rocky River Shore (RVx43) within these areas. Crack willow (*Salix* X *fragilis*) was abundant along the shore. Overall, vegetation cover was sparse, with a notable presence of non-native and invasive species.

RVx43a2 Bedrock/Boulder Shore (Permanent Stream Subtype)

A portion of Chester Creek near Skyline Parkway features a bedrock boulder shore, which was classified as Permanent Stream Subtype (RVx43a2). Vegetation is limited in this area, with some species established in rock crevices. Crack willow is present, with branches extending over the bedrock in certain sections.

Rare plant Occurrences

No rare plant occurrences were observed in Chester.

Invasive Species

Invasive and non-native species were most prevalent along the main trail and in disturbed areas where canopy gaps occurred. Mature common buckthorn were present but not abundant, and scattered seedlings were found throughout the survey area in relatively low abundance. Rowan mountain-ash (*Sorbus aucuparia)* was established along the creek and within forested NPCs. Non-native honeysuckle (*Lonicera* spp.) were also present, especially in lower Chester and in areas nearest to developed land.

Congdon

Table 11. Native Plant Communities, Condition Ranks, and Acres at Congdon Survey Area

Congdon Native Plant Communities	Condition Rank	Acres
Developed	NA	6.87
Disturbed	NA	0.33
FDn43b	B	22.52
MHn35b	B	9.77

Developed

A narrow stretch of forest between a paved trail and a crushed limestone trail was classified as developed in Congdon. This area had heavy foot traffic and a high number of naturalized weedy species like creeping bellflower (*Campanula rapunculoides*) and smooth brome (*Bromus inermis*). Mature white pine and northern white cedar provided good parent material, but heavy deer browse in this area have kept most seedlings from maturing into saplings.

Disturbed

Two small areas on the eastern side of Congdon were disturbed from forest conversion into lawn. The impacts were observed creeping into the mesic hardwood forest that grew beside these lawns. Tansy was growing in the forest edges where the lack of canopy gave it more sunlight. Garbage had also accumulated on the slope down to Tischer Creek either from floodwaters depositing loose trash or from adjacent homeowners dumping into the creek.

FDn43b Aspen-Birch Forest

Aspen - Birch Forest consisted of quaking aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca).* The understory had low diversity and included large-leaved aster, low bush honeysuckle, and Pennsylvania sedge. Mature eastern white pine and eastern white cedar were observed along and on top of the rhyolite canyon walls. Some cedar was found beside Tischer Creek, but primarily the canopy cover species within the stream corridor was crack willow. As the elevation rose heading upstream of the canyon, the canopy cover became patchier with larger pockets of quaking aspen, white spruce, and balsam fir. Occasional common buckthorn was observed in these areas. 1939 imagery indicates there was partial clearing of the forest up to the creek with occasional mature trees left, but much of it looked to be young forest.

MHn35b - Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest

The Red Oak – Sugar Maple – Basswood (bluebead lily) Forest (MHn35b) occurred in narrow bands along either side of the White Pine – Red Pine Forest (FDn33a) that lined the Tischer Creek corridor. The Red Oak – Sugar Maple – Basswood (bluebead lily) Forest (MHn35b) forest was a mix of quaking aspen

(*Populus tremuloides*), red oak, sugar maple, white spruce, and balsam fir. Some pockets closely resembled Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn35b), while others exhibited characteristics more typical of the adjacent White Pine – Red Pine Forest (FDn33a). Common buckthorn was problematic in some areas and threatened many others with abundant seedlings observed in several locations. Aerial imagery from 1939 indicates that much of the forest on the east, downstream end of Congdon, had been cleared.

Rare Plant Occurrences

Eastern hemlock

One mature eastern hemlock *(Tsuga canadensis)* was found adjacent to private property growing in upland habitat above the creek. Other known populations exist downstream of the survey area.

Invasive Species

Common buckthorn was the primary concern impacting the health of the forest and plant community. Crack willow was impacting water flow with exposed red roots that the creek had to flow around and over. Crack willow had displaced the native tree species, eastern white cedar which was still found growing adjacent to Tischer Creek in other areas. Eastern hemlock was also found growing beside the creek bed just downstream of the surveyed Congdon forests, indicating crack willow might be impeding the growth and regeneration of the endangered hemlock.

Enger

Table 12. Native Plant Communities, Condition Ranks, and Acres at Enger Survey Area

Enger Native Plant Communities	Condition Rank	Acres
Developed	NA	27.72
Disturbed	NA	65.43
MHn35b	B, C	156.35
MHn47a	A, C	41.67
ROn23a	Not assessed	24.43
WFn55a	B, C	25.40
WFn74a	C	7.59
WMn82b1	C	2.49

Developed

Arlington Avenue bisects Enger North, and the Enger Golf Course separates Enger North from Enger South with patches of remnant mesic hardwood forest. Some forest patches retained species composition integrity and provided a shaded buffer along some of Buckingham Creek. Common

buckthorn was occasional to frequent in these forest patches. Human-created ponds were scattered within the golf course and had invasive cattails along the shoreline. Part of the Arlington soccer field complex had converted mesic hardwood forest to create a third field and the majority of the parking lot.

Disturbed

The disturbed plant communities within Enger consisted of communities that no longer retained native species assemblages due to the invasion of invasive species like common buckthorn and garden escapees, or forests that had been converted to mixed coniferous pine plantations or had severely altered canopies. These disturbed communities occurred adjacent to private property or development, which heavily influenced the decline of the native species' composition.

MHn35b Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest

Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest was the most common plant community throughout Enger. Much of the forest was mature with longer-lived species such as red oak and sugar maple. Natural regeneration was rare, and deer browse was heavy on many seedlings. Pockets of early successional forests were also common with trembling aspen (*Quercus tremuloides*) and paper birch. When reviewing the 1939 aerial imagery, the eastern side of the forest had been cleared and has since recovered, with red oak, quaking aspen, and paper birch the main canopy species.

Bedrock outcrops were scattered throughout the mesic hardwood forest but were too small to map individually. Exposed bedrock with lichen and small grasses growing in the cracks was common, as were small islands of bedrock shrubland within these outcrops. These features contribute to important structural diversity within the otherwise closed canopy. They are often sites where birds deposit invasive species seeds through droppings; however, common buckthorn and honeysuckle (*Lonicera* spp.) were not prevalent in these areas. Historical aerial imagery from 1939 shows that these bedrock outcrops and the mesic hardwood forest on the east side of Arlington Ave. had been cleared of forest and shrubs. While these bedrock outcrops and shrublands provide suitable habitat for the special concern soapberry, no soapberry was observed.

Much of the mesic hardwood forest did not burn in 1918. The far northwest corner of Enger sits right on the advancing front of where the fire is believed to have stopped burning. This forested region sits amidst mixed use development with Lake Superior College and the Enger Golf Course separating the closed canopy forest and neighborhood housing with isolated trees surrounding. This closed canopy is a critical connection between the Piedmont/Brewer's forest and the smaller pockets of closed canopy forest at St. Scholastica, Chester Bowl, and Bagley Nature Area that connect to the larger Hartley Park.

MHn47a Sugar Maple – Basswood - (Bluebead Lily) Forest

The Sugar Maple – Basswood - (bluebead lily) Forest was found in the higher elevations of Enger surrounding the Arlington Soccer Field Complex. Characteristic species such as yellow birch, sugar maple, and ironwood were observed. Several small depressions indicated potential vernal pools that contribute to the groundwater recharge for Coffee and Buckingham Creeks. Foot paths from the soccer fields cut through the forest toward Coffee Creek and the rocky outcrops. Common buckthorn was at times thick, displacing the herbaceous groundcover species and decreasing diversity. Occasional super canopy white

pine could be found, especially near Coffee Creek. A smaller sugar maple – basswood forest was observed in the far northwest corner to the west of the Coffee Creek wetlands, and common buckthorn had established and displaced most of the groundcover and shrub layer. The canopy species were the primary indicator of this forest type, and it was not regenerating.

Aerial imagery from 1939 indicated that much of this forest remained intact from Coffee Creek east. The 1918 fire boundary indicates that the northwest corner might have burned and was right on the edge of the advancing front, but the 1939 imagery shows a more mature forest in that area.

ROn23a Bedrock Shrubland (Inland)

Small bedrock shrubland islands were very small and grew within the bedrock outcrops that were scattered within the greater mesic hardwood forest. These shrublands contained decent shrub diversity with serviceberry (*Amelanchier sp*), hazel (*Corylus sp*.), and low bush honeysuckle and were not limited to only invasive shrubs like common buckthorn and honeysuckle (*Lonicera sp*). These bedrock outcrops had been cleared of forest and shrubs in 1939 aerial imagery, and on the east side of Arlington Ave., the mesic hardwood forest had also been cleared. These bedrock outcrops and bedrock shrublands are suitable habitat for the special concern soapberry but no soapberry was found. These habitats often contain fire-adapted species and could potentially benefit from fire to decrease invasive species when they begin to lower the species' diversity.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

The Black Ash – Aspen – Balsam Poplar Swamp was found along Buckingham Creek and a small tributary to Coffee Creek. The canopy was dominated by black ash that were stressed from the emerald ash borer with bark having been scratched away by woodpeckers. These narrow ash swamps had some shrub components with sometimes tag alder and sometimes mountain maple. Occasional mature northern white cedar was present but did not reach sapling stage. The ash swamp near the headwaters of Buckingham Creek had a higher abundance of northern white cedar, and included cinnamon fern, an uncommon fern species in Duluth. This wet forest also contained a healthy population of eastern rough sedge that has not been found in Minnesota before. The population continued along Buckingham Creek until Observation Road and was again located in a forested island on the Enger Golf Course growing in the floodplain forest beneath yellow birch.

In early 1939 imagery, these wetland corridors remained forested while much of the surrounding forest had been cleared. These wet forests did not burn in the 1918 fire, though the wet forest along the tributary to the Coffee Creek appears to be close to the edge of the fire. Deer prevented seedlings of desired species such as cedar and yellow birch from growing beyond seedling stage.

The Coffee Creek corridor was a mix of boulders and bedrock with mountain maple growing between boulders, rooted in the wet organic soil below the boulders. The forest canopy was a mix of black ash, speckled alder, and mountain maple. The ash were stressed and sometimes dying from the emerald ash borer. The groundcover was less diverse than expected due to the boulders restricting the growth of some species. Occasional mature cedar were observed with no seedlings or saplings.

This wet forest is very narrow, and early 1939 aerial imagery show that much of the forest to the west and on the upstream end of the wet forest had been cleared. Several rock outcrops and a rocky ridge on the west confine the wetland along Coffee Creek to a narrow corridor. These bedrock features as well as the bedrock exposed in the creek illustrate just how little soil is available in this wetland to the species present.

WFn74a Alder - (Red Currant – Meadow-Rue) Swamp

The alder swamp follows the Coffee Creek corridor downstream of a wet meadow through a narrow valley confined by rocky outcrops on either side. Much of the forest north of the alder swamp was impacted with common buckthorn, but the alder swamp maintained little invasive species and a good diversity of native wetland species. This alder swamp maintained a consistent canopy with alder shrubs reaching around 8-12 feet tall. Overall shrub diversity was low and was primarily alder in the canopy with occasional mountain maple. Other indicator species of this community included red currant (*Ribes triste*) and early meadow rue (*Thalictrum dioicum*).

Alder swamps indicate groundwater connectivity and often maintain a high diversity of native species, but they can also be an indication of suitable conditions for northern white cedar, which might have been found at the site prior to ditching. Historic aerial photographs from 1939 show the ditched creek and clearing that had been done both in the alder thicket and into the wet meadow. Downstream aerial imagery showed mature trees within the stream corridor, which were relatively lacking in 2025 surveys. One mature northern white cedar was marked with no regeneration.

The 1918 fire burned very close to this community, but current maps indicate that this alder thicket likely escaped the fire. This plant community is within close proximity to housing and heavily impacted communities. Deer browse was not very common in the alder thicket because deer do not favor alder.

WMn82b1 Sedge Meadow Bluejoint Subtype

A wet meadow was present in the ditched section of Coffee Creek, characterized by a high diversity of native species. The meadow featured prominent hummocks now dominated by Canada bluejoint, which covered 75–100% of the area. These hummocks were likely once dominated by tussock sedge and, prior to that, may have been part of an acid peatland. The ground layer supported a variety of native forbs, including Joe-Pye weed and northern bugleweed (*Lycopus uniflorus*). Shrub cover was less than 25%, with native willow species (*Salix* spp.), speckled alder, and white meadowsweet present throughout the meadow.

Rare Plant Occurrences

Eastern rough sedge

Eastern rough sedge was found growing in a wetland and alongside Buckingham Creek. Many individuals were documented and grew within a closed forest canopy. Further downstream, eastern rough sedge was also found within the Enger Golf Course, though there was a section of Buckingham Creek where it was not observed that did not have a forested canopy and a small human made pond that did not contain the eastern rough sedge before it was again located in a forested island in between golf greens. The sedge grew within a mesic forest that likely experiences periodic flooding in the spring or major

storm events. The canopy had a mix of mesic tree species, but yellow birch was noted as much of the other forest upstream on the golf course was mostly quaking aspen.

Invasive Species

The most concerning invasive species in Enger North was common buckthorn which was frequent and at times had dense cover. Buckthorn was particularly concerning in the far northwest of the area near residential homes. This was an area that had burned in the 1918 fire. The buckthorn was encroaching a high-quality Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a), and where it had gone untreated, it had transformed the mesic hardwood forest into a buckthorn grove with little to no herbaceous species beneath. Buckthorn had also invaded patches of the mesic hardwood forest on the east of Coffee Creek and was occasional on the rocky outcrops within the mesic hardwood forest on either side of Arlington Road. Buckthorn is also a problem in the understory of the forested islands on the Enger Golf Course.

Other invasive species were present but infrequent, including common valerian (*Valeriana officinalis),* Canada thistle (*Cirsium arvense*), forget-me-not, orange hawkweed (*Hieracium aurantiacum*), narrowleaf cattail (*Typha angustifolia*), glossy buckthorn, and reed canary grass (*Phalaris arundinacea*).

Forest Hill Cemetery

Table 13. Native Plant Communities, Condition Ranks, and Acres at Forest Hill Cemetery Survey Area

Forest Hill Cemetery Native Plant Communities	Condition Rank	Acres
Developed	NA	16.79
Disturbed	NA	74.92
FDn43b	C, D	9.86
MHn35b	B, C, D	249.53
MHn46b	B, C, D	68.66
MHn47a	A, B, C, D	46.32
MRn83a	B	1.29
ROn23a	C	20.00
WFn55a	B, C	32.52
WFn74a	C, D	3.39

Developed

Developed areas included the City of Duluth gravel pit and Vermilion Road.

Disturbed

Disturbed areas in the Forest Hill survey region included forests with high invasive species that had altered canopy species and didn't indicate a native plant community structure. The forest in the northwest of the Forest Hill survey area had a high cover of common buckthorn. When comparing it with the 1918 fire map, it likely burned. That forest is also surrounded on two sides by residential land and has a snowmobile trail and hiking trail running through it.

Other disturbed areas were found along Vermillion Road and had similar histories, having likely been burned over and are in close proximity to the road and hiking trails. Other small, disturbed areas were found east of Vermillion Road and had some historical land clearing for gravel excavation or unknown purposes.

A series of wet meadows create a wet meadow shrub carr complex along the Amity Creek corridor. Beavers have created a series of dams along this stretch of Amity Creek. These meadows appear to be dominated by Canada bluejoint with speckled alder and shrubby willow species like slender-leaved willow (*Salix petiolaris*) growing on the margins of the meadow complex where they are slightly higher in elevation than the grass and sedge meadows (WMn82b).

FDn43b Aspen – Birch Forest

Two polygons in the northern portion of the survey area near the creek were classified as this community. While there are some pockets of WFn74 and possibly FDn33 present, the majority of the area is likely FDn43. This is a low-quality community characterized by a high cover of invasive species and limited forb diversity. The canopy is primarily composed of quaking aspen. There is a small inclusion of Upland White Cedar Forest (FDn43c) closer to the creek, but it is too small to map separately.

MHn35b Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest

The Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest was extensive within the Forest Hill region and contained numerous vernal pools with pockets of small, consistent wetlands, and some indications of rich mesic forest in patches, such as maidenhair fern (*Adiantum pedatum).* Some forests contained large red oak, with occasional yellow birch and eastern white cedar. Younger, pioneering forests were frequent with the canopy dominated by quaking aspen and paper birch. Black ash was a component of this pioneering forest canopy. Common buckthorn was more abundant in the pioneering stage forest than the red oak dominant forest.

Early 1939 aerial imagery shows much of the Forest Hill survey area had not been cleared. Mapping of the 1918 fire indicate that the northern portion of this forest burned, and the 1939 aerial imagery shows dense regrowth in the northern region with larger, mature trees scattered in the southern region and

along Amity Creek, which might have been spared from the fire where the creek wound through a wet forest.

A series of neighborhood trails cut through this forest as well as a snowmobile corridor trail, mountain biking trails, and the Superior Hiking Trail.

A very small inclusion of White Cedar – Yellow Birch Forest (MHn45b) was observed in the Forest Hill survey area on the northeast facing slope along Amity Creek. The more intact canopy contained eastern white cedar and yellow birch with occasional black ash. The surrounding canopy consisted of pioneering forest species like quaking aspen and paper birch, but the herbaceous species still indicated possible white cedar – yellow birch forest that had been disturbed. Indicators of a mesic hardwood (cedar) forest observed along Amity Creek white cedar – yellow birch forest included mountain maple, beaked hazel (*Corylus cornuta*), beech fern, and Canada yew (*Taxus canadensis*).

MHn46b Black Ash – Basswood Forest

The wet mesic forest community was characterized by a black ash canopy that was in decline due to the effects of emerald ash borer. Quaking aspen was also abundant, with lesser amounts of sugar maple and basswood (*Tilia americana*) present. Understory diversity was good in areas not overtaken by common buckthorn. Some portions of the community contained wetter inclusions that could be classified as WFn55, but the overall area was best classified as Northern Wet-Mesic Hardwood Forest (MHn46). Additionally, there were small, drier inclusions of Northern Mesic Hardwood Forest (MHn35) that were too limited in extent to be mapped separately.

MHn47a Sugar Maple – Basswood - (Bluebead Lily) Forest

The Sugar Maple – Basswood - (Bluebead Lily) Forest was observed in some of the southern regions of the Forest Hill survey area. The canopy consisted of old sugar maple with occasional yellow birch and basswood. These forests also contained unique indicator species maidenhair fern, white baneberry, and leatherwood of very rich soils, which were absent in other forest types. Vernal pools were also indicative of these forests.

Early 1939 aerial imagery shows these forests did not experience clearing or other human impacts. The 1918 fire did not burn through these areas, though it burned the northern part of the Forest Hill survey area.

MRn83a Cattail – Sedge Marsh (Northern)

The cattail – sedge marsh adjacent to Jean Duluth Road contained some wet meadow species like lake sedge and Canada bluejoint, some emergent marsh species such as cattail (*Typha sp.*), arrowhead

(*Sagittaria latifolia*), and blue flag iris (*Iris versicolor*), and some willow (*Salix sp.*) and other shrub species.

In old 1939 aerial imagery, a road had been present north of this marsh running east to west.

ROn23a Bedrock Shrubland (Inland)

The Bedrock Shrubland occurred on the exposed bedrock bluff on the east side of the East Branch of Amity Creek in a narrow band. As bedrock had broken from the parent material, piles of boulder had collected below the bluff with little vegetation. Shallow to no soils favored bush honeysuckle, low bush blueberry (*Vaccinium angustifolium*), and three-leaved cinquefoil (*Potentilla tridentata*). An emerging threat to this community was an escaped sedum known as orange stonecrop (*Phedimus kamtschaticus*) which does well in dry, exposed sites with little soil. This has been spreading along the bedrock, displacing native vegetation.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

The Black Ash – Aspen – Balsam Poplar Swamps in the Forest Hill survey region were experiencing large scale black ash mortality of the mature ash that remain in the swamps as snags. Young black ash are sometimes observed but other times speckled alder or other hardwood tree species have taken advantage of the open canopy. In the cases where these Black Ash – Aspen – Balsam Poplar communities have transitioned to a 50-75 percent canopy of alder; these are described in the northern wet alder swamp section.

Small, wet ash swamp inclusions were scattered within the mesic hardwood forest across the entire Forest Hill survey region. They were mapped as vernal pools when small in size and exhibiting the water drawdown characteristics such as leaf material with no vegetation in the lowest pockets of elevation, indicator species such as black ash and Tuckerman's sedge (*Carex tuckermanii*). These vernal pools are often too small to delineate within the larger mesic hardwood forest, but they still play an important role within the forest, providing a change in forest species and structure, periodic water access for wildlife, and water retention and recharge for Amity Creek.

The larger Black Ash – Aspen – Balsam Poplar Swamps in the northeast were still impacted by black ash mortality, but the understory remained diverse with black ash snags still providing some shade to the species below. These wet ash swamps appear to be within the 1918 fire footprint, and old aerial imagery from 1939 show they had not been cleared at that time.

WFn74a Alder - (Red Currant - Meadow-Rue) Swamp

Alder - (Red Currant - Meadow-Rue) Swamp in the Forest Hill survey region had been a Black Ash – Aspen – Balsam Poplar Swamp (WFn55a), but the black ash had died from emerald ash borer. Speckled alder had taken advantage of the open canopy, and these wet forests were in transition to northern wet alder swamps.

In 1939 aerial imagery, a road ran east to west north of where these ash/alder swamps now are. This general region had very disturbed forests and high densities of common buckthorn.

Rare Plant Occurrences

No rare plants were observed.

Invasive Species

Common buckthorn was the primary concern throughout the Forest Hill survey area. The largest infestations were frequently near roadways and adjacent to the cemetery lawns where they had spread through the understory. The intact mesic hardwood forests contained fewer observations of buckthorn or other invasive species while the pioneering stage forests with quaking aspen as a dominant canopy species often contained buckthorn as a component of the shrub layer. An emerging threat to this community was an escaped sedum known as orange stonecrop which does well in dry, exposed sites with little soil. This has been spreading along the bedrock, displacing native vegetation.

Hawk Ridge

Table 14. Native Plant Communities, Condition Ranks, and Acres at Hawk Ridge Survey Area

Hawk Ridge Native Plant Communities	Condition Rank	Acres
Developed	NA	11.21
Disturbed	NA	90.71
FDn33a1	A, B	5.48
FDn33b	B, C, D	16.52
FDn43b	B, C, D	48.62
FDn43b1	B, C	42.84
FDn43c	B, C	4.97
FFn57a	C	14.29
MHn35b	A, B, C	51.80
MHn46b	A, B, C	31.34
ROn23a	B, C, D	39.34
RVx32	C	3.89
WFn55a	B, C, D	45.48
WFn74a	B, C, D	22.87
WMn82b1	C	0.96

Developed

Developed polygons were primarily associated with roads, encompassing both paved and unpaved areas.

Disturbed

Many disturbed communities in the survey area consisted of conifer plantations, primarily with planted Scots pine (*Pinus sylvestris*) and red pine. Some of these plantations supported a relatively diverse understory and retained characteristics of Aspen – Birch Forest (FDn43b). Significant utility corridors intersected several native plant communities, typically exhibiting high cover of invasive species. Old fields were also present throughout the area, characterized by a high abundance of invasive and aggressive native species.

FDn33a1 Red Pine – White Pine Balsam Fir Subtype

Red Pine – White Pine Balsam Fir Subtype was occasionally found in small pockets. In previous surveys, these plant communities were mapped because balsam fir was dominant in the canopy and other characteristic canopy species were lacking, such as white pine and red pine and occasional jack pine (*Pinus banksiana*).

FDn33b Aspen – Birch Woodland

Northern Dry-Mesic Mixed Woodland was occasionally found along higher elevations and was common between rocky outcrops (Bedrock Shrubland (Inland) (ROn23a)) throughout Hawk Ridge. These dry-mesic forests contained some of the soapberry species observations. The canopy was mainly comprised of stunted paper birch and quaking aspen with occasional red oak *(Quercus rubra*) that was not naturally regenerating due to deer pressure. Species that are characteristic of this NPC were lacking including white, red, and jack pine and, in some cases, replaced by the non-native Scots pine.

FDn43b Aspen – Birch Forest

Aspen – Birch Forest occurred on shallow, mesic soils. Dominant canopy species were primarily quaking aspen and paper birch, both young and mature. Common buckthorn is a main stressor in the understory and is inhibiting the natural regeneration of desirable species. Regeration is limited further by intense browse pressure by white tail deer. More aggressive native species were often observed in the herbaceous and shrub layers, primarily low bush honeysuckle, beaked hazelnut, and large-leaved aster. These species outcompete more diminutive or less aggressive species characteristic of this NPC such as fly honeysuckle (*Lonicera canadensis*), bluebead lily (*Clintonia borealis*), sarsaparilla (*Aralia nudicaulis*), and Canada mayflower.

FDn43b1 Aspen – Birch Forest Balsam Fir Subtype

Aspen – Birch Forest Balsam Fir Subtype was typically found within the greater Aspen – Birch Forest (FDn43b) and FDn33 forest growing out of exposed bedrock or very shallow soils. They were characterized by a balsam fir dominant canopy. The herbaceous understory had very low diversity

compared to the surrounding woodland due to the deep shade beneath the balsam fir. This plant community was mapped and designated as balsam fir dominant in prior surveys within Hawk Ridge.

FDn43c Upland White Cedar Forest

Upland White Cedar Forest was found in a larger polygon near Amity Creek. Small inclusions or narrow bands of upland cedar forest were observed immediately adjacent to Amity Creek, but those were too small to map individually and were part of the larger, surrounding plant community.

FFn57a Black Ash – Silver Maple Terrace Forest

Black Ash – Silver Maple Terrace Forest was found along Amity Creek and dominated by black ash in the canopy. Both terrace forests and wet forests shared these features and were distinguished by differences in herbaceous species. The terrace forests included more floodplain species that tolerate fluctuating hydrology, including ostrich fern, wood nettle (*Laportea canadensis*), tall meadow-rue, and sensitive fern (*Onoclea sensibilis*). Silver maple (*Acer saccharinum*), which can be abundant in floodplain forests, was missing from the canopy. In Hawk Ridge along Amity Creek, several of the terrace communities were perched above bank full, cutting off access to the floodplain and reducing flooding of these systems during very wet years or after large rain events. Beavers were further impacting some of these floodplain forests with a dam that was permanently flooding the community.

Aerial imagery from 1939 shows land clearing had taken place very close to these floodplain communities and additional selective clearing had occurred within, putting further pressure on the East Branch of Amity Creek with far greater tree canopy to moderate the seasonal floods and rain events, potentially leading to downcutting of the stream.

MHn35b Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest

Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest generally occurred in higher elevations with deeper, well-drained mesic soils. In Hawk Ridge, several larger polygons contained higher quality stands that had a diverse, mature canopy consisting of red oak, sugar maple, and basswood. Occasional super canopy white pine would be expected in this community, but none were observed. Characteristic shrubs such as pagoda dogwood (*Cornus alternifolia*), beaked hazelnut, and fly honeysuckle were present. Some herbaceous species expected in this NPC were observed but in low densities including bluebead lily, rose twisted stalk (*Streptopus roseus*), wild sarsaparilla, and sweet-scented bedstraw (*Galium triflorum*). More tolerant characteristic species included Pennsylvania sedge and mountain rice grass (*Oryzopsis asperfolia*).

Aerial imagery from 1939 revealed that the higher quality red oak – sugar maple – basswood forest on either side of West Skyline had not been cleared and appeared to be a mature closed canopy at that time. The 1918 fire boundary also appears to have swept west to east just north of the red oak – sugar maple – basswood forest, potentially following a historic road or other human fragmented line that created a fire break.

MHn46b Black Ash – Basswood Forest

Black Ash – Basswood Forest occurred on moderate to soft slopes adjacent to the East Branch of Amity Creek. Characteristic canopy species included basswood, black ash, and quaking aspen. Herbaceous indicator species were limited due to the disturbance history within these communities but included woodbine (*Parthenocissus inserta*), jack in the pulpit (*Arisaema triphylla*), and graceful sedge (*Carex gracillima*) along with some of the more tolerant upland species like Pennsylvania sedge, large-leaved aster, and lady fern (*Athyrium filix-femina).* The absence of floodplain species such as ostrich fern and wood nettle indicated these areas were not Black Ash Silver Maple Terrace Forest (FFn57a).

ROn23a Bedrock Shrubland (Inland)

Bedrock Shrubland (Inland) was mapped in Hawk Ridge at higher elevations with shallow to no soil. These rocky outcrops varied in size and were surrounded by forests that occurred at lower elevations with more soil. Vegetation structure consisted of scattered islands of shrubs such as serviceberry, low bush honeysuckle*,* and prairie willow (*Salix humilis*). Lower shrub and herbaceous species surrounded the islands of shrubs and grew within the bedrock cracks, such as pale corydalis (*Corydalis sempervirens*), rock spikemoss (*Selaginella rupestris*), poverty oat grass (*Danthonia spicata*), and pussy toes (*Antennaria spp.*). Other common species included caribou moss (*Cladina sp.)* and cliff ferns such as rusty wood fern (*Woodsia ilvensis*). Occasionally, bedrock outcrops supported small populations of soapberry.

RVx32 Sand/Gravel/Cobble River Shore

RVx32b2 Sand Beach/Sandbar (River) and RVx32c2 Gravel/Cobble Beach (River) occurred along the East Branch of Amity Creek. These two communities were often narrow bands along the stream or pointbars of cobble or sand deposited by flooding events from storms or snowmelt. Due to the small and sporadic nature of these NPC and disturbances causing frequent changes in shape and sometimes sediment type, they were classified to the higher level of Sand/Gravel/Cobble River Shore (RVx32) and lumped together.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

Black Ash – Aspen – Balsam Poplar Swamp (Northeastern) occurred along the riparian corridors of upper Amity Creek before it enters the gorge along Seven Bridges Road and in a large wetland centrally located north of the Hawk Ridge bedrock bluffs and south of Amity Creek. Along Amity Creek, black ash used to be the dominant canopy species, but early infestations of the emerald ash borer have caused near full ash mortality causing the canopy to transition. There was scattered mature yellow birch. Several of these large black ash swamps experiencing significant mortality were transitioning to either Wet Meadow with dense Canada bluejoint (Sedge Meadow Bluejoint Subtype (WMn82b1)), reducing species diversity, or Northern Wet Alder Swamp (WFn74) with a canopy of either speckled alder or non-native common buckthorn and glossy buckthorn.

WFn74a Alder - (Red Currant - Meadow-Rue) Swamp

Alder - (Red Currant - Meadow-Rue) Swamp was typically found in low lying depressions between rocky outcrops within Hawk Ridge. Higher quality swamps were dominated by speckled alder, but more often

they were overtaken with common buckthorn and glossy buckthorn with a very low diversity of herbaceous species. Areas of particularly low-quality include the western side of Hawk Ridge near the bird research lanes and the northwest end of the forest in Lester, both of which were disturbed by historic trails.

WMn82b1 Sedge Meadow Bluejoint Subtype

The Sedge Meadow Bluejoint Subtype was observed along Amity Creek near the active beaver dam. In some places, reed canary grass has taken over. Low diversity of herbaceous species was observed. Standing dead black ash illustrated the transition this community had recently gone through, either because of the emerald ash borer or a larger beaver dam, or a combination of the two stressors. Aerial imagery from 1939 show that these meadows did not appear at that time and were forested wetlands.

Rare Plant Occurrences

Soapberry

Hawk Ridge was known to support several occurrences of soapberry, dating back to early observations by Olga Lakela (MN DNR). Some of the historic populations were revisited, and over 120 new populations were identified in rocky outcrops, fire dependent forest, bedrock riverbanks, and eroding clay bluffs. Approximately 200 individuals were documented, mostly as single individuals and occasionally in small groups of 2-10 plants.

Soapberry prefers full sun to part sun along forest openings, in shrubby bedrock communities, and occasionally in sloughing clay/mud slopes. In the western United States where it is more common, soapberry rebounds quickly after wildfire, suggesting that it is a fire dependent or fire tolerant species and might be an indicator of suitable habitats to incorporate wildfire as a management tool. Soapberry is a dioicous shrub with male and female flowers occurring on separate individuals, and one isolated shrub cannot self-pollinate. It is not a preferred food of deer, but browsed twigs were occasionally observed.

Invasive Species

Populations of invasive species were documented throughout, but the greatest infestations occurred adjacent to roads or trails, adjacent to private property, and within forested communities with evidence of past land alteration like homesteads or clearing. The primary invaders were established species including common buckthorn, glossy buckthorn, and honeysuckle species (*Lonciera tatarica, Lonicera marrowii,* and *Lonicera X bella*). The most prevalent invasive species was common buckthorn, which at times had high cover in the most heavily impacted areas with scattered individuals between dense populations. It was often a mature shrub or small tree with fruit in rock outcrop areas and generally a non-fruit bearing seedling in shadier habitats. Glossy buckthorn was more common in the Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a) and Alder thicket (WFn74), while common buckthorn is most prevalent in the rock outcrop (Bedrock Shrubland (Inland) (ROn23a)) and upland forested communities (Aspen – Birch Forest (FDn43b) and Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn35b)).

Honeysuckle species were generally located in Bedrock Shrubland (Inland) (ROn23a), fire-dependent forest (FDn33a), and transitional areas between those communities. It was often observed as a mature, fruit-bearing shrub.

Many non-native, weedy species were documented throughout but were generally scattered as individuals and did not account for a significant portion of ground cover in the NPCs. The most frequently encountered weedy species were common dandelion (*Taraxacum officinale*), bittersweet nightshade (*Solanum dulcamara*), clover species (*Trifolium* spp.), brittlestem hemp-nettle (*Galeopsis tetrahit*), Kentucky bluegrass (*Poa pratensis*), and creeping bentgrass (*Agrostis stolonifera*).

Other non-native species observed that are not known to be established in the Duluth area but have the potential to become invasive were cotoneaster and barberry (*Berberis vulgaris*). The cotoneaster was primarily observed in the rock outcrop communities in significant numbers on some outcrops. The barberry was observed within the mesic forests. These species were not widespread and usually occurred as a single induvial. A rising threat observed in wild spaces on the west side of Duluth in Magney-Snively and Mission Creek is helleborine orchid (*Epipactis helleborine*) in mesic hardwood forests. More research is needed to determine if this orchid will form dense colonies and displace native orchids or other sensitive vegetation, impact pollinators foraging availability, or influence the mycorrhizal species composition since orchids are often linked with specific soil fungi. This is a species to look for in mesic hardwood forests (Northern Wet-Mesic Boreal Hardwood-Conifer Forest (MHn44), Northern Wet-Mesic Hardwood Forest (MHn46), MHn47, FDn33, FDn43).

Janette Pollay

Table 15. Native Plant Communities, Condition Ranks, and Acres at Janette Pollay Survey Area

Janette Pollay Native Plant Communities	Condition Rank	Acres
Developed	NA	7.48
FDn43b	C	15.35
FFn57a	C	6.54
MHn46b	C	13.78
MHn47a	A	5.82
RVx32	C	1.66
WFn55a	C	2.62

Developed

There is one developed polygon in the survey area, representing the Girl Scout camp and its associated infrastructure.

FDn43b Aspen – Birch Forest

Aspen – Birch Forest occurred on well-drained mesic soils. Dominant canopy species were primarily quaking aspen and paper birch with occasional red pine. Occasional yellow birch, basswood, and black ash indicated that this community might have had richer soils but suffered some historical disturbance that altered the canopy. Regeneration is limited further by intense browse pressure by white tail deer. More aggressive native species were often observed in the herbaceous and shrub layers, primarily low bush honeysuckle, Canada bluejoint, beaked hazelnut, and large-leaved aster. These species outcompete more diminutive or less aggressive species characteristic of this NPC such as fly honeysuckle, bluebead lily, sarsaparilla, and Canada mayflower.

The northern edge of the 1918 fire was right in this area and is inconclusive as to whether it burned the Amity Creek valley or not. The 2016 blowdown hit this area particularly hard, and the effects were observed with the majority of quaking aspen littering the forest floor while the yellow birch, black ash, and sugar maple were unaffected.

FFn57a Black Ash – Silver Maple Terrace Forest

Black Ash – Silver Maple Terrace Forest was found along Amity Creek and dominated by black ash in the canopy with occasional crack willow, along with pioneering species such as speckled alder, quaking aspen, box elder (*Acer* negundo), balsam poplar, and common buckthorn. Both terrace forests and wet forests shared black ash and were distinguished by differences in herbaceous species, and the herbaceous species were the main indication of what this system once had been. The terrace forests included more floodplain species that tolerate fluctuating hydrology, including ostrich fern, wood nettle, tall meadow-rue, and sensitive fern. Silver maple, which can be abundant in floodplain forests, was not observed in the canopy and likely wasn't a component with black ash filling that primary canopy species role. In Amity Creek this terrace appeared to be perched above bank full, cutting off access to the floodplain and reducing flooding of these systems during very wet years or after large rain events. Some upland mesic species were also observed such as sugar maple, fly honeysuckle, bloodroot, and red baneberry (*Actaea rubra*), suggesting this community is in transition. Invasive herbaceous species were frequent, including moneywort (*Lysimachia nummularia*), bull thistle (*Cirsium vulgare), common* valerian, and reed canary grass.

Aerial imagery from 1939 show that this section of Amity Creek had remained forested but included what appeared to be trails along the creek, fragmenting the canopy. Adjacent to the riparian forest, much of the surrounding landscape had been cleared and upstream showed heavy land clearing for agriculture. This area was right on the edge of the 1918 fire, and it is unclear if it burned or not.

MHn46b Black Ash – Basswood Forest

The Black Ash - Basswood Forest occurred in the transition between the floodplain forest and the mesic hardwood forest along Amity Creek. Characteristic canopy species included black ash and quaking aspen . The absence of floodplain species such as ostrich fern and wood nettle indicated these areas were not Black Ash Silver Maple Terrace Forest (FFn57a). These wet forests did not have basswood as would indicate a healthy black ash – basswood forest. The herbaceous layer had little indicator species as well

that have fidelity for that community and were not indicating wet enough conditions for Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a). The topography and mix of ash and aspen were the main driving factors that categorized this community as black ash – basswood forest.

MHn47a Sugar Maple – Basswood – (Bluebead Lily) Forest

Sugar Maple – Basswood - (Bluebead Lily) Forest was mapped within the far northern polygon north of East Amity Creek. The canopy was dominated by old sugar maple with a sparse shrub layer and characteristic herbaceous species such as rose twisted stalk, mountain rice grass, and Pennsylvania sedge. Leatherwood, a common indicator of rich mesic soil, was searched for but not found. This plant community did not suffer a blowdown that occurred in 2016 to the south, which consisted mostly of quaking aspen in the canopy.

RVx32 Sand/Gravel/Cobble River Shore

At baseflow water levels, exposed gravel and cobble line the streambank of the East Branch of Amity and form occasional cobble islands in the channel. Additional mounds of cobble were observed above the stream within the floodplain forest but tree and shrub species like mountain maple and crack willow were able to grow in the rock.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

The Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) was primarily north of the East Branch of Amity Creek. The canopy was quaking aspen with black ash in the subcanopy. Very little herbaceous diversity was observed on the ground beneath the ash and aspen. This wet forest was surrounded by wet to upland forest communities as the elevation rose surrounding the wetland.

Rare Plant Occurrences

No rare plant occurrences were observed.

Invasive Species

Crack willow and common buckthorn were the two primary threats degrading the creek and surrounding forests. Reed canary grass was occasional, but didn't seem to prefer the cobble. Buckthorn was found along the creek as well as in the forested communities.

Jean Duluth Dog Park

Table 16. Native Plant Communities, Condition Ranks, and Acres at Jean Duluth Dog Park Survey Area

Jean Duluth Dog Park Native Plant Communities	Condition Rank	Acres
Disturbed	NA	5.47
WMn82b	C	26.45

Disturbed

The forest to the north of the Sedge Meadow was disturbed and difficult to determine a representative native plant community. The eastern half was a mix of conifer species such as northern white cedar and Scots pine with some hardwood species mixed in such as quaking aspen and paper birch. The conifers appeared to have been planted with several rows evident, though they had been neglected, and the hardwoods had filled in as the mature conifers had died. The western side began to include more speckled alder and other wet shrub species such as willows (*Salix sp*) as the forest grew closer to the wet meadow. The forest floor had a mix of more aggressive native species that don't have a strong preference for one community over another such as large-leaved aster.

The forest to the north beyond public property contained sugar maple and red oak. These mesic hardwood canopy species growing just beyond the disturbed forest might indicate what this forest might once have been.

WMn82b Sedge Meadow

The Sedge Meadow surrounding Amity Creek north of the dog park was a mix of good quality native meadow species such as wool grass *(Scirpus cyperinus*), retrorse sedge (*Carex retrorsa),* and joe pye weed but also contained invasive species such as Canada thistle, tansy, and reed canary grass. A tributary to the East branch of Amity Creek had been ditched through the meadow, and the invasive species were most frequent along that ditched section.

In early 1939 aerial imagery, this area had been cleared along the tributary and along the East branch of Amity Creek to the east. The indication of the ditch was faint, but it didn't appear to have been dug out at the time of the photo. Prior to that, the general region had been within the footprint of the 1918 fire and had either been burned over or already cleared. The ditch might also have been dug to drain the wetland for agricultural purposes.

Rare Plant Occurrences

No rare plant occurrences were observed.

Invasive Species

Invasive species present at the site included Canada thistle, tansy, common valerian, smooth brome, crack willow, and reed canary grass.

Kohls

Table 17. Native Plant Communities, Condition Ranks, and Acres at Kohls Survey Area

Kohls Native Plant Communities	Condition Rank	Acres
Disturbed	NA	60.56

Disturbed

The forested upland or wet mesic forests surrounding Miller Creek were disturbed and did not exhibit indicators or characteristic species that would point to one native plant community. The canopy consisted primarily of quaking aspen with occasional white spruce or white pine. These conifers had likely been planted in earlier restoration attempts. The herbaceous species consisted primarily of aggressive native species such as Canada bluejoint, large-leaved aster, and low bush honeysuckle.

1939 aerial imagery indicated that this forest and the Sedge Meadow (WMn82b) were cleared and farmed in much of the area. Miller Creek had already been ditched in the photo. The 1918 fire map showed that this was within the boundary of the fire.

The Sedge Meadow (WMn82b) and shrub carr system behind the retail store Kohls was the site of a remeander of Miller Creek to restore it from having been ditched, but it was classified as disturbed during this survey due to historical impacts and current powerline work. The Sedge Meadow (WMn82b) was still re-establishing and had a very high diversity of species. It was still predominantly meadow, but slender-leaved willow was common outside of the restoration area and was also filling in quickly within the restoration. As the willows continue to expand, this might change into a willow – dogwood shrub swamp with greater structural complexity. Within the stream channel were emergent species such as arrowhead and some aquatic floating leaved species such as pondweeds (*Potamogeton sp.*). The state endangered floating marsh marigold was also observed on the shore of Miller Creek, in the water, but rooted in soft, mucky sediment. Reed canary grass was found within the restoration and beyond and will continue to be a threat to the meadow carr system.

Rare Plant Occurrences

Floating marsh marigold

Floating marsh marigold was found within the stream channel of Miller Creek with access to full sun. It was lightly rooted in soft, mucky sediment in a straight stretch of slow water between to oxbows. The plant had produced a flower earlier in the year, and seeds were developing.

Invasive Species

Invasive species present in the wet meadow included reed canary grass, Canada thistle, and tansy. No invasive species were observed within the creek channel.

Lester

Table 18. Native Plant Communities, Condition Ranks, and Acres at Lester Survey Area

Lester Native Plant Communities	Condition Rank	Acres
Developed	NA	31.51
Disturbed	NA	115.06
FDn33b	B, C	39.53

Lester Native Plant Communities	Condition Rank	Acres
FDn43a	A	26.66
FDn43b	B, C, D	429.21
FFn57a	B, C	62.90
MHn35b	C	4.03
MHn44a	B, C, D	85.40
MHn46b	B, C	82.98
MRn93b	B	0.07
ROn23a	C	4.73
RVx32	C	3.76
RVx43a2	B, C	25.94
RVx54a	B, C	34.86
WFn55a	B, C	25.62
WFn74a	D	5.61

Developed

Developed polygons consisted of the gravel Skyline Parkway and small pullout parking areas.

Disturbed

The largest disturbed polygon in the survey area is the proposed site of the solar field. This area is surrounded by Aspen - Birch - Red Maple Forest (MHn44a), which is likely the original community type, with the possibility that a WFn55 community once existed along the stream that runs through the site. Other disturbed polygons in the area include conifer plantations and utility corridors.

FDn33b Aspen – Birch Woodland

Northern Dry-Mesic Mixed Woodland was occasionally found along higher elevations near Lester River. These dry-mesic forests contained some of the soapberry species observations and some of the more aggressive native species in the herbaceous and shrub layers, primarily low bush honeysuckle, Canada bluejoint, thimbleberry, and large-leaved aster. The canopy was mainly comprised of mature paper birch and quaking aspen. Species that are characteristic of this NPC were lacking including white, red, and jack pine and, in some cases, replaced by the non-native Scots pine.

FDn43a White Pine – Red Pine Forest

Located in the southern portion of the survey area just outside the natural area boundary, this community featured a canopy with 25–50% cover of white pine and 1–5% cover of red pine. White cedar

was a significant component, comprising 5–25% cover. Lesser amounts of balsam fir, paper birch, quaking aspen, and white spruce were present, primarily in the subcanopy. Eastern hemlock seedlings were also observed in this community. Weedy species such as Kentucky bluegrass had low cover and were mostly restricted to areas near trails. Otherwise, the community was in excellent ecological condition, with a diverse herbaceous ground layer including wild sarsaparilla, smooth wild rose (Rosa blanda), false melic grass (Schizachne purpurascens), and Canada mayflower. This community serves as a valuable reference for restoring declining Aspen – Birch Forest (FDn43b) polygons in northern areas to this community type.

FDn43b Aspen – Birch Forest

Aspen – Birch Forest had the most acreage of all NPCs and occurred on well-drained mesic soils. Dominant canopy species were primarily quaking aspen and paper birch, both young and mature. Common buckthorn is a main stressor in the understory and is inhibiting the natural regeneration of desirable species. Regeration is limited further by intense browse pressure by white tail deer. More aggressive native species were often observed in the herbaceous and shrub layers, primarily low bush honeysuckle, Canada bluejoint, beaked hazelnut, and large-leaved aster. These species outcompete more diminutive or less aggressive species characteristic of this NPC such as fly honeysuckle, bluebead lily, sarsaparilla, and Canada mayflower.

FFn57a Black Ash – Silver Maple Terrace Forest

Black Ash – Silver Maple Terrace Forest was typically found along Lester River and was dominated by black ash in the canopy. Both terrace forests and wet forests shared these features and were distinguished by differences in herbaceous species. The terrace forests included more floodplain species that tolerate fluctuating hydrology, including ostrich fern, wood nettle, tall meadow-rue, and sensitive fern. Silver maple, which can be abundant in floodplain forests, was missing from the canopy. Along the Lester River, the terrace communities were perched above bank full, cutting off access to the floodplain and reducing flooding of these systems during very wet years or after large rain events.

MHn35b Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest

A few polygons in the southwest part of Lester, adjacent to a large disturbed area and Hawk Ridge, represent a lower quality community influenced by their proximity to disturbance. These areas were difficult to classify due to their transitional nature. The canopy is primarily composed of young quaking aspen, with low understory diversity throughout.

MHn44a Aspen – Birch – Red Maple Forest

Aspen – Birch – Red Maple Forest was scattered within the larger northern mesic mixed forest and transitioned into other communities without obvious shifts in vegetation. Quaking aspen, paper birch, and red maple with dominant in the canopy and black ash occurred in the subcanopy. These plant communities had greater diversity in the herbaceous and shrub layers with a mix of wet species like bladder sedge (Carex intumescens), jewelweed, and white avens (Geum canadense) and dry species including large-leaved aster, low bush honeysuckle, and beaked hazel.

MHn46b Black Ash – Basswood Forest

Black Ash – Basswood Forest occurred on moderate to soft slopes adjacent to Lester River and Amity Creek or intermittent streams. Characteristic canopy species included basswood, black ash, and quaking aspen. Herbaceous indicator species were limited due to the disturbance history within these communities but included woodbine, jack in the pulpit, and graceful sedge along with some of the more tolerant upland species like Pennsylvania sedge, large-leaved aster, and lady fern. The absence of floodplain species such as ostrich fern and wood nettle indicated these areas were not Black Ash Silver Maple Terrace Forest (FFn57a).

MRn93b Spikerush – Bur Reed Marsh (Northern)

The spikerush – bur reed marsh was observed on the east side of Amity Creek and appeared to have been created from a beaver or human made dam. The plant community within and around the ponded water contained a diverse set of species, both emergent, aquatic, and wet meadow. The primary indicator species included northern and rattlesnake mannagrass (Glyceria borealis and G. grandis), water horsetail (Equisetum fluviatile), Potamogeton foliosus, arrowhead, northern water plantain (Alisma triviale), and leafy pondweed (Eleocharis obtusa). Additional small ponds (i.e. abandoned oxbows) were located along Amity but were hydrologically separated from the main channel. Most of them remained forested due to steeper elevation gradients around with upland species. They did not have ash in the canopy to lose. Reed canary grass and Canada thistle are both threats to this community either growing within it in small percentages like reed canary grass or in the adjacent community as both reed canary grass and Canada thistle were found in much higher percentages.

ROn23a Bedrock Shrubland (Inland)

Bedrock Shrubland (Inland) was mapped in Hawk Ridge at higher elevations with shallow to no soil. These rocky outcrops varied in size and were surrounded by forests that occurred at lower elevations with more soil. Vegetation structure consisted of scattered islands of shrubs such as serviceberry, low bush honeysuckle, and prairie willow. Lower shrub and herbaceous species surrounded the islands of shrubs and grew within the bedrock cracks, such as pale corydalis, rock spikemoss, poverty oat grass, and pussy toes. Other common species included caribou moss and cliff ferns such as rusty wood fern. Occasionally, bedrock outcrops supported small populations of soapberry.

RVx32 Sand/Gravel/Cobble River Shore

RVx32b2 Sand Beach/Sandbar (River) and RVx32c2 Gravel/Cobble Beach (River) occurred along Amity Creek. These two communities were often narrow bands along the stream or point bars of cobble or sand deposited by flooding events from storms or snowmelt. Due to the small and sporadic nature of these NPC and disturbances causing frequent changes in shape and sometimes sediment type, they were classified to the higher level of Sand/Gravel/Cobble River Shore (RVx32) and lumped together.

RVx43a2 Bedrock/Boulder Shore (Permanent Stream Subtype)

Bedrock/Boulder Shore (Permanent Stream Subtype) was within and immediately adjacent to Lester River and Amity Creek. Stunted tree species such eastern white cedar, white spruce, and balsam fir grew

just beyond the ordinary high-water mark. Characteristic herbaceous species of Bedrock/Boulder Shore along a permanent stream included harebell (Campanula rotundifolia), giant goldenrod (Solidago gigantea), hairy goldenrod (Solidago hispida), water hemlock (Cicuta maculata), fowl manna grass (Glyceria striata), and common bladder fern (Cysopteris bulbiferus). Within the understory and edges of the Bedrock/Boulder Shore community were several observations of soapberry.

RVx54a Slumping Clay/Mud River Slope

Slumping Clay/Mud River Slope was typically found adjacent to Lester River and Amity Creek where the water had eroded away at the steep clay slopes. The dominant canopy species was speckled alder with shrubby willow species like sandbar, slender-leaved willow, and Bebb's willow (Salix interior/petiolaris/bebbiana) and occasionally eastern white cedar. Exposed clay was common with characteristic herbaceous species such as hairy goldenrod (Solidago hispida), Philadelphia fleabane (Erigeron philadelphicus), horsetails (Equisetum sp), tall meadow-rue and yellow rocket (Barbarea vulgaris). Occasional soapberry occurrences were found within the clay bluffs, usually at the top of an eroded bank near the edge of the vegetation. Some invasive species were taking advantage of the exposed clay such as orange hawkweed and tansy.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

Black Ash – Aspen – Balsam Poplar Swamp (Northeastern) occurred along the riparian corridors of upper Amity Creek along Seven Bridges Road and along unnamed and intermittent streams that flow into the Lester River. The Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a) communities along the unnamed, intermittent streams were narrow forested wetlands with black ash dominating the canopy. Along Amity Creek, black ash used to be the dominant canopy species, but early infestations of the emerald ash borer have caused near full ash mortality causing the canopy to transition. There was scattered mature yellow birch. Several of these large black ash swamps experiencing significant mortality were transitioning to either Wet Meadow with dense Canada bluejoint (Sedge Meadow Bluejoint Subtype (WMn82b1)), reducing species diversity, or Northern Wet Alder Swamp (WFn74) with a canopy of either speckled alder or non-native common buckthorn and glossy buckthorn.

WFn74a Alder - (Red Currant - Meadow-Rue) Swamp

Alder - (Red Currant - Meadow-Rue) Swamp was found in low lying depressions surrounded by upland mesic forests within Lester. Higher quality swamps were dominated by speckled alder, but more often they were overtaken with common buckthorn and glossy buckthorn with a very low diversity of herbaceous species. Areas of particularly low-quality include the northwest end of the forest in Lester, which were disturbed by historic trails. Aerial imagery from 1939 shows the alder swamp that has been overtaken by common buckthorn had been cleared and resembled an open field within the greater forest. The 1918 fire boundary indicates that this forest likely burned.

Rare Plant Occurrences

Four state-listed vascular plant species were found within the Lester River woodlands, including soapberry, barren strawberry, pale sedge, and eastern hemlock.

Soapberry

The primary observations of soapberry were identified in rocky outcrops, fire dependent forest, bedrock riverbanks, and eroding clay bluffs. Approximately 150 individuals were documented, mostly as single individuals and occasionally in small groups of 2-10 plants.

Soapberry prefers full sun to part sun along forest openings, in shrubby bedrock communities, and occasionally in sloughing clay/mud slopes. In the western United States where it is more common, soapberry rebounds quickly after wildfire, suggesting that it is a fire dependent or fire tolerant species and might be an indicator of suitable habitats to incorporate wildfire as a management tool. Soapberry is a dioicous shrub with male and female flowers occurring on separate individuals, and one isolated shrub cannot self-pollinate. It is not a preferred food of deer, but browsed twigs were occasionally observed.

Barren strawberry

Barren strawberry, a species of concern, was documented in four colonies in one geographic region within Aspen-Birch Forest (FDn43b) in the Lester area. Scattered individuals were observed on either side of a snowmobile trail, and a large population occurred near the snowmobile trail in full shade of dense conifer canopy.

While barren strawberry is an infrequent herbaceous groundcover species in Minnesota, it is fairly common in Wisconsin and further east. It can tolerate part to full shade and dry to mesic soil. It has been found along logging roads and in conifer plantations, indicating it may benefit from disturbance.

Pale sedge

Three isolated individuals of pale sedge, a state endangered species, were observed along a dry path along a forest edge in partial sun. This sedge has cylinder-shaped spikes and distinct perigynia, making it easily identifiable once the perigynia are mature.

Other observations of pale sedge within Duluth were found in similar habitat consisting of well-drained soils in hardwood forests with access to sunlight, often due to an artificial canopy gap like a trail.

Eastern hemlock

Eastern hemlock is a state endangered species. Three seedlings were found just south of the DNAP boundary that were 3 feet tall, heavily browsed, and growing along an intermittent stream in dense conifer canopy. In shaded habitat, eastern hemlock can remain in seedling stage for up to 100 years, so these individuals could be quite old and of natural origin. Alternatively, they could have been planted within the last 20 years or more, coming from Wisconsin origin or elsewhere. An attempt was made to locate a seed tree within the dense conifer canopy, but none were found.

Eastern hemlock persists in a variety of habitats throughout its range. In Minnesota, the populations have been observed along river and stream ravines in shady habitats with surrounding mesic hardwood forests. It is also documented in mesic mixed coniferous forests, sometimes far away from a stream and in the super canopy, similar to white pine.

Invasive Species

Populations of invasive species were documented throughout, but the greatest infestations occurred adjacent to roads or trails, adjacent to private property, and within forested communities with evidence of past land alteration like homesteads or clearing. The primary invaders were established species including common buckthorn, glossy buckthorn, and honeysuckle species (Lonciera tatarica, Lonicera marrowii, and Lonicera X bella). The most prevalent invasive species was common buckthorn, which at times had high cover in the most heavily impacted areas with scattered individuals between dense populations. It was often a mature shrub or small tree with fruit in rock outcrop areas and generally a non-fruit bearing seedling in shadier habitats. Glossy buckthorn was more common in the Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a) and alder thicket (WFn74), while common buckthorn is most prevalent in Bedrock Shrubland (Inland) (ROn23a) and upland forested communities (Aspen – Birch Forest (FDn43b) and Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn35b)).

Honeysuckle species were generally located in Bedrock Shrubland (Inland) (ROn23a), fire-dependent forest (FDn33a), and transitional areas between those communities. It was often observed as a mature, fruit-bearing shrub.

Many non-native, weedy species were documented throughout but were generally scattered as individuals and did not account for a significant portion of ground cover in the NPCs. The most frequently encountered weedy species were common dandelion, bittersweet nightshade, clover species, brittlestem hemp-nettle, Kentucky bluegrass, and creeping bentgrass.

Other non-native species observed that are not known to be established in the Duluth area but have the potential to become invasive were cotoneaster and barberry (Berberis vulgaris). The cotoneaster was primarily observed in the rock outcrop communities in significant numbers on some outcrops. The barberry was observed within the mesic forests. These species were not widespread and usually occurred as a single induvial. A rising threat observed in wild spaces on the west side of Duluth in Magney-Snively and Mission Creek is helleborine orchid (Epipactis helleborine) in mesic hardwood forests. More research is needed to determine if this orchid will form dense colonies and displace native orchids or other sensitive vegetation, impact pollinators foraging availability, or influence the mycorrhizal species composition since orchids are often linked with specific soil fungi. This is a species to look for in mesic hardwood forests (Northern Wet-Mesic Boreal Hardwood-Conifer Forest (MHn44), Northern Wet-Mesic Hardwood Forest (MHn46), MHn47, FDn33, FDn43).

LSC

Table 19. Native Plant Communities, Condition Ranks, and Acres at LSC Survey Area

LSC Native Plant Communities	Condition Rank	Acres
Developed	NA	2.77
Disturbed	NA	17.59

LSC Native Plant Communities	Condition Rank	Acres
MHn35b	Not assessed	49.76
WFn53a	Not assessed	11.99

Developed

The Lake Superior College buildings and parking lots were constructed in what had been mesic hardwood forest. A large percent of the canopy of that hardwood forest was removed to construct the buildings, and that area now drains into Miller Creek.

Disturbed

The disturbed plant communities within the Lake Superior College Campus consisted of communities that no longer retained native species assemblages due to the planting of non-native Scots pine and the historic clearing that occurred prior to 1939 that left an altered plant community. Additional disturbed areas include the corridor of a sewer line that must remain open for maintenance of vehicle access. Some of the southwest mesic hardwood forests have been invaded by the ***Rowan*** mountain-ash and do not resemble a native plant community any longer.

Within some of these disturbed areas as well as the mesic hardwood forest, buckthorn was controlled and exclosure plantings of red oak, northern white cedar, basswood, and sugar maple were doing well.

MHn35b Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest

Red Oak – Sugar Maple – Basswood (Bluebead Lily Forest) was the most common plant community throughout the Lake Superior College campus and surrounding forest. Mature yellow birch, sugar maple, super canopy white pine, and occasional red oak in very low frequencies indicated what this mesic forest had once been. The majority of the canopy consisted of quaking aspen and paper birch. The understory of the aspen and paper birch dominated forests had lower herbaceous species diversity than was found in areas with mature sugar maple, yellow birch, and red oak. More aggressive native species such as large-leaved aster and low bush honeysuckle dominated the herbaceous layer beneath the aspen and paper birch.

Early 1939 aerial imagery some of the forests had been cleared, and the remaining forest had scattered mature trees with dense young saplings or shrubs. The 1918 fire boundary suggests that this forest did not burn but was close to the leading edge of the fire.

WFn53a Lowland White Cedar Forest (North Shore)

The lowland white cedar forest was classified based on several indicator species, such as northern white cedar, yellow birch, paper birch, mountain maple, speckled alder, and beech fern. It also included species that are not primary indicators of lowland white cedar forest but rather indicate disturbance such as crack willow, Rowan mountain-ash, and thimbleberry or influence from the adjacent mesic hardwood

forest such as quaking aspen and pagoda dogwood. Large boulders and bedrock were common along the Miller Creek stream bed and occasional ravines.

Rare Plant Occurrences

No rare species were found in the Lake Superior College area, but surveys were not comprehensive in the area. Floating marsh marigold was found upstream in Miller Creek, but little suitable habitat exists in this stretch of Miller Creek with much more bedrock and boulder conditions in the streambed.

Invasive Species

Common buckthorn and Rowan mountain-ash were the two primary concerning invasive species found within the Lake Superior College forest. European mountain ash was common on the western side of the mesic hardwood forest and less often toward the east, suggesting that it had been planted on the west side either at a residential home that escaped or was planted on LSC property in the past. Common buckthorn was found throughout but had been controlled by LSC students in the past.

LSC – ERTC

This area was mapped through desktop review only. No field surveys were conducted, and as a result, no data were collected on native plant communities, rare plants, or invasive species.

Table 20. Native Plant Communities, Condition Ranks, and Acres at LSC-ERTC Survey Area

LSC - ERTC Native Plant Communities	Condition Rank	Acres
Disturbed	Not assessed	4.17
MHn35	Not assessed	60.30
MHn44	Not assessed	40.15
MHn46	Not assessed	2.48
WFn55a	Not assessed	1.79
WFn64	Not assessed	16.29

Mission Forest

Table 21. Native Plant Communities, Condition Ranks, and Acres at Mission Forest Survey Area

Mission Forest Native Plant Communities	Condition Rank	Acres
CTn11e	B	1.12
Disturbed	NA	34.67
FDn43b	B	19.15

Mission Forest Native Plant Communities	Condition Rank	Acres
FFn57a	A, B	41.00
MHn35b	A, B, C	1210.36
MHn44	B	39.09
MHn44a	A, B	63.66
MHn44b	A, B	196.90
MHn44c	A, B	195.30
MHn45b	A, B	12.10
MHn46b	A, B	184.85
MHn47a	A, B	14.56
RVx32	A, B, C	14.50
RVx54a	B, C	36.73
WFn55a	A, B, C	7.24
WMn82b1	C	3.34

CTn11e Dry Sandstone Cliff (Northern)

Dry Sandstone Cliff were present but not numerous along the St. Louis River below the Fond du Lac dam. These were very inaccessible due to steep terrain. Some characteristic, dry, sun-loving species included howell's pussytoes (*Antennaria* howellii), early goldenrod (*Solidago* juncea), harebell (*Campanula rotundifolia*), tall thimbleweed (*Anemone virginiana*), and poverty oat grass. Numerous shrub species like staghorn sumac (*Rhus typhina*), sandbar willow (*Salix inerior*), and stunted cedar were also present. The state listed special concern soapberry was observed at the top and bottom of the steep sandstone cliffs. Mountain biking trails were cut through these communities and required considerable benching to maintain safety.

Disturbed

Mission Creek remained relatively undisturbed with few areas mapped as disturbed. A wide powerline in the northwest and some lower reaches of Mission Creek where the 2012 flood had damaged the floodplain were two locations classified as disturbed. Smaller disturbed pockets existed such as the corridor of the historic Mission Creek Parkway, the corridor of the old rail line that followed the river with abandoned infrastructure, and an old homestead near the Minnesota Power facility within the mesic hardwood forest. Remnants of a sidewalk and stairs were present under the forest canopy.

FDn43b Aspen – Birch Forest

Aspen – Birch Forest was not a common native plant community in Mission Forest and occurred on well-drained mesic soils. Dominant canopy species were primarily quaking aspen and paper birch, both young and mature. Common buckthorn was an occasional stressor in the understory and is inhibiting the natural regeneration of desirable species. Regeration is limited further by intense browse pressure by white tail deer. More aggressive native species were often observed in the herbaceous and shrub layers, primarily low bush honeysuckle, Canada bluejoint, beaked hazelnut, and large-leaved aster. These species outcompete more diminutive or less aggressive species characteristic of this NPC such as fly honeysuckle, bluebead lily, sarsaparilla, and Canada mayflower.

FFn57a Black Ash – Silver Maple Terrace Forest

Black Ash – Silver Maple Terrace Forest was found along Mission Creek and dominated by black ash in the canopy. Both terrace forests and wet forests shared these features and were distinguished by differences in herbaceous species. The terrace forests included more floodplain species that tolerate fluctuating hydrology, including ostrich fern, wood nettle, tall meadow-rue, and sensitive fern. Silver maple, which can be abundant in floodplain forests, was missing from the canopy. In the Mission Forest, several of the terrace communities were perched above bank full, cutting off access to the floodplain and reducing flooding of these systems during very wet years or after large rain events. The black ash were still showing little to no sign of beetle stress at the time of survey. Additional species such as yellow birch and northern white cedar exhibited other species that could do well in that area and be planted before the mass die-off of the ash canopy.

In 1939 aerial imagery, the floodplain forest appeared to have been fairly open and possibly manicured, suggesting the forest had recovered from past disturbance well. The 1918 fire map boundary shows that Mission Creek did not burn in that fire.

MHn35b Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest

Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest generally occurred in higher elevations with deeper, well-drained mesic soils. In Mission Creek this was most of the upland forest throughout the forest and contained higher quality stands that had a diverse, mature canopy consisting of red oak, sugar maple, and basswood. Occasional super canopy white pine was observed. Characteristic shrubs such as pagoda dogwood, beaked hazelnut, and fly honeysuckle were present. Some herbaceous species expected in this NPC were observed but in low densities including bluebead lily, wild sarsaparilla, and sweet-scented bedstraw. More tolerant characteristic species included Pennsylvania sedge and mountain rice grass. In the south-central area, poison ivy (*Toxicodendron rydbergii*) was frequent.

Within the northwest of Mission Forest, many forests were dominated by quaking aspen with occasional mesic hardwood species like sugar maple, basswood, and yellow birch. These forests are considered younger northern mesic hardwood stands that may be prevented from progressing to later successional stages due to the high deer population within city limits. Early 1939 aerial imagery show evidence of timber harvesting in the northwest region of the forest and was likely the cause of the altered forest canopy to this day.

The mountain biking trails and the Superior Hiking Trail run through this forest type, providing opportunities for invasive species introductions and proliferation. Many weedy species like dandelion and clover species (*Triflolium sp*) were confined to the weed whipped trail corridor.

MHn44 Northern Wet – Mesic Boreal Hardwood – Conifer Forest

Several polygons consisted of a mix of Northern Wet-Mesic Boreal Hardwood-Conifer Forest (MHn44) types, either displaying characteristics of multiple community types or containing small inclusions of various types that could not be easily separated. In some cases, these areas were not field verified, and the specific type could not be distinguished through desktop review. Some of these northern wet - mesic boreal hardwood – conifer forests were dominated by quaking aspen with occasional black ash and poorly defined herbaceous layers with low diversity. Invasive species were not generally a problem, but the herbaceous layer often consisted of more aggressive native species such as large-leaved aster, dwarf raspberry (*Rubus pubescens*), and Pennsylvania sedge. The characteristic species that would have indicated a strong affinity for one of the subtypes were absent. Aerial imagery from 1938 did not reveal any large-scale land clearing, but some selective cutting appeared to have taken place.

MHn44a Aspen – Birch – Red Maple Forest

Aspen – Birch – Red Maple Forest was a fairly uncommon plant community along the steep terrain rising up in elevation from a wetland seepage or a stream. These communities had quaking aspen, paper birch, balsam fir and occasional red oak, sugar maple, or basswood. Common buckthorn was not a huge issue in these communities. These communities appeared to also contain some of the sloughing clay slopes, suggesting clay might be present in the soils of these communities.

MHn44b White Pine – White Spruce – Paper Birch Forest

White pine - white spruce – paper birch forest was a very common plant community within Mission Forest and was often found on steep slopes with mesic soils. The primary canopy species were a mix of white pine, red pine, sugar maple, basswood, northern white cedar, balsam fir, and white spruce. Some of the pines had fire scars at their bases. Understory species were sparse and included wild sarsaparilla, Pennsylvania sedge, large-leaved aster, thimbleberry, and fly honeysuckle. No regeneration of desired species like white pine, red pine, or northern white cedar was observed in these communities, despite how steep the terrain was. The understory was fairly open with low growing herbaceous or scattered shrubs and few young saplings. The topography protects these communities from severe wind events. The mountain bike trail travels through many of these communities and would be the main pathway for new introductions of invasive species.

MHn44c Aspen – Fir Forest

Aspen – fir forest was dominated by quaking aspen but also had a higher frequency of black ash in the canopy. Additionally, the herbaceous species on the forest floor indicated wetter soils than either of the other two northern wet-mesic boreal – conifer forests listed above. Occasional swamp aster (*Synphyotrichum puniceum*) sweet-scented bedstraw, and fringed brome (*Bromus ciliatus*) were observed in the wetter soils. These forests typically did not have older canopy species, and natural

regeneration was primarily restricted to aspen and black ash, despite the occasional basswood or sugar maple that happened to be present. These forests didn't often have the mountain bike trail within them, but often the bike trail delineated an upper elevation of the community to avoid the steep terrain and soft, wet soils.

Eroding clay bluffs were frequently found in these communities, and canopy species were at varying ages from prior to or present eroded clay bluffs.

White Cedar – Yellow Birch Forest

This community was dominated by white cedar with 50–75% canopy cover and yellow birch comprising 5–25% of the canopy. Mountain maple was present in the shrub layer. Characteristic forbs included beech fern and thimbleberry. The largest polygon occurred in the southwestern portion of the survey area, on steep, primarily north facing slopes that were separated by Northern Wet-Mesic Hardwood Forest (MHn46) in the ravines. Ground cover ranged from sparse to over 50%. There were small inclusions of MHn45 within other community types, some of which were too small to map. No natural regeneration of seedlings or saplings of either cedar or yellow birch were observed in these communities.

MHn46b Black Ash – Basswood Forest

Black Ash – Basswood Forest occurred just above the lowest elevations of ravines, wet forest seepages and streambeds. These communities denoted the transition between the wettest soils with poor drainage below and the well-drained, mesic soils of the mesic hardwoods in the higher elevations. These black ash – basswood forests had steep and leveling slopes depending on how close they were to a stream channel. The primary canopy consisted of black ash, basswood, and quaking aspen. Sometimes characteristic herbaceous species were present, such as sarsaparilla, Pennsylvania sedge, lady fern, and Canada mayflower and sometimes they were not.

MHn47a Sugar Maple – Basswood – (Bluebead Lily) Forest

Sugar Maple – Basswood - (Bluebead Lily) Forest was mapped very seldom within the Mission Forest. The nutrient rich, well drained, mesic soils support a continuous canopy, dominated by sugar maple that also has occasional to frequent basswood and yellow birch. Characteristic species of this forest type include jack-in-the-pulpit (*Arisaema triphyllum*), the wood ferns (*Dryopteris carthusiana* and *D. cristata*), oak fern (*Gymnocarpum dryopteris*), and bloodroot (*Sanguinaria canadensis*).

RVx32 Sand/Gravel/Cobble River Shore

RVx32b2 Sand Beach/Sandbar (River) and RVx32c2 Gravel/Cobble Beach (River) occurred primarily within the stream channel of Mission Creek anywhere below the ordinary high-water mark. The stream channel was a mix of gravel and cobble with areas of finer sediments like clay in places where recent bluffs had eroded into the stream. Crack willow which is commonly found growing within and beside stream channels in small Duluth creeks was not observed within or alongside the Mission Creek channel.

RVx54a Slumping Clay/Mud River Slope

Slumping Clay/Mud River Slopes were frequently found along the ravines of Mission Creek and small tributaries. These clay bluffs were at varying stages of sloughing with some having fully revegetated, the only evidence was the shape of the steep forest floor, and others having recently sloughed down to the river, taking all vegetation down and leaving behind exposed clay. Indicator species of these steep clay bluffs are those that colonize it well, including willows like sandbar, slender-leaved, and bebb's (*Salix interior, S. petiolaris,* and *S. bebbiana*), and green alder (*Alnus viridis*). Also found in these eroding clay bank communities, though seldom, was the state listed special concern soapberry. This shrub has been found frequently in the eroding clay banks along Lester River and Amity Creek and also found in the bedrock outcrops at Magney-Snively. It was always searched for within the eroding clay bluff communities, but seldom located.

Early 1939 aerial imagery reveal that the slumping clay slopes were always common in Mission Forest, particularly along the steep terrain of the Mission Creek valley. Comparing the exposed clay banks from 1939 with the 2025 field surveys and desktop analysis appears to show an increase in these eroding clay banks. This is likely highlighting the impacts of the 2012 flood to the Mission Creek valley and not a trend.

Some invasive species have taken advantage of the exposed clay soils, including tansy, common valerian, reed canary grass, and hawkweed species (*Hieracium sp*). These invasives are displacing the native species that have adapted to these systems like golden-fruited sedge (*Carex aurea*), Philadelphia fleabane (*Erigeron philadelphicus*), field horsetail (*Equisetum arvense*), and pussytoes (*Antennaria sp.).* These species quickly vegetate the exposed clay.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

Black Ash – Aspen – Balsam Poplar Swamp (Northeastern) occurred along the lowest elevations of narrow ravines. Black ash dominated these small wetlands and were still in good health at the time of the 2025 field surveys. Some narrow wet forests along seepages and intermittent or small stream channels were not mapped because they were too small. The herbaceous vegetation in those small wetlands revealed the waterlogged soils.

WMn82b1 Sedge Meadow Bluejoint Subtype

This community was represented by a single small polygon characterized by 50–75% cover of Canada bluejoint and 5–25% cover of reed canary grass with shrub willows *(Salix sp*) and red osier dogwood in patches and along the edges. Other invasive species present included Canada thistle, broad-leaved cattail (*Typha latifolia*), meadow hawkweed (*Hieracium caespitosum*), and common valerian. Native species such as Joe-Pye weed and jewelweed were also present. The mountain biking trail went through and around the meadow.

Rare Plant Occurrences

Barren strawberry

Barren strawberry, a species of special concern, was observed under a full canopy within mesic hardwood forest (MHn35) in the Mission Creek forest.

Pale sedge

Several individuals of pale sedge, a state endangered species, were observed along the Mission Creek Parkway, growing on the weedy edge of the footpath. The individuals had access to part to full sun but grew in competition with other sedges and grasses and a canopy of speckled alder.

Invasive Species

The primary concern throughout the Mission Forest was common buckthorn. Though buckthorn wasn't common, it was frequently found as a component of the shrub layer, sometimes in high numbers. Due to the challenging terrain of the area and the widespread occurrences of buckthorn even while still in relatively low abundance when found, controlling this species will be both costly and require a significant effort.

Moose Hill

Table 22. Native Plant Communities, Condition Ranks, and Acres at Moose Hill Survey Area

Moose Hill Native Plant Communities	Condition Rank	Acres
Developed	NA	0.86
Disturbed	NA	16.66
FDn43b2	B, C	235.81
ROn23a	Not assessed	10.78
WFn55a	B, C, D	18.22
WFn74a	C	8.61

Developed

Developed polygons adjacent to or associated with MN-61 represent areas of infrastructure and land use directly connected to the highway corridor.

Disturbed

This area consists of disturbed upland forest that was formerly classified as Aspen – Birch Forest (FDn43b), primarily located adjacent to MN-61. In addition, there is an old field connected to private property and other small, non-native uplands.

FDn43b2 Aspen – Birch Forest Hardwood Subtype

The dominant canopy species included quaking aspen and paper birch with lesser amounts of red and sugar maple (and *A. saccharum*), balsam fir, white spruce, and black ash. Understory species were a mix of wet, mesic, and drier sites, including swamp red currant, Canada bluejoint, colt'sfoot (*Petasites frigidus*), wild oats (*Uvularia sessilifolia*), rose twisted stalk (*Streptopus lanceolatus*), and long-stalked sedge (*Carex pedunculata*). The canopy species were the primary indicator that most of the site was Northern Mesic Mixed Forest – Hardwood Subtype (FDn43b2).

1939 aerial imagery revealed that much of the area had remained forested as the surrounding forest was cleared for residential fields and home construction. The 1918 fire map boundary shows that this area burned in the fire. The oldest trees located were the longer-lived hardwoods like sugar and red maple.

A small, unmapped drainage cut across the hardwood forest and crossed Homestead Road. Two populations of a previously DNR tracked species, nodding sedge *(Carex gynandra)* were located along that intermittent stream. This species remains uncommon in Minnesota and has only been located in the northeast of the state. Also found at the stream crossing with Homestead Road was the invasive queen of the meadow (*Filipendula ulmaria*). This weedy species is a concern in wetlands and has been spreading north along the expressway from Brighton Beach in the ditches.

A small inclusion of Balsam Fir Subtype (FDn43b1) was infrequent and occurred as a large pocket within the Hardwood Subtype (FDn43b2) above a tributary on the east side of Homestead Road. Very few herbaceous species could grow under the dense shade from the balsam fir and included large-leaved aster (*Eurybia maculata*). This area was searched for the state listed special concern barren strawberry since it somewhat resembled the Lester canopy where it had been found; however, the balsam fir canopy was likely too dense to support the barren strawberry. Common buckthorn is also a concern throughout this forest, but the largest population was located on the far west side which had been cleared in 1939. Buckthorn was scattered throughout the hardwood forest at low densities as individual saplings or small populations of saplings and occasional mature adults.

Ron23a Bedrock Shrubland (Inland)

This community was not field verified due to inaccessibility, as it was surrounded by private land.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

The Black Ash – Aspen – Balsam Poplar Swamps were heavily impacted in the Moose Hill forest. The black ash has suffered mass die-offs from the emerald ash borer and the only tall canopy tree species left include balsam poplar and paper birch. The wet forest to the west was in poorer quality than the wet forest to the east. In the western wet forest, the black ash have been replaced at times with speckled alder, but common buckthorn has been more aggressive than native shrubs and the diversity of herbaceous species has degraded. The total number of species observed was under 20, and those included native species that tolerate changes in their environment, such as large-leaved aster, lance leaved aster (*Symphyotrichum lanceolatum*), downy yellow violet (*Viola pubescens)* and bladder sedge (*Carex intumescens*). Early 1939 aerial imagery indicates a large area of forest had been cleared on the western boundary, correlating with the higher number of invasive species.

The wet forest to the east of Homestead Road was in better condition with a higher diversity of species in the understory. Common buckthorn was very uncommon in this area, allowing native species to grow in response to the black ash die-off. This wet forest had not been cleared, though it was within the 1918 fire boundary and might have burned.

WFn74a Alder - (Red Currant - Meadow-Rue) Swamp

Alder - (Red Currant - Meadow-Rue) Swamp had been a Black Ash – Aspen – Balsam Poplar Swamp (WFn55a) but as the black ash has died off due to the emerald ash borer and currently remains as snags, speckled alder has succeeded in transitioning this community into a shrub dominated wetland. The herbaceous species included a variety of wetland species, including fringed loosestrife (*Lysimachia ciliata*), virgin's bower (*Clematis virginiana*), and beech fern.

Rare Plant Occurrences

No rare species were observed within this area, though nearby forests like the Moose Mountain Scientific and Natural Area (SNA), Lester Park, and Brighton Beach all have documented the special concern species soapberry somewhere on site.

The previously DNR tracked nodding sedge (*Carex gynandra*) was observed in two separate populations along an intermittent stream. While this is no longer being tracked by the DNR, it is still a very uncommon species and is only found in the northeastern part of Minnesota.

Invasive Species

Common buckthorn was the greatest concern in the Moose Hill Forest and was actively replacing black ash as emerald ash borer killed it. The other two concerning species located in the Moose Hill Forest were Japanese barberry growing very infrequently as scattered individuals within the hardwood forest and queen of the meadow found as dense populations along the ditch of Homestead Road and spreading into the forested canopy of an intermittent stream to the west of the road.

SLC Public Safety

Table 23. Native Plant Communities, Condition Ranks, and Acres at SLC Public Safety Survey Area

SLC Public Safety Native Plant Communities	Condition Rank	Acres
Disturbed	Not assessed	46.78
MHn47a	Not assessed	4.79

This area was not field verified so NPC descriptions, rare plants, and invasive species were not assessed.

Spirit Mountain

Table 24. Native Plant Communities, Condition Ranks, and Acres at Spirit Mountain Survey Area

Spirit Mountain Native Plant Communities	Condition Rank	Acres
Disturbed	NA	0.59
FPn73a	C	7.75
MHn35b	B, C	157.14
MHn46b	B	8.67
MHn47a	A, B	401.51
WFn55a	B	2.59
WFn64c	B	35.98

Disturbed

One disturbed polygon was located within Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a), consisting of shrubby vegetation growing on a rocky slope with shallow or absent soils. The area was strongly dominated by common buckthorn and non-native honeysuckle (likely *Lonicera x bella*).

FPn73a Alder Swamp

Speckled alder dominated the canopy of the alder swamp. Unique understory species, including cinnamon fern were observed in this wetland. Common buckthorn has invaded one of these wetlands near the northwestern boundary and has degraded the herbaceous layer, lowering species diversity.

MHn35b Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest

The red oak – sugar maple – basswood forest was more common on the lower elevation slope below West Skyline. This forest had a dense network of mountain biking trails along with the Superior Hiking Trail, and work is being done to construct a cross-country ski connector trail through this forest. The canopy consisted of sugar maple, red oak, and paper birch and less frequent was basswood and very rarely was white pine observed.

Common buckthorn was frequent east of West Skyline and when found, the abundance was high, impacting the species diversity and quality of the herbaceous species. Deer browse was also observed to be high throughout the area. Hawkweed (*Hieracium aurianticum*) was spreading across the forest floor.

MHn46b Black Ash - Basswood Forest

A narrow black ash – basswood forest was observed along the corridor of Lenroot Street Creek. The canopy had co-dominant black ash and yellow birch with some basswood, red oak, and sugar maple present. Herbaceous species observed included beech fern, lady fern, and Pennsylvania sedge. Common buckthorn were uncommon in this wet-mesic forest.

MHn47a Sugar Maple – Basswood - (Bluebead Lily) Forest

The sugar maple – basswood – forest was dominated by sugar maple, with red oak, and yellow birch as less co-dominant species, and ironwood in the subcanopy. Little to no conifers were observed or could be seen in early spring leaf off imagery. This plant community contains numerous vernal pools and several moderately sized forested wetlands. Several small streams and tributaries flow down the hillside from this rich forest and empty into the St. Louis River.

Common buckthorn was occasional, and very few other invasive species were observed in the rich hardwood forest. A dense network of cross-country ski trails cuts through this forest and winds around wetlands and occasionally runs through them. A snowmobile trail travels near the northern boundary within the rich hardwood forest.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

This community was represented by a single small polygon connected to Black Ash - Conifer Swamp (Northeastern) (WFn64a) and bordered by Sugar Maple - Basswood - (Bluebead Lily) Forest (MHn47a). The canopy included sugar maple and dead or dying black ash. Speckled alder was present in the shrub layer. The ground layer featured a variety of forbs, including ostrich fern, beech fern, false Solomon's seal (*Maianthemum racemosum*), woodland horsetail (*Equisetum sylvaticum*), Pennsylvania sedge, and interrupted fern (*Osmunda claytoniana*). No invasive species were observed in this community.

WFn64c Black Ash – Alder Swamp (Northern)

The Black Ash - Alder Swamp (Northern) contained black ash that was suffering from EAB but still had good species diversity in the understory. Shrubs such as speckled alder and mountain maple often compose a dense subcanopy and can play an important role of maintaining canopy during the anticipated community shift due to the mass die-off of black ash. In some places, young black ash saplings were observed. Occasional northern white cedar was observed as a small canopy component. Natural cedar regeneration was not observed in these wetlands that contained mature adults. These wetlands are uncommon in Duluth.

Rare Plant Occurrences

Pale sedge

Pale sedge had been located within Spirit Mountain in the early 2000's, and those two sites were revisited. The first had been growing in an access trail on the east side of Skyline Road, but the trail had recently been mowed, and very little vegetation could be identified. The second location was along a ski trail within the mesic hardwood forest, and a single pale sedge individual at the center of the historic location was identified with no other individuals around.

Invasive Species

Common buckthorn was observed as scattered individuals in low density. Other invasive species observed included tansy, reed canary grass, and bird's foot trefoil (*Lotus corniculatus*). These species were often observed along the ski or snowmobile trails and did not often spread into the forest.

St. Scholastica

Table 25. Native Plant Communities, Condition Ranks, and Acres at St. Scholastica Survey Area

St. Scholastica Native Plant Communities	Condition Rank	Acres
Disturbed	NA	25.98
FDn43c	B	8.70
MHn35b	C, D	51.78
MHn46b	C, D	9.08
MHn47a	B	2.24
WFn53a	B	0.85
WFn64a	B	14.53

Disturbed

Land closest to the university and adjacent residential areas was disturbed and had previously supported mesic hardwood forest. These areas exhibited a very high cover of common buckthorn in the tall shrub layer, including mature, fruiting individuals, as well as the presence of Rowan mountain-ash. The canopy was primarily composed of quaking aspen and birch (*Betula* spp.), with some sugar maple and dead black ash also present.

FDn43c Upland White Cedar Forest

A band of forest dominated by white cedar with 50–75% canopy cover was present, accompanied by lesser amounts of balsam fir, paper birch, and black ash. Star flower (*Trientalis borealis*), an indicator of this community type, was found in the understory. This forest occurred adjacent to a cedar-dominated swamp, primarily on the north and east sides, and was situated on slight to steep slopes. Glossy buckthorn, common buckthorn, and Rowan mountain-ash were also present. Some larger boulders were scattered throughout the area.

MHn35b Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forest

The canopy of this community was dominated by sugar maple, with lesser amounts of red oak, quaking aspen, paper birch, and white cedar. The subcanopy featured ironwood and beaked hazelnut. Many polygons consisted of younger forest stands characterized by aggressive understory species such as large-leaved aster and low bush honeysuckle. Both glossy buckthorn and common buckthorn were present in the shrub layer and as seedlings throughout the area.

MHn46b Black Ash – Basswood Forest

This community was dominated by aspen and black ash, with paper birch and green ash (*Fraxinus pennsylvanica*) also present in the canopy. The shrub layer featured abundant non-native species,

including Rowan mountain-ash, common buckthorn, and glossy buckthorn. The ground layer supported a mix of wetter and drier species, such as jewelweed and jack-in-the-pulpit. Numerous non-native species were present in the understory, including creeping charlie (*Glechoma hederacea*) and tall buttercup (*Ranunculus acris*).

MHn47a Sugar Maple – Basswood – (Bluebead Lily) Forest

One polygon in the survey area contained a forest connected to a large MHn47 stand located outside the survey boundary on private land. This community had a dense sugar maple canopy, with basswood and paper birch also present. The understory was sparse, consisting primarily of Pennsylvania sedge, sugar maple seedlings, *Dryopteris carthusiana* (spinulose wood fern), and jack-in-the-pulpit. Overall diversity was low, potentially due to the presence of earthworms. Multiple age classes of both basswood and sugar maple were present.

WFn53a Lowland White Cedar Forest (North Shore)

This cedar-dominated community was distinct from both the cedar swamp and the upland cedar forest. The canopy consisted of 75–100% white cedar and 5–25% yellow birch, with additional species in the subcanopy including black ash, balsam fir, and white spruce. The shrub layer was generally sparse, with species such as mountain maple and speckled alder. The ground layer included dwarf raspberry (*Rubus pubescens*), common oak fern (*Gymnocarpium dryopteris*), long beech fern, and floating marsh marigold. Upland species were more common on the hummocks, while wetland species were found in wetter hollows.

WFn64a Black Ash-Conifer Swamp

This community was characterized by a mosaic of areas dominated by white cedar and black ash, with occasional paper birch and yellow birch present in the canopy. Most of the black ash exhibited signs of decline or mortality due to the effects of emerald ash borer. There was notable white cedar regeneration. The ground layer supported a very high diversity of forbs, including turtlehead (*Chelone glabra*), lesser purple fringed orchid (*Platanthera psycodes*), and swamp saxifrage (*Saxifraga pensylvanica*). Graminoid diversity was also high, with species such as bristle-stalked sedge, lake sedge, and Canada bluejoint commonly present. Sphagnum moss cover varied across the area but was high in certain locations, accompanied by other moss species. In these areas, species such as *Carex trisperma* were present, giving the community characteristics similar to Northern Cedar Swamp (FPn63); however, the overall composition was more consistent with Northern Very Wet Ash Swamp (WFn64). Occasional common buckthorn and purple loosestrife (*Lythrum salicaria*) were observed. Pooled water was present in some areas, contributing to the structural and species diversity of the community.

Rare Plant Occurrences

No rare plants were observed in the survey area.

Invasive Species

The abundance of common buckthorn and glossy buckthorn varied across the survey area but was very dense in certain locations, resulting in reduced understory diversity. Infestations were generally most

severe near the campus and in other disturbed or developed areas. Many non-native and weedy species were also present adjacent to these locations. Rowan mountain-ash was widespread and formed a significant component of the shrub canopy in several areas. Purple loosestrife was observed in Northern Very Wet Ash Swamp (WFn64) in low abundance and should be addressed to prevent further spread.

Tischer Headwaters

Table 26. Native Plant Communities, Condition Ranks, and Acres at Tischer Headwaters Survey Area

Tischer Headwaters Native Plant Communities	Condition Rank	Acres
Developed	NA	17.94
Disturbed	NA	49.68
MHn35b	B	109.47
MHn46b	B, D	45.03
MHn47a	A, B	60.37
WFn55a	B	58.62
WFn64c	B	76.42
WFn74a	C	20.30
WMn82a	B	25.44
WMn82b1	A	8.13

Developed

Developed areas include roads as well as cleared or manicured vegetation adjacent to a structure.

Disturbed

The forest between the west branch of Chester and Norton Road was classified as disturbed with a dense network of foot trails, a high percentage of common buckthorn, and little to no natural species composition to indicate which plant community it had once been. This location provides access to the center of Tischer Headwaters but has no parking options with a narrow road shoulder.

MHn35b Red Oak – Sugar Maple – Basswood - (Bluebead Lily) Forest

The red oak – sugar maple – basswood forest had mature red oak and sugar maple as the dominant canopy species. Further indicative of mesic soils were maidenhair fern and leatherwood which prefer large, mature hardwood forests that protect from wind and other disturbance. Small vernal pools were scattered throughout with indicator species such as black ash and tuckerman's sedge.

A network of well-maintained local hiking and cross-country skiing trails cut across multiple plant communities, including the red oak – sugar maple – basswood forest.

Common buckthorn was scattered as seedlings or saplings and occasionally as larger infestations. The largest infestations occurred to the south near the boundary where residential properties likely played a role in introduction and spread.

MHn46b Black Ash – Basswood Forest

The black ash – basswood forest contained a high percentage (65) of non-native and invasive species that were displacing the native canopy species. Glossy buckthorn was the primary concern. Pockets of mature quaking aspen were observed, but the understory had been invaded by buckthorn. The black ash had mostly died from emerald ash borer and remained in the forest as snags. Basswood was not observed or other herbaceous indicators, but the species like winterberry and downy arrowwood (*Viburnum rafinesquianum*) were also absent. Black ash – basswood forest was the more common plant community in the Duluth region.

Early 1939 aerial imagery showed that the land south of the east branch of Chester Creek had been cleared, and several attempts to farm or hay had been made at that time. The aspen – ash forest was just north of an alder thicket on the north side of Chester Creek and the cleared land. The 1918 fire boundary shows that nearly all of the Tischer Headwaters forest and floodplain of the East Branch of Chester Creek likely burned over, sparing only those communities with the wettest or richest soils. The age class of the canopy (0-30 years old) suggests that the forest might have also been cleared in the past or took a while to establish after the fire. The ash snags were older than 30 years, but they were no longer the dominant canopy, and the new canopy consisted of buckthorn, averaging 20-30 years old with numerous younger, non-dominant saplings and seedlings in the understory.

MHn47a Sugar Maple – Basswood - (Bluebead Lily) Forest

The sugar maple – basswood forest contains up to 100-year-old sugar maple, yellow birch, and red maple. Indicator species of a rich mesic forest included ironwood and leatherwood. Vernal pools were frequent in this forest type, another indicator of deep glacial till. 1939 aerial imagery will show that clearing had not occurred in the area, but the rich mesic hardwood forest was within the 1918 fire boundary and had likely burned in the fire. The approximate ages of the oldest trees fit the fire timeline.

The forest directly to the north of the maple – basswood forest had been harvested right up to the boundary, and the common buckthorn was much denser near the boundary and moving into the rich mesic understory.

WFn55a Black Ash – Aspen – Balsam Poplar Swamp (Northeastern)

When present, the Black Ash – Aspen – Balsam Poplar Swamp were of decent quality, sometimes with unique features. The emerald ash borer has killed most of the black ash. High-quality, desireable species such as mature northern white cedar, yellow birch, and basswood were scattered throughout. These species were not naturally regenerating due to the heavy presence of deer. In the understory, some hummocks of *Sphagnum* moss were observed, which is a very unique feature within Duluth and can provide vital nesting habitat for salamanders in the spring. In the smaller Black Ash – Aspen – Balsam Poplar Swamp to the east, the tuckerman's sedge was observed, which further suggests that this wetland might be a vernal pool.

Glossy buckthorn was established in the understory and was competing with speckled alder for dominance. In a potential vernal pool with mature forest surrounding, this is a likely significant wetland feature for amphibians throughout the spring and summer months and should be protected.

WFn64c Black Ash – Alder Swamp (Northern)

A large Black Ash - Alder Swamp (Northern) is in the central region of the Tischer Headwaters. The emerald ash borer had killed most of the black ash which were still present as snags. Speckled alder was taking over as a new dominant, but some quaking aspen, yellow birch, and balsam poplar still persisted.

Some common buckthorn was occasionally observed as mature adults with seedlings and pockets of saplings scattered throughout. If left too long without treatment, these will likely become buckthorn thickets.

WFn74a Alder - (Red Currant - Meadow-Rue) Swamp

A northern wet alder swamp was documented on the north side of the East Branch of Chester Creek but converted to a glossy buckthorn dominated swamp with a percent cover of 90. Little herbaceous vegetation was found beneath the thick canopy but was primarily bare soil with buckthorn leaves. This was the plant community where mountain lion tracks were observed in the soft, organic muck.

Early 1939 aerial imagery showed that this community had not been cleared, but the swamps immediately to the south had been cleared just across Chester Creek. When the 1918 fire came through, it likely burned this community unless the soil was too wet at the time to carry the flame. The high percent of buckthorn illustrates those legacy disturbances.

A few additional Alder - (Red Currant - Meadow-Rue) Swamp (WFn74a) polygons were classified through desktop review but were not field verified and may potentially be Alder Swamp (FPn73a).

WMn82a Northern Wet Meadow/Carr Willow-Dogwood Shrub Swamp

One polygon in this community was assessed, while others were not field verified. Common buckthorn was present at a moderate level, but the area was not as heavily infested as other locations. The shrub layer included speckled alder at 5–25% cover, pussy willow (*Salix discolor*) at 1–5%, and white meadowsweet at 5–25%. There was significant graminoid cover, with lake sedge present at 1–5%. The wet meadow shrub carr complex is all one large community that extends along Chester Creek, but the shrub carr is a separate polygon due to isolation from property lines.

WMn82b1 Sedge Meadow Bluejoint Subtype

This bluejoint-dominated wet meadow exhibited good species diversity, with Canada bluejoint comprising 50–75% cover and wool grass (*Scirpus cyperinus*) present at 25–50% cover. Shrub cover was low, less than 25%, and included species such as white meadowsweet and slender-leaved willow. Invasive species were minimal, and no recent beaver dams were observed, although both had been noted in past imagery. One meadow bordering a road showed some encroachment of reed canary grass. The forb layer included notable species such as marsh bellflower (*Campanula aparinoides*) and wild calla (*Calla palustris*). Wetter areas supported additional aquatic species, including common duckweed

(*Lemna minor*). Chester Creek has been ditched through this area, and earlier aerial imagery spanning back decades shows that this creek has frequent and impactful beaver activity, often flooding the wetland out. The wet meadow is connected to the shrub carr closer to the forest edges, but the property lines isolate them.

Rare Plant Occurrences

No rare species were observed in the Tischer Headwaters. Wild rice (*Zizania palustris*) was observed within a ditched section of the east branch of Chester Creek. Wild rice is common in lakes and slow-moving streams, but on these upper reaches of Duluth's small creeks, it hasn't been documented.

Invasive Species

Common buckthorn and glossy buckthorn were concern throughout the Tischer Headwaters, but it had the worst impacts in the wet forest and swamps, in some cases converting alder swamps into buckthorn groves. Scattered individuals or small, dense populations were observed throughout the mesic hardwood forests, but large, dense populations were observed to replace the dying black ash in the Black Ash – Aspen – Balsam Poplar Swamp.

Management Recommendations

On a broad scale, the NPCs within the city of Duluth were of mixed quality. Informed management could improve the integrity and protect these unique NPCs within the city. The following recommendations have been drafted based on observations and findings from the 2025 survey of the city of Duluth's public lands and are prioritized based on ecological integrity, rarity, restoration feasibility, and risk of irreversible transition. These tiers are intended to guide phased implementation, with Tier 1 actions prioritized for immediate protection, Tier 2 for ongoing management, and Tier 3 for longer-term restoration investment.

1. Tier 1. Preservation/Conservation Framework
    a. Preservation of ranked highest quality NPCs
    b. Preservation of large intact communities and habitat corridor connectors
    c. Preservation and promotion of sensitive species and the NPCs that support them
2. Tier 2. Management Actions
    a. Removal of seed producing invasives, followed by saplings and seedlings
    b. Restoration and underplanting of desired tree species
    c. Introduction of fire as a management tool
3. Tier 3. Restoration of disturbed communities

Tier 1 Preservation/Conservation Framework

Preservation of ranked highest quality NPCs

Because high-quality (Condition A - B) plant communities are relatively uncommon within the City of Duluth and are vulnerable to fragmentation, declines in species diversity, heavy herbivory, and other human- and natural-caused disturbances, it is recommended that these communities be preserved. Preservation of these communities is defined as maintaining species diversity and structure that is characteristic of those NPCs. Invasive species infestations should be limited to none or minimal so they are not impacting the ecological integrity and function of the NPC. Fragmentation is a primary pathway for invasive species introductions and edge effect shifts in species composition. New trail construction should be limited or reviewed by a panel of experts to determine if alternative options exist to bypass these sensitive communities, or if trails can be thoughtfully incorporated without damaging or degrading the integrity. Trails also provide easier access for deer and human traffic, though it is acknowledged that limiting human exposure to these unique ecosystems might also lower public awareness and stewardship of these places.

Due to heavy herbivory city-wide, sapling-stage recruitment of many desirable species is often impossible without protection from deer and hare browse. In these areas where no seedling or sapling regeneration is observed, planting and caging, or constructing enclosures, will be necessary to achieve this preservation recommendation. Likewise, where species have been determined to disrupt the NPC, native or non-native, it may be necessary to implement mechanical or chemical control.

Preservation of large intact communities and habitat corridor connectors

Duluth retains large acreages of intact forest with minimal fragmentation. Large, intact forests often have fewer invasive species, lesser impacts from windthrow events, and greater overall ability to retain water. These larger acreages of forest should be prioritized for long-term protection, adopted into the Duluth Natural Areas Program (DNAP), or given similar protection that would prevent small sales of exterior acreages over time. Mission Forest, also known as the Rodney Paine Forest Preserve, is the largest continuous forest within the city that is not in the DNAP. However, Mission Forest connects Jay Cooke State Park with Magney-Snively Natural Area and fulfills the criteria to be included as a natural area. Other moderate to large forests exist and should continue to be maintained as wild green space.

Small patches of intact forest play an important role within the City of Duluth. Although these smaller forests have limited capacity to support populations of large mammals, they connect larger forest tracts that do support high biodiversity and habitat for larger mammals. Examples of these smaller patches of intact forests include Enger North, Chester, St. Scholastica, Bagley Nature Area, and Tischer Creek/Congdon Park which connect the larger Piedmont/Brewer area to the larger Hartley Park, Forest Hill, and Lester – Amity – Hawk Ridge Natural Area. Preservation of these corridors should be a consideration in land-use and development decisions.

Preservation and promotion of sensitive species and the NPCs that support them

The 2025 field surveys located 175 records of 5 state listed species and one new state record throughout the city. Other populations of state listed species have been documented in prior surveys. These sensitive species and the plant communities that support them should be preserved. Since rare species searches were not a primary objective of the 2025 field surveys, it is likely that more sensitive species would be observed with more targeted searches. Future restoration projects should keep in mind the presence of these species and consider increasing suitable habitat to promote population expansion.

One effective approach to preserving sensitive species is to proactively involve local recreation interest groups during trail construction, reroutes, and maintenance activities. Training these groups to identify and avoid rare species during on-the-ground work can prevent unintentional impacts. Large gatherings of people and activities such as invasive species treatment can negatively affect sensitive species when participants are unaware of what to look for or where known occurrences are located. Providing this information in advance helps prevent damage to known populations, increases the likelihood of discovering previously undocumented occurrences, and reduces the need for time-consuming coordination with recreation groups.

This approach is also true for sensitive plant communities, such as northern White Cedar – Yellow Birch Forest (MHn45b), which function as microclimate-dependent relict system. These communities are maintained by cold-air drainage, topographic shading, and intact canopy continuity rather than regional climate conditions or habitat features such as vernal pools. Given the sensitivity and ecological

functioning of these systems, the City should use known locations of sensitive species and communities to take preventative measures that avoid disturbance and preserve the conditions necessary for their long-term viability.

Tier 2 Management Actions

Removal of seed producing invasives followed by saplings and seedlings

To slow the spread of buckthorn and honeysuckle a targeted approach to invasive species removal is recommended, beginning with mature, seed-producing individuals. High quality plant communities with easy access, and areas that have a history of invasive species control effort, should be the highest priority areas. Mechanical or chemical control is recommended to remove mature woody shrubs. Goats are sometimes used as a mechanical treatment for invasive woody shrubs, but this treatment is only recommended in areas where communities have received a condition ranking D due to extremely low diversity within the herbaceous groundcover. While goats may be effective at controlling woody shrub seedlings, they may eliminate both native and non-native species. The overall goal should be invasive species removal without harming the integrity of the plant community.

Early detection and rapid response (EDRR) is recommended for emerging threats, such as cotoneaster, which has been found on bedrock outcrops and shrubby bedrock communities. Another emerging threat is queen of the meadow, which has been found on the east side of Duluth and aggressively displaces native vegetation in open and shrubby wetlands. EDRR is an effective method for quickly assessing the most sensitive plant communities before a threatening species has time to spread and alter the plant community.

Restoration and underplanting of desired tree species

Forested uplands within northern mesic and northern-mesic mixed forest (Aspen – Birch Forest (FDn43b)) should be underplanted with suitable species to promote species diversity, forest health, improve soil moisture stability, and reduce rapid runoff during peak precipitation events. Desired underplanting species include white pine, red oak, sugar maple, basswood, yellow birch, and eastern white cedar. They need to be protected from deer browse, which has prevented many of these species from naturally regenerating. The northern-mesic mixed forest has a mix of mesic to dry soils and allows for a mix of species that can tolerate varying amounts of soil moisture.

Bedrock Shrubland (Inland) (ROn23a) has been impacted by invasive species, primarily common buckthorn and honeysuckle (*Lonicera* sp.), but an emerging threat to rocky outcrops is the cotoneaster. Continuing to remove these invasive, sun-loving shrubs is important and can be done by cutting and chemically treating the stumps or through a reintroduction of wildfire. These rocky outcrops will have occasional trees or isolated groups of trees, so protecting naturally regenerating red oak, white pine, red pine, or jack pine will increase the structural diversity of these communities, maximizing the benefits to wildlife and increasing native vegetation that can compete with invasive species.

The wet forest communities (Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a), Black Ash - Conifer Swamp (Northeastern) (WFn64a), and WFn74) have been transitioning due to invasive

species. Wet ash forests have declined significantly in black ash canopy cover due to the invasion of the emerald ash borer, and these forested communities are becoming either open wet meadow communities or shrub dominated wetlands with speckled alder or glossy buckthorn. Underplanting the ash forests with suitable species such as yellow birch, eastern white cedar, basswood, American elm (*Ulmus americana*), red maple, and bur oak (*Quercus macrocarpon*) prior to the decline of black ash will maintain the tree canopy that many herbaceous understory species prefer. These same species are recommended for planting and protection after the black ash has died in order to restore the canopy, though herbaceous diversity may already have decreased by that point. Consider soil moisture conditions when selecting species. Plant white cedar, yellow birch, and red maple in the wetter sites while reserving basswood and bur oak for sites with moderate soil moisture.

Northern wet mesic hardwood forests (Northern Wet-Mesic Boreal Hardwood-Conifer Forest (MHn44) and Northern Wet-Mesic Hardwood Forest (MHn46) were observed in pockets within the northern mesic mixed forest (FDn43), along stream corridors within Northern Mesic Hardwood Forest (MHn35), and in steep ravines in places like Mission Forest. Underplanting of targeted species to progress these plant communities toward a longer-lived, more diverse canopy that supports a more diverse herbaceous groundcover is recommended. Plant a mix of yellow birch, basswood, red maple, and occasional eastern white cedar, sugar maple, and red oak (*Quercus macrocarpa*) and protect from deer and hare. Where Northern Wet-Mesic Boreal Hardwood-Conifer Forest (MHn44) is mapped along steep slopes, it includes more conifer species, such as eastern white cedar, white pine, and potentially eastern hemlock, since it has been found in several locations in the city. Stream corridors in Duluth are characterized by steep, forested ravines that function as pathways for cold-air drainage. These topographically constrained systems support cooler and more stable microclimatic conditions due to reduced solar exposure and downslope movement of cold air and are considered microclimate refugia. Increasing conifer abundance within these corridors is expected to reinforce canopy shading and enhance microclimatic stability, particularly in north-facing ravine systems. Increased conifers within the streams' watersheds will also slow snowmelt and further increase the microclimate that was already created from topography and the cold water, especially when planted along north facing ravine slopes.

Introduction of fire as a management tool

Fire-adapted plant communities within the City of Duluth include Bedrock Shrubland (Inland) (ROn23a), Northern Dry-Mesic Mixed Woodland (FDn33a/Aspen - Birch Woodland (FDn33b)), and White Pine - Red Pine Forest (FDn43a). These communities historically experienced fire at intervals of approximately 20–100 years, which helped maintain open structure, exposed mineral soils, and stimulated species-specific regeneration from seedbanks and propagules (MN DNR, 2003). These systems are often associated with higher elevations and shallow, rocky soils shaped by glacial activity, where limited soil development and drier conditions support fire-adapted vegetation.

In these communities, prescribed fire can serve as both a restoration tool, reintroducing historical disturbance regimes, and a management tool, particularly for reducing biomass and managing invasive species. Many native species in these systems are adapted to periodic ground fires and can respond positively through increased regeneration and competitive advantage when light availability increases.

The effectiveness of prescribed fire is context dependent. Long-term fire suppression has altered fuel structure and species composition, introducing uncertainty in how these communities will respond to reintroduction of fire. As a result, prescribed fire should be applied within an adaptive management framework, emphasizing site-specific evaluation and monitoring. Key factors to consider include fuel continuity, slope position, and soil moisture regime, as these influence fire behavior and ecological outcomes.

Prescribed fire can be effective for controlling invasive species such as common buckthorn, particularly when used on seedlings and saplings. However, fire alone is typically insufficient for controlling mature individuals. Best results are achieved when fire is used following initial removal of mature plants, with follow-up burns implemented at intervals (e.g., every 1–3 years) to support native species recovery and limit reinvasion.

While fire plays an important ecological role in some systems, its application across all plant communities is not appropriate. NPCs vary in their relationship to fire. Some are fire-dependent, others may tolerate occasional fire without requiring it, and some, particularly mesic hardwood systems, may be degraded by it. Applying fire outside of its historical or ecological context can lead to unintended consequences, especially when combined with other stressors such as heavy white-tailed deer browse, non-native earthworm activity, and invasive species. These factors can limit recovery following disturbance and shift plant communities toward lower diversity states.

Prescribed fire may also produce secondary effects that require consideration. It can stimulate resprouting of invasive species if not followed by additional control measures, increase deer browse pressure by opening the understory, and simplify already stressed herbaceous layers. In some cases, fire may also promote aggressive native species such as Canada bluejoint, which can form dense stands and suppress the establishment of other native plants.

Care should be taken to avoid degrading ecosystem function when implementing fire. Potential risks include fire spread into adjacent non-fire-adapted systems, impacts to soil structure and organic layers in mesic or wet environments, and rapid recolonization by invasive species if follow-up treatments are not implemented.

Before implementing prescribed fire, the following questions should be considered:

1. What are the specific management goals for this plant community?
2. Will prescribed fire meaningfully contribute to achieving those goals?
3. What are the potential risks or negative impacts in this setting?
4. What type of fire (intensity, frequency, seasonality, and scale) is appropriate to meet the objectives?

Where fire is used, it should be applied in a spatially patchy manner and treated as an opportunity for learning. Pre- and post-burn monitoring is recommended to evaluate changes in species composition, diversity, and overall condition. This is particularly important in urban and semi-urban environments, where interacting stressors may alter expected outcomes. Monitoring results should be used to refine

future management actions and ensure that prescribed fire is contributing to desired ecological conditions.

Tier 3 Restoration of disturbed communities

The tightly packed red pine plantations within the city of Duluth densely shade the understory and form single species, monotypic stands. Similarly, non-native Scots pine forms monotypic stands and is not preferred by deer, resulting in higher survival and reproduction rates than native pine species and associated deciduous species. To improve forest diversity and increase access to sunlight, thinning both pine species within these disturbed pine plantations coupled with underplanting of desired species such as white pine (*Pinus strobus*), red oak, and occasional white cedar would improve species diversity and increase sunlight to the forest floor.

Abandoned hay fields and sites formerly cleared for homesteading or farming purposes have recolonized to varying degrees across the city. In many pockets of forests, unusual species composition was observed with higher densities of invasive species. Upon desktop review of these areas, 1939 aerial imagery revealed that many of these sites had experienced agricultural or homesteading land use with canopy species removed. These sites should have invasive species removed, and they should be planted with suitable species for the site conditions. If field surveys did not reveal a strong plant community signature, soil and hydrology should be surveyed and a review of the presettlement vegetation maps is recommended to select which plant community would be most suitable for that site.

Expanded Stewardship Opportunities

The following recommendations represent logical next-phase extensions of the 2025 City of Duluth NPC assessment. These items were identified during the project as high-value opportunities to further enhance ecological integrity, improve restoration outcomes, and support long-term resilience of NPCs. While not included within the scope of the current effort, these actions are strongly recommended for future implementation as funding and capacity allow.

1. Further mapping opportunities
    a. Map potential vernal pool locations through sink analysis
    b. Prioritize and map areas across the city for invasive species treatment
    c. Map climate refugia features (north facing slopes, cold-air drainage, groundwater fed wetlands)
    d. Identify and prioritize hydrologic restoration
2. Field verification and long-term monitoring opportunities
    a. Verify vernal pools identified in sink analysis
    b. Look for rare species in suitable habitat not surveyed in 2025
    c. Continue NPC Monitoring, particularly in sensitive NPC's and those receiving management treatments
    d. Identify which NPC's may shift as a result of climate change and how these shifts may impact the distribution, condition, and management and of NPCs across the city

Further mapping opportunities

Map potential vernal pool locations through sink analysis

Vernal pools occur in regions with deep glacial till deposits that form mesic soils supportive of mesic hardwood forests. Through their association with these plant communities, vernal pools contribute substantially to groundwater recharge for Duluth's coldwater trout streams. In addition, vernal pools are ecologically significant because their characteristic seasonal water drawdown supports amphibians like frogs and salamanders, fairy shrimp, and aquatic macroinvertebrates. These landscape features may also provide valuable insight into overall watershed health.

Mapping potential vernal pool locations across the city would provide multiple benefits. Trail placement could avoid vernal pools in the drier summer conditions, reducing habitat disturbance and preventing wet trail systems in spring. Because vernal pools often have a component of ash (*Fraxinus* sp.) in their canopy, adding diversity within the otherwise sugar maple-dominated forest, some pools may be suitable targets for tree planting and restoration. Vernal pools also attract wildlife and are recognized as biodiversity hotspots, making them valuable focal areas for future wildlife research and monitoring.

Prioritize and map areas across city for invasive species treatment

Due to limited budgets, staff time, and accessibility across a long and narrow city, prioritizing locations to target would cut down on staff time making those decisions. Highest priority locations would be the

high-quality plant communities that maintain diversity and function, have easy access from a road or trail, and are readily visible to the public. The second highest priority locations would be those high-quality communities that have easy access but might not be as readily visible. The third highest priority would be both the high-quality communities that are difficult to access and the moderate quality communities that are easy to access and highly visible. The lowest priority for invasive species treatment would be the plant communities that have been severely altered and are difficult to access and not readily visible to the public. Mapping this framework by varying priority colors would allow city staff to quickly locate high priority areas to target for invasive species treatment.

Climate refugia mapping

The climate in northern Minnesota is anticipated to experience increasing average winter temperatures, particularly at night, and generally shorter winters. Lake Superior creates its own microclimate that moderates temperature extremes, making Duluth a regional climate refugia. Within that greater context, there is also nuance within each forest tract. Landscape features can create areas of climate refugia long into the future. These landscape features can support species that prefer cool temperatures and moist conditions, which may become less common as the climate continues to change. Mapping topography, slope, and drainage patterns can identify priority areas for conservation and climate-adapted restoration, including opportunities to plant and maintain species that prefer cool, moist environments, such as northern white cedar, which is also a culturally significant species.

Identify and prioritize hydrologic restoration

When a native plant community has been disturbed, species composition may shift, making classification more challenging. Disturbances observed along stream corridors included bank erosion and floodplain isolation, where floodplains were no longer connected to the streams and did not receive the seasonal flush of sediment and nutrients that previously maintained these systems. This resulted in some floodplain species still present like ostrich fern (*Matteucchia struthiopteris*), wood nettle, and sensitive fern, along with drier species like large leaved aster and low bush honeysuckle. These areas represent hydrologically altered systems where disrupted floodplain connectivity has led to shifts in species composition and reduced ecological function. Non-native and invasive species were also common in these disturbed sites. Mapping these disturbed sites could identify restoration priorities.

Another opportunity would be to identify areas within a watershed that were historically mesic hardwood forests, based on soil types and historic land cover mapping, and to locate watersheds that currently contain few or no vernal pools. These areas may benefit from targeted recreation of vernal pools in locations where they are likely to have occurred historically within those plant communities.

Field verification and long-term monitoring opportunities

Verify vernal pools identified in sink analysis

Field verifying vernal pools is important for understanding overall water retention, wildlife benefits, and strategic trail construction. Since ash trees are a component of vernal pools, knowing the location of

vernal pools is also important for underplanting and not wasting resources in areas lacking vernal pools. Field verifying should be prioritized in impaired watersheds with a high potential for vernal pools.

Look for rare species in suitable habitat not surveyed in 2025

The objective of the 2025 Duluth NPC surveys was not to locate rare species, however, rare species were observed. Ample opportunity exists to continue to search for rare species. Knowing rare species locations would allow the city to protect those resources. Rare species can also indicate plant community health and integrity. Species to prioritize would be soapberry and eastern rough sedge. 2025 surveys vastly increased the number of known individuals of soapberry, may have implications for future state listing status. Eastern rough sedge was a new state record and had many detections. This species is likely to become state-listed, so having a better understanding of its habitat requirements in Minnesota would be helpful for conservation and management.

Continue NPC monitoring

Continued monitoring is a powerful tool, particularly when trying to understand long-term trends or response to management treatments. This city-wide condition assessment and NPC classification can serve as baseline data. If repeated every 5 to 10 years NPC health and any changes can be monitored. Long-term monitoring plots can also be valuable in observing trends, especially as the climate continues to change. Returning fire to the fire adapted plant communities hasn't been done within the city of Duluth on bedrock outcrops and bedrock shrublands. Documenting vegetation response to fire would be informative and could help guide future adaptive management strategies.

Together, these efforts would build upon the current assessment to create a comprehensive, spatially informed framework for long-term ecological management within the City of Duluth.

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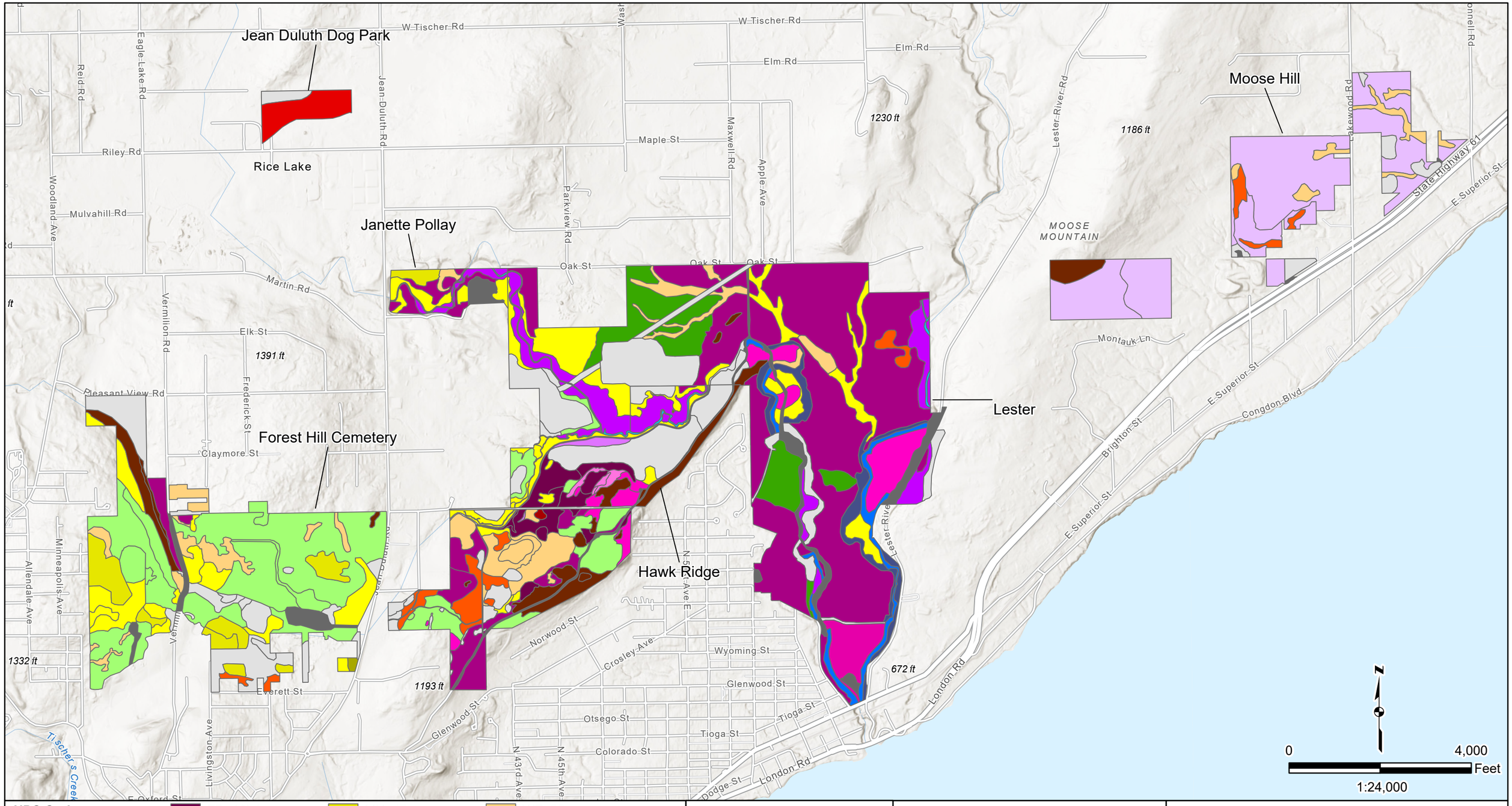
Figures



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FDn33a1	FDn43c	MRn93b	WMn82b
FDn33b	FFn57a	ROn23a	WMn82b1
FDn43a	MHn35b	RVx32	
FDn43b	MHn44a	RVx43a2	
	MHn46b	RVx54a	

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NATIVE PLANT COMMUNITY MAPPING DULUTH, MINNESOTA

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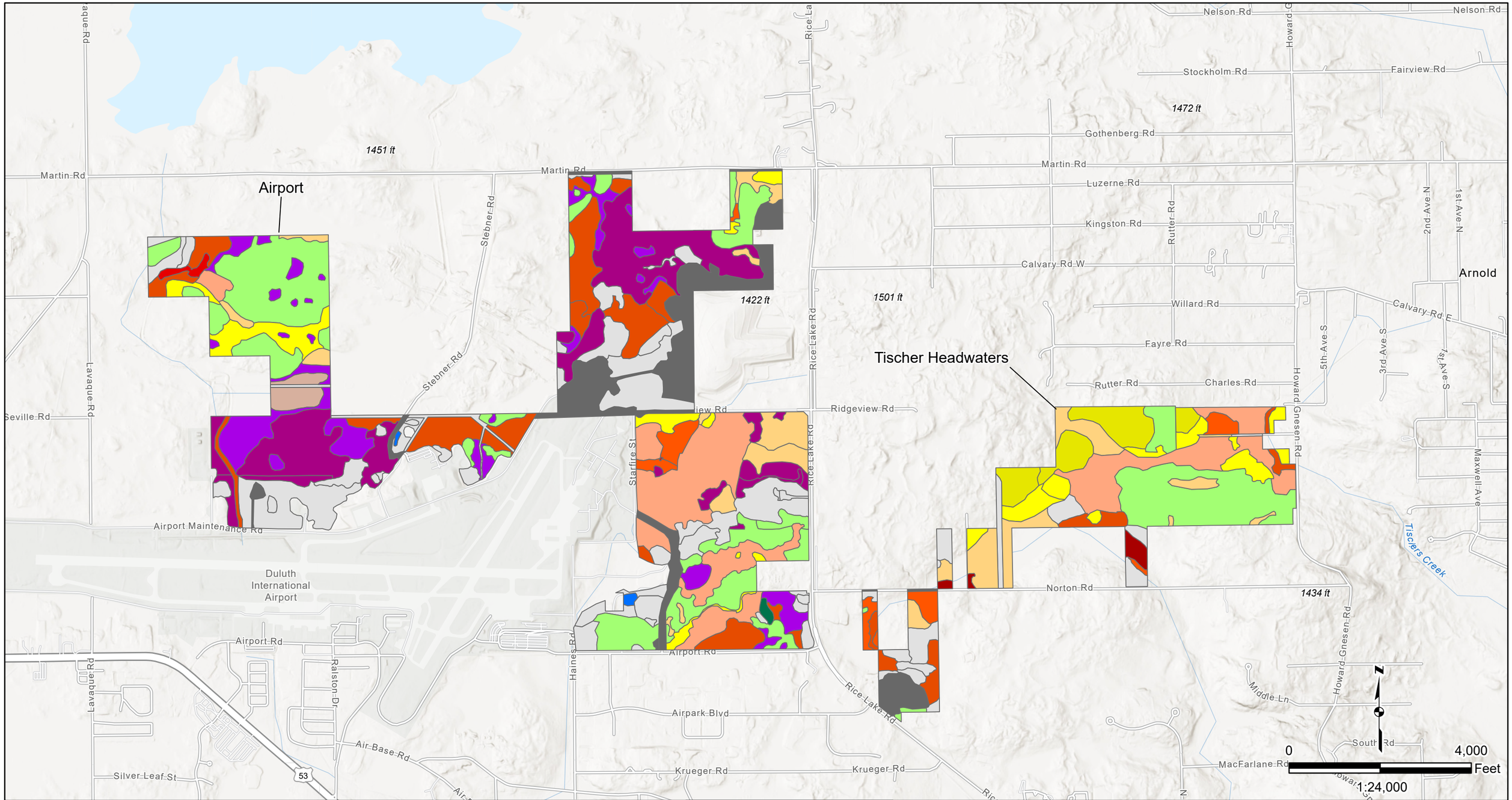
FIGURE 01

NATIVE PLANT COMMUNITIES
APRIL, 2026

GEI Office: Duluth, MN | Source: B:\Working\MINNESOTA LAND TRUST\2408194 Duluth NPC Data\05_GIS\ArcPro\ArcPro.aprx, 4/28/2026, 1:50 PM, NAD 1983 UTM Zone 15N

Drawn: 4/28/2026



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FDn43b	OW	
FPn73a	WFn55a	
MHn35b	WFn64c	
	WFn74a	

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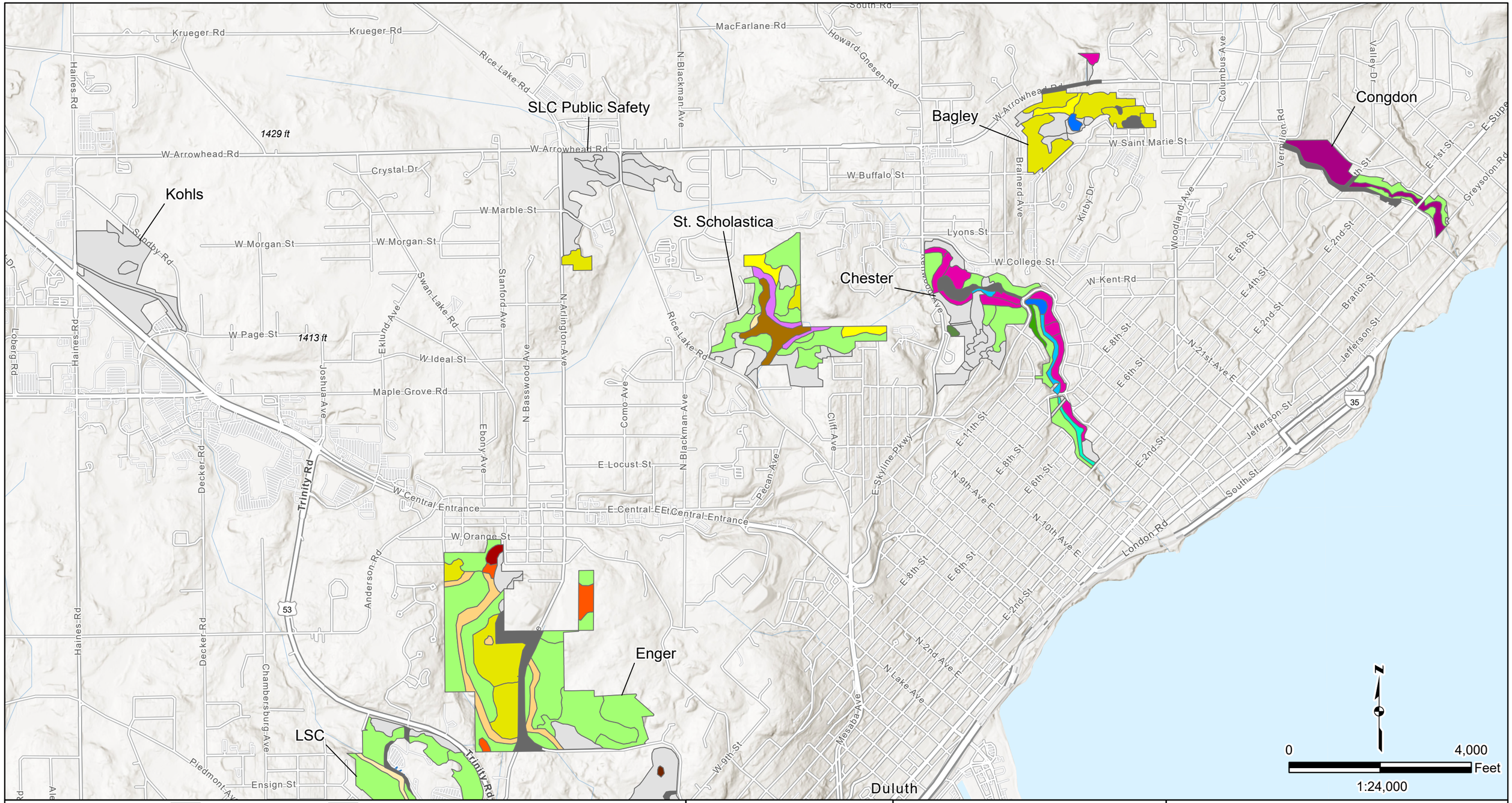
Drawn: 4/28/2026



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FDn43a	MHn46b	WFn53a
FDn43b	MHn47a	WFn55a
FDn43c	OW	WFn64a
MHn35b	ROn23a	WFn74a
	RVx	WMn82b1

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Drawn: 4/28/2026

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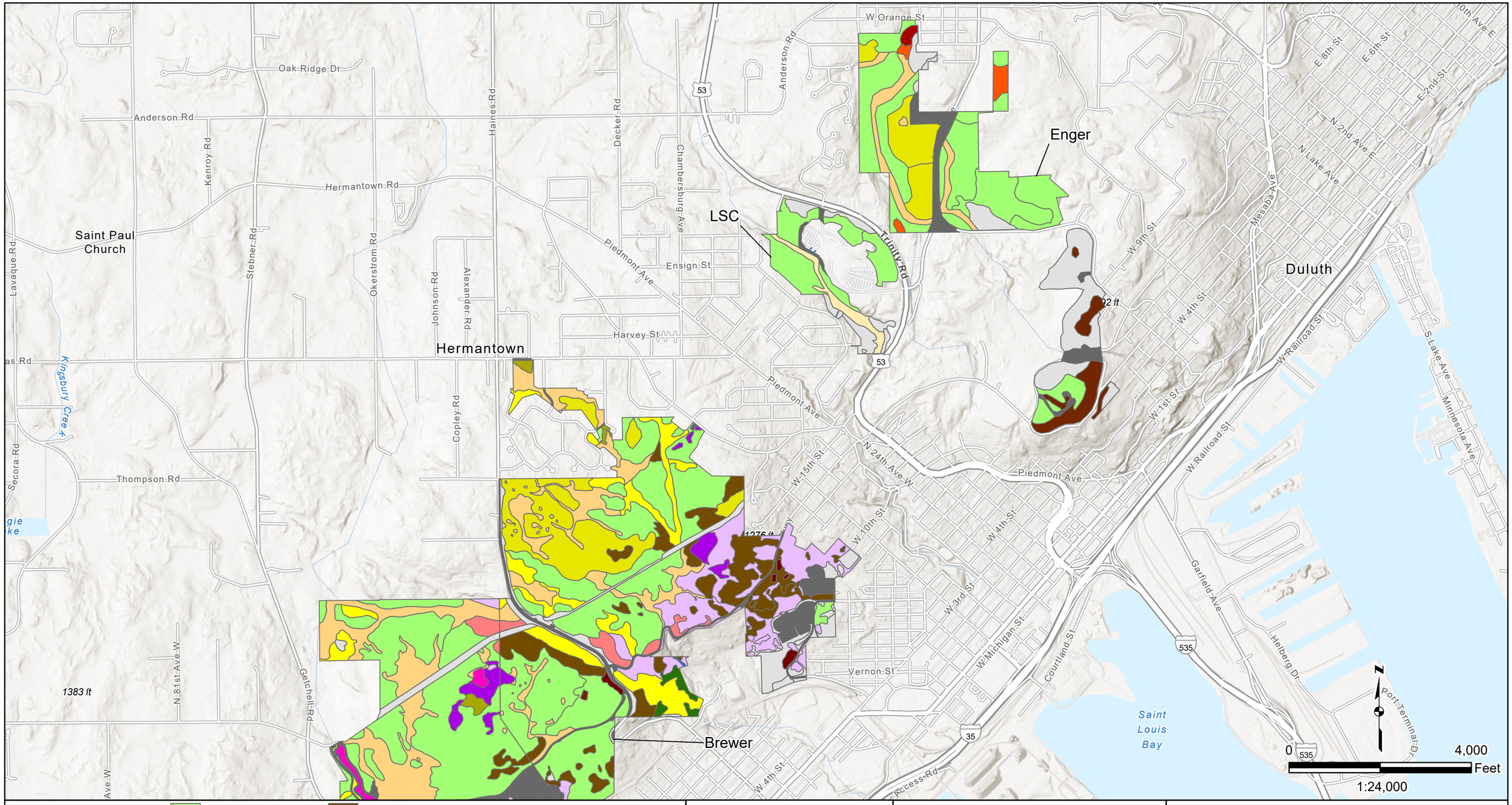

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FDn43b2	MRn83a	WFn74a	
FPn73a	ROn12b	WMn82b1	
	ROn23a		

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Drawn: 4/28/2026

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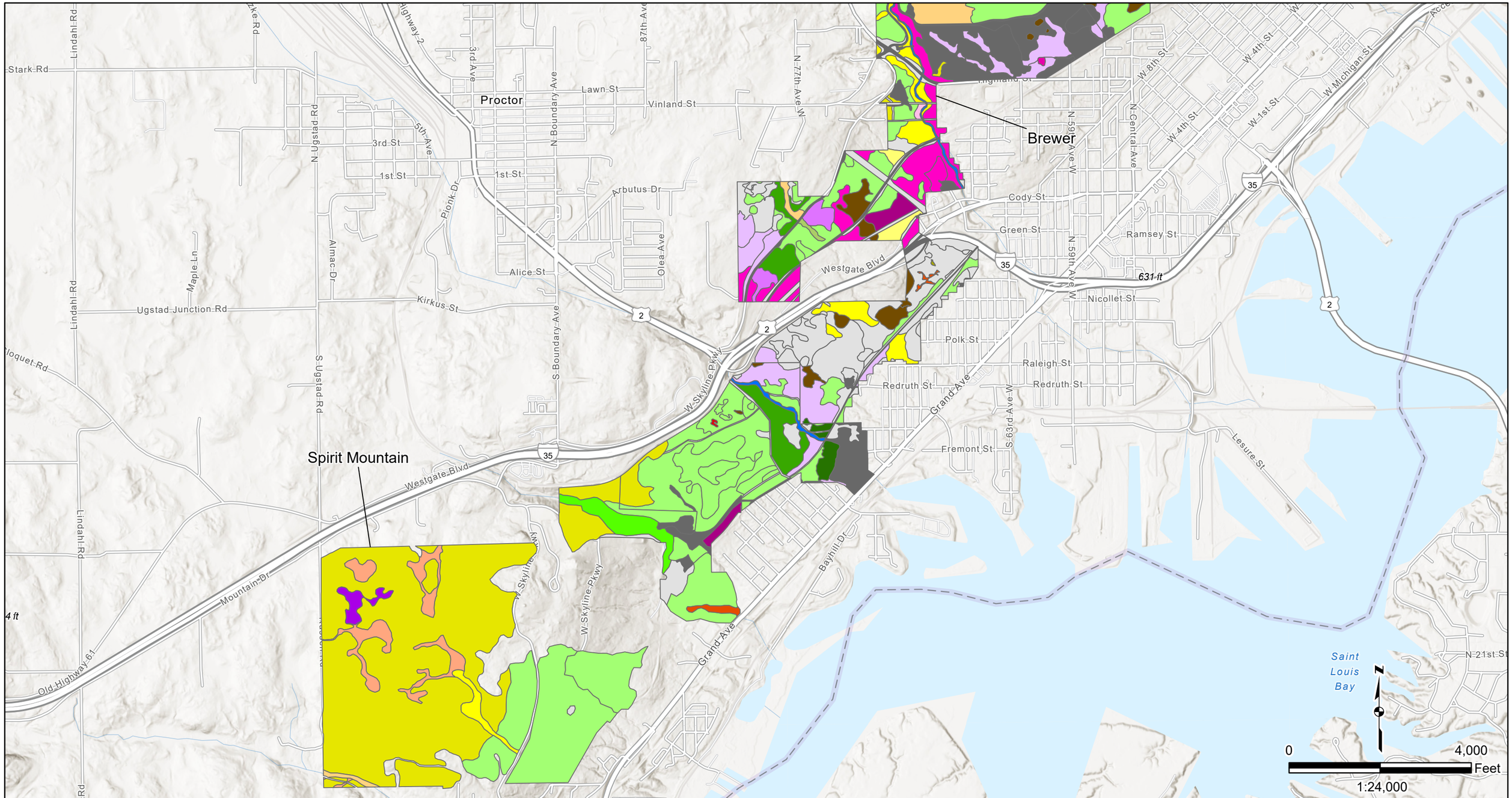

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FDn32	FPn73a	MHn46b	WMn82a
FDn33b	MHn35b	MHn47a	WMn82b
FDn43a	MHn44	MRn83a	
FDn43b	MHn44a	ROn23b	
	MHn44b	RVx43a2	

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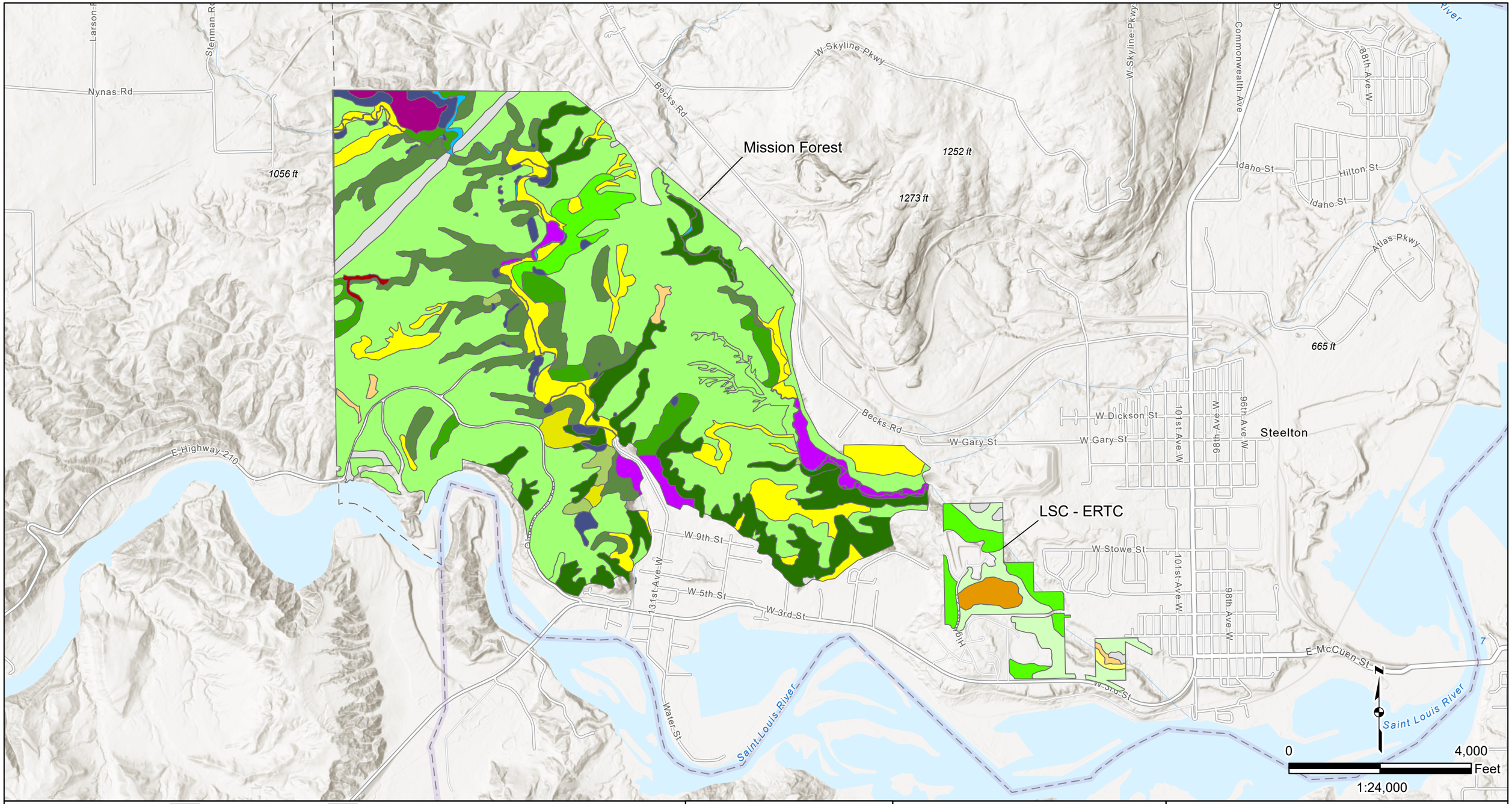
Drawn: 4/28/2026



NPC Code

- CTn11
- Disturbed
- FDn43b
- FFn57a
- MHn35
- MHn35b
- MHn44
- MHn44a
- MHn44b
- MHn44c
- MHn45b
- MHn46
- MHn46b
- MHn47a
- RVx32
- RVx54a
- WFn55a
- WFn64
- WMn82b1

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Appendix A Duluth Native Plant Community GIS Metadata

Duluth Native Plant Community GIS Metadata

The map is hosted on ArcGIS Online. The names of the available layers in the map are presented in bold, and the attributes of each layer are described using bulleted points.

Final NPC Polygons (GEI, 2026) Compilation of data collected through desktop review and field surveys. The following fields were assessed:

- **Survey Area** Name assigned to polygons organized into survey areas based on existing parks and natural areas
- **Original NPC Code** NPC code assigned to a polygon prior to 2025 survey
- **Original NPC Code Source** Entity that classified NPC polygon prior to 2025 survey
- **Original NPC Condition Ranking** Assigned prior to 2025 survey
- **GEI Final NPC Code** NPC code assigned by GEI based on desktop review and/or 2025 field survey
- **Label** NPC code and associated name
- **GEI Condition Ranking** Assigned by GEI based on criteria outlined by the MNDNR and described in table 2 of the report
- **Condition Ranking Description** Notes about the factors that contributed to the condition ranking assigned
- **Disturbance Category** Type of disturbance observed
- **Prior Disturbance Description** Observations about disturbances identified in historic imagery or field surveys
- **Estimated NPC Code Prior to Disturbance** Probable NPC of a polygon before it was altered by a disturbance, primarily based on adjacent NPC types
- **Approximate Invasive Species % Cover** Estimate of invasive species cover based on meander route through a polygon
- **Rare Species Present?** “Yes” when a rare species was documented in a polygon
- **Was Area Burned in 1918 Fire?** “Yes” when a polygon overlapped with the 1918 fire extent
- **Buckthorn Abundance Ranking** 1: Abundant, numerous fruiting; more capable of maturing; abundant seedlings 2: Common; seedlings might be abundant; fruiting plants not numerous 3: Infrequent to scarcely present (or none seen)
- **Buckthorn MGMT Priority Ranking** 1: High; threat high-quality native veg; do annually; visitor area; along trails; test methods 2: Medium; more difficult to control; take action or re-assess 2-5 years; visitor area; along trails; spot removal to free desirable plants from competition; wait for funding opportunities; not as immediate threat to native

vegetation 3: Low; major infestation in veg w/ low biodiversity significance; adjacent to other infestations on private or inaccessible land; no recovery plants available to recolonize; difficult site to reestablish plants

- **Deer Browse Ranking** 1: Low intensity, tree seedlings taller than deer can reach, abundance of preferred species present, minimal browse of woody twigs observed 2: Moderate intensity, some tree seedling not taller than a deer can reach, preferred species are “hedged” or kept short, browse on less preferred species is noticeable, some browse of woody twigs observed 3: High intensity, seedlings not taller than deer can reach, reduced tree diversity in understory from selective browsing, open or “park like” look to the forest understory from over browsing ground cover and understory, significant browse of woody twigs observed
- **Ash Dominant Community?** “Yes” if classified as any WFn55, WFn64, MHn46 type or MHn44c
- **Is Prescribed Burning an Appropriate MGMT Tool?** “Yes” if classified as rock outcrop (RO) or FDn33 types, “Parameter dependent” for FDn43 types
- **Notes** Compilation of observations by ecologists recorded during field surveys

Invasive Species Detections Points and polygons of invasive species occurrences observed during 2025 field surveys

1918 Fire Extent (Approximate) Boundary of area that burned during the 1918 fire

Photo location Georeferenced photos taken during 2025 field surveys