

Monitoring of Priority Bird Species at Managed Waterfowl Hunt Areas



Prepared By:

Eric C. Branch and M.J. Monfils, Michigan Natural Features Inventory, Michigan State University Extension, PO Box 13036, Lansing, MI 48901-3036

Prepared For:

Michigan Department of Natural Resources, Wildlife Division

October 31, 2025

MNFI Report Number 2025-25

Suggested Citation:

Branch, E.C., and M.J. Monfils. 2025. Monitoring of Priority Bird Species at Managed Waterfowl Hunt Areas. Michigan Natural Features Inventory, Report No. 2025-25, Lansing, MI.

Copyright 2025 Michigan State University Board of Trustees.

MSU Extension programs and materials are open to all without regard to race, color, national origin, gender, gender identity, religion, age, height, weight, disability, political beliefs, sexual orientation, marital status, family status, or veteran status.

We collectively acknowledge that Michigan State University occupies the ancestral, traditional, and contemporary Lands of the Anishinaabeg – Three Fires Confederacy of Ojibwe, Odawa, and Potawatomi peoples. In particular, the University resides on Land ceded in the 1819 Treaty of Saginaw. We recognize, support, and advocate for the sovereignty of Michigan’s twelve federally recognized Indian nations, for historic Indigenous communities in Michigan, for Indigenous individuals and communities who live here now, and for those who were forcibly removed from their Homelands. By offering this Land Acknowledgement, we affirm Indigenous sovereignty and will work to hold Michigan State University more accountable to the needs of American Indian and Indigenous peoples.

Cover: Moist soil habitat at Shiawassee River State Game Area. Photo by E. Branch.

EXECUTIVE SUMMARY

The Michigan Department of Natural Resources (DNR) is finalizing a 10-year strategic plan for its Managed Waterfowl Hunt Areas (MWHAs), centered on enhancing ecosystem function and increasing waterfowl abundance and diversity. To achieve these objectives, DNR staff identified several priority management strategies including increasing moist soil management, implementing new water level management regimes in marsh units, and establishing and restoring grasslands. The Michigan Natural Features Inventory (MNFI) partnered with the DNR to develop a monitoring program that assesses the following: 1) migrant waterbird and vegetation response to moist soil management; 2) secretive marsh bird response to water level management; and 3) use of managed grasslands by breeding birds and nesting waterfowl. Data produced from this program can be used to evaluate bird and habitat response to priority management actions and track progress towards the plan's fundamental objectives.

In 2025, we implemented the first year of the monitoring program and conducted initial bird and vegetation surveys at 44 management units located across five MWHAs. In total, we completed 483 surveys for migrant waterbirds, breeding secretive marsh birds, breeding grassland birds, and nesting waterfowl species, and completed an additional 317 quadrat samples to assess vegetation response to moist soil management. We recorded 95 bird species across all surveys, 34 of which have at least one special status designation, such as state listed or special concern, species of greatest conservation need, DNR featured species, or focal species of the Upper Mississippi / Great Lakes Joint Venture. These results highlight the valuable habitat that MWHAs provide to a myriad of breeding and migrating birds.

Relative to traditionally managed row crop units, preliminary results indicate that moist soil units support more waterbird diversity, notably greater densities of ducks and shorebirds, more than eight times as many individuals of SGCN, state listed, and State Special Concern species, and greater percent cover of 75% of the observed plant species or genera known to provide high nutritional value for waterfowl. Surveys in marsh units and managed grasslands provided substantial data on rare species and the overall bird communities using these areas during the breeding season. Repeated monitoring of these units over multiple years will permit more formal analyses that can be used to evaluate management outcomes and assess progress toward the fundamental objectives outlined in the 10-year plan. We suggest that the monitoring plan continue to be reassessed annually so it can be adapted as priorities, resources, and site conditions change.

ACKNOWLEDGEMENTS

Funding for this project was provided by the Michigan Department of Natural Resources (DNR) Wildlife Division in cooperation with the U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program. Barb Avers (DNR) initiated the project and assisted with development of the monitoring framework, along with Cameron Dole (DNR), Kaitlyn Barnes (DNR), and Karen Cleveland (DNR). Cameron Dole, Marvin Kish (DNR), Pat Brickel (DNR), Ryan Soulard (DNR), Matt O'Neill (DNR), John Darling (DNR), and Mike Richardson (DNR) provided logistical support and assisted with access to the MWHAs. Sarah DeGuise (MNFI) and Alec Zuhorski (MNFI) assisted with field surveys. Brett DeGregorio (Michigan Cooperative Fish and Wildlife Unit) assisted with marsh bird surveys and provided feedback on proposed sampling methods. Ashley Adkins (MNFI), Sarah Carter (MNFI), Katelyn Brolick (Michigan State University Extension), and Deb Richardson (Michigan State University Extension) provided administrative support for the project.



Sunset waterbird surveys at a moist soil unit in St. Clair Flats SWA. Photo by E. Branch.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS.....	iii
LIST OF TABLES.....	iv
LIST OF FIGURES.....	v
INTRODUCTION.....	1
METHODS.....	2
Sample Design	2
Bird and Habitat Surveys	2
Waterbird Surveys	2
Annual Vegetation Surveys	3
Secretive Marsh Bird Surveys.....	4
Grassland Bird Surveys.....	4
Nesting Waterfowl Surveys.....	5
RESULTS	6
Waterbird Surveys.....	6
Annual Vegetation Surveys.....	11
Secretive Marsh Bird Surveys	14
Grassland Bird Surveys	17
Nesting Waterfowl Surveys	21
DISCUSSION	24
LITERATURE CITED	25
APPENDIX A: Common and scientific names of bird species detected at Managed Waterfowl Hunt Areas in 2025.....	26
APPENDIX B: Mean density (individuals per hectare) and standard error for each waterbird species detected at moist soil and row crop reference units during both migration periods.	29

LIST OF TABLES

Table 1. Waterbird species detected across all moist soil and row crop reference units during 2025 surveys. Scientific names are provided in Appendix A.	6
Table 2. Mean densities (individuals per hectare) and standard errors for major waterbird groups observed at moist soil and row crop reference units during both migration periods.	11
Table 3. Mean percent cover and standard error for plant species observed during annual vegetation surveys at moist soil and row crop reference units. Listed waterfowl food values (High, Mod, Low) are derived from Loges et al. (2021) Appendix SM-6.....	12
Table 4. Target species detected during 2025 surveys at Fish Point SWA, Nayanquing Point SWA, and Shiawassee River SGA. Scientific names are provided in Appendix A.....	14
Table 5. Species detected during 2025 surveys at managed grassland units located at Nayanquing Point SWA and Shiawassee River SGA. Scientific names are provided in Appendix A.	17

LIST OF FIGURES

Figure 1. Moist soil and row crop reference units at Nayanquing Point SWA, Fish Point SWA, and Shiawassee River SGA surveyed for migrant waterbird species in 2025.	8
Figure 2. Moist soil and row crop reference units at St. Clair Flats SWA surveyed for migrant waterbird species in 2025.	9
Figure 3. Moist soil and row crop reference units at Fennville Farm Unit of Allegan SGA surveyed for migrant waterbird species in 2025.	10
Figure 4. Marsh units and point count stations at Nayanquing Point SWA and Fish Point SWA surveyed for breeding secretive marsh birds in 2025.	15
Figure 5. Marsh units and point count stations at Shiawassee River SGA surveyed for breeding secretive marsh birds in 2025.	16
Figure 6. Managed grassland units and point count stations at Nayanquing Point SWA surveyed for breeding birds in 2025.	19
Figure 7. Managed grassland units and point count stations at Shiawassee River SGA surveyed for breeding birds in 2025.	20
Figure 8. Active and inactive Mallard nests found within managed grassland units at Nayanquing Point SWA during 2025 surveys.	22
Figure 9. Location of the single inactive and depredated Mallard nest found within a managed grassland unit at Shiawassee River SGA during 2025 surveys.	23

INTRODUCTION

Managed Waterfowl Hunt Areas (MWHAs) are locations where intensive waterfowl management occurs and highly regulated draw waterfowl hunts are provided, with six MWHAs located on state lands: Fennville Farm Unit of Allegan State Game Area (SGA), Fish Point State Wildlife Area (SWA), Nayanquing Point SWA, Pointe Mouille SGA, Shiawassee River SGA, and St. Clair Flats SWA. The Michigan Department of Natural Resources (DNR) is nearing completion of a 10-year strategic plan for these MWHAs that generated five fundamental objectives, with the primary objectives being to enhance ecosystem function and increase waterfowl abundance and diversity. Under the fundamental objective to enhance ecosystem function, the plan aims to increase habitat and species diversity, with a focus on improving habitat for Species of Greatest Conservation Need (SGCN; Derosier et al. 2015) and State Threatened or Endangered species. Area-specific plans outlining management actions to achieve the above objectives were developed for each MWA. Although each plan is slightly unique, the following actions are being implemented across multiple MWHAs and were identified as high-priority management activities by DNR staff for assessment: 1) increase moist soil management; 2) implement new water level management regimes in marsh units; and 3) establish, restore, and maintain grasslands.

Monitoring is a critical part of adaptive management by facilitating an assessment of success in reaching stated objectives and informing changes to actions if desired outcomes are not achieved. We worked closely with DNR staff to develop a multi-year monitoring framework to evaluate bird and habitat response to high-priority management actions implemented as part of the 10-year plan. We worked with DNR staff to identify areas where these management actions were being implemented and co-developed a monitoring framework to assess the following: 1) migrant waterbird and vegetation response to moist soil management; 2) breeding secretive marsh bird response to water level management of marsh units; and 3) use of managed grasslands by breeding birds and nesting waterfowl. In spring and summer of 2025, we implemented the monitoring framework and conducted initial bird and habitat surveys.

Data produced from these surveys can be used to determine how management actions are influencing bird species diversity and use of these areas by SGCN and State Threatened and Endangered species. Implemented over multiple years, this framework will produce sufficient data to help the DNR evaluate the success of management actions and determine progress towards the fundamental objectives outlined in the 10-year plan. This report provides an overview of the sample design and protocols developed as part of this framework and summarizes results from the first year of surveys. These data provide an early indication of bird and habitat response to ongoing management actions and provide a baseline for comparison across successive years.

METHODS

Sample Design

Through discussions with DNR biologists and use of area-specific management plans, we identified management units to monitor bird and habitat response to the high-priority management activities identified above. To assess migrant waterbird (i.e., waterfowl, shorebird, and wading bird) and vegetation response to moist soil management, we identified 12 management units scheduled for conversion from row crops to moist soil habitat. To provide a means for comparison, we also identified 13 traditionally managed row crop units, hereafter referred to as row crop reference units, where no moist soil conversion was scheduled to occur. These 25 units were located within the following five MWHAs: Fennville Farm Unit (n = 1 moist soil, n = 2 reference), Fish Point SWA (n = 2 moist soil, n = 2 reference), Nayanquing Point SWA (n = 2 moist soil, n = 3 reference), Shiawassee River SGA (n = 4 moist soil, n = 3 reference), and St. Clair Flats SWA (n = 3 moist soil, n = 3 reference).

To assess breeding secretive marsh bird response to water level management of marsh units, we identified 13 marsh units where modified water level management regimes (e.g., altered drawdown frequency) were scheduled to occur. These 13 units were located within Fish Point SWA (n = 4), Nayanquing Point SWA (n = 4), and Shiawassee River SGA (n = 5). For each unit, we randomly located the maximum number of bird survey points possible with a minimum separation of 400 m.

To assess use of managed grasslands by breeding birds and nesting waterfowl, we identified existing grasslands and areas scheduled for grassland establishment. Given that many grassland bird species are known to be area sensitive, we prioritized grassland units ≥ 10 hectares in size. We identified a total of seven units that met these criteria, with three located at Nayanquing Point SWA and four located at Shiawassee River SGA. For each unit, we randomly located the maximum number of bird survey points possible with a minimum separation of 250 m.

Bird and Habitat Surveys

Waterbird Surveys

We designed waterbird surveys to document use of both moist soil and row crop reference units by migrant waterfowl, wading birds, and shorebirds. We closely followed protocols developed for the Integrated Waterbird Management and Monitoring Program (Loges et al. 2021), which consists of visual surveys conducted from multiple vantage points located around the perimeter of pre-defined management units. We conducted surveys on a weekly basis during spring migration (late April to mid-June) and early fall migration (early to late August) during one of two time periods: morning (sunrise-12 pm) or afternoon (12 pm-sunset). To control for a potential effect of time-of-day on bird use, we alternated the time period and order in which units were surveyed between visits. Weather conditions that may reduce the

detectability of waterbirds were avoided (e.g., strong winds, moderate to heavy precipitation or fog).

During each visit, we walked the entire perimeter of the unit and added additional vantage points as needed until all visible portions of the unit had been surveyed. At each vantage point, we systematically scanned the visible area and counted all waterbirds present, identifying to species whenever possible. When species identification was not possible, we identified individuals to the lowest known taxonomic unit using the Unidentified Waterbird codes provided in Loges et al. (2021). When waterbirds flushed and landed within a different area of the same unit, we noted the location to avoid double-counting individuals at subsequent vantage points. Waterbirds were only recorded if we were confident they were not previously counted. To account for reduced visibility caused by late season growth of emergent vegetation and row crops during August surveys, we walked two pre-defined transects located within each unit after completing the perimeter survey. We recorded any additional species observed while walking to, along, or between transects. Non-waterbird species considered of interest (e.g., rare raptors, rare songbirds) observed during surveys were not included in the waterbird counts but were noted on the data sheet.

Annual Vegetation Surveys

We designed annual vegetation surveys to document plant species composition and abundance within both moist soil and row crop reference units. Quadrats were sampled at multiple designated sampling points located along established transects. Spacing between sampling points varied according to the total transect length (sum of both transects) of the unit (Webb et al. 2010), with separation distances assigned according to the following scale: 25 m spacing for transects ≤ 500 m; 50 m spacing for transects 501-750 m; 75 m spacing for transects 751-1,000 m; and 100 m spacing for transects $> 1,000$ m. We used this approach because it produced a feasible number of sampling points while providing adequate spatial coverage and a relatively balanced distribution across units, with no unit containing fewer than 10 sampling points (range = 10-16, mean = 13).

We conducted all vegetation surveys once annually during late August, when dominant plant species have matured, but prior to senescence and the start of hunting season. To avoid sampling trampled vegetation located along the transect, we placed a 1-m² quadrat 1 m to the right of each designated sampling point. The following six variables were recorded within each quadrat: 1) water depth; 2) vegetation height; 3) areal percent cover of vegetation structural groups; 4) dominant species composition; 5) areal percent cover of dominant species; and 6) proportion of each dominant species producing seed heads.

When water was present, we recorded water depth by placing a meter stick in the center of the quadrat and measuring to the nearest centimeter. We recorded vegetation height by measuring the height (cm) at which approximately 80% of the vegetation was growing below. We characterized overall structure by estimating the areal percent cover of each of the following vegetation structural groups: persistent emergent (e.g., *Typha* spp., *Juncus* spp.,

Schoenoplectus spp.), non-persistent emergent (e.g., *Echinochloa* spp., *Setaria* spp., *Persicaria* spp.), floating leaved and free-floating vegetation (e.g., *Nuphar* spp., *Lemna* spp.), submersed aquatic vegetation (e.g., *Potamogeton* spp., *Chara* spp.), and row crops (e.g., corn, soybean). We characterized plant species composition by identifying the five most abundant species (based on % cover) to the lowest taxonomic level possible (e.g., family, genus, species) and estimated the areal percent cover of each. To provide a coarse measure of potential food availability, we estimated the proportion of each dominant species that was actively producing seed heads.

Secretive Marsh Bird Surveys

We conducted marsh bird surveys to document use of selected marsh units by a suite of rare, declining, and secretive marsh bird species. We followed the North American Marsh Bird Monitoring Protocols (Conway 2011), which were further refined for the Michigan Marsh Bird Survey (Michigan Bird Conservation Initiative [MiBCI] 2015). The survey methods target 10 primary species (e.g., rails, bitterns, grebes) and eight secondary species (e.g., selected songbirds, marsh-nesting terns) that occur in marshes and other wetlands dominated by emergent vegetation.

Conway (2011) recommends survey points separated by at least 400 m be visited three times during the breeding season (early May to mid-June). We conducted surveys in the morning between 30 minutes before to three hours after sunrise. During each visit, we completed a 10-minute point count consisting of a five-minute passive listening period followed by one-minute broadcast periods for the following five species: least bittern (*Ixobrychus exilis*, State Threatened), sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), king rail (*Rallus elegans*, State Endangered), and American bittern (*Botaurus lentiginosus*, State Special Concern). We recorded observations of primary target species by individual bird across each minute of the 10-minute survey and estimated the distance at first detection to the nearest five meters. We tracked secondary species at the species level, with only the period of first observation of the species noted and the total number of individuals recorded within three distance bins (0-50 m, 51-100 m, and > 100 m).

Grassland Bird Surveys

We used grassland bird surveys to document use of managed grassland units by breeding birds, with a specific focus on use of these areas by SGCN and state-listed or special concern species. We conducted two visits during the breeding season (late May to late June) at points separated by at least 250 m. We completed surveys from sunrise to four hours after sunrise (Ralph et al. 1995) and avoided conducting surveys during weather conditions that could reduce bird detectability, such as strong winds and moderate to heavy precipitation. During each visit, we recorded all birds seen or heard during a 10-minute point count that consisted of three time periods: the first three minutes (minutes 1-3), the next two minutes (minutes 4-5), and the final five minutes (minutes 6-10; Ralph et al. 1995). During each time period, we assigned each bird observation to one of four distance categories at the time of first observation (0-25 m, 26-50 m,

51-100 m, and > 100 m) based on the estimated distance of the bird from the observer. Birds detected outside of unit boundaries or as flyovers were recorded, but these observations were noted accordingly so they could be excluded from data summaries and formal analyses.

Nesting Waterfowl Surveys

We designed these surveys to document waterfowl nesting activity within managed grassland units. We performed rope drag surveys, a widely used technique for finding dabbling duck nests in grassland habitats (Higgins et al. 1969, Klett et al. 1986). This method involves dragging a rope through grassland habitat, which creates a physical disturbance and causes hens to flush from their nests. Our drag consisted of a 30 m (100 ft) rope with 46 cm (18 in) long metal chains attached at evenly spaced 2-m (6.6 ft) intervals.

We conducted a single rope drag survey at each grassland unit during late May to early June. Surveys were done between 9 am and 3 pm, which maximizes the probability of finding nests (i.e., females most likely to be incubating) while minimizing the probability of finding nests early in the laying stage when the risk of nest abandonment is greatest (Gloutney et al. 1993). Surveys were completed using a series of transects paralleling the outer boundary of the grassland unit, with two individuals spaced approximately 30 m apart hand-pulling the rope drag, and a third individual walking behind the drag watching for flushing birds. We pulled ropes across the vegetation at a steady rate until the end of the unit was reached, at which point we pivoted and repeated the process until the entire unit was surveyed. We did not survey portions of units containing > 90% shrub cover or wet areas containing open water. Portions of units where shrubs did not exceed 90% cover but were dense enough to prevent rope pulling were searched by walking the areas systematically with three surveyors spaced 2-m apart, sweeping the top of the vegetation with bamboo poles to flush birds (Winter et al. 2003). For each observation of a flushed bird, we used a Survey 123 form to record a GPS waypoint, the common name of the species, the method of detection (rope drag or systematic walking), and if a nest was found. When a nest was found, we recorded the number of eggs present and photographed the nest.



Rope drag survey at a managed grassland unit located in Nayanquing Point SWA. Photo by S. DeGuisse.

RESULTS

Waterbird Surveys

We completed 199 surveys across all moist soil and row crop reference units (Figures 1-3) during spring migration (late April to mid-June), and an additional 98 surveys during early fall migration (early to late August). Across both migration periods we completed 143 surveys at moist soil units (n = 12) and 154 surveys at row crop reference units (n = 13). In total, we completed 297 waterbird surveys in 2025, with 22 units having 12 visits each and 3 units having 11 visits each. We recorded 52 unique species across all surveys, 25 of which have at least one special status designation (Table 1). Although not included in waterbird counts, we also documented numerous observations of northern harrier (*Circus hudsonius*; SC, SGCN), bald eagle (*Haliaeetus leucocephalus*; SC, SGCN), and short-eared owl (*Asio flammeus*; E, SGCN) hunting over survey units and heard eastern meadowlark (*Sturnella magna*; SC), marsh wren (*Cistothorus palustris*; SC), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*; SC, SGCN) within units.

Table 1. Waterbird species detected across all moist soil and row crop reference units during 2025 surveys. Scientific names are provided in Appendix A.

Species	Special Status ¹	Fennville Farm Unit	Fish Point SWA	Nayanquing Point SWA	St. Clair Flats SWA	Shiawassee River SGA
American Bittern	SC, SGCN, JV-WB, DNR	---	X	X	---	---
American Black Duck	---	---	---	---	---	X
American Coot	JV-WB	---	---	X	---	---
American Wigeon	---	---	---	X	---	X
Black-bellied Plover	---	---	---	X	---	---
Black-crowned Night-Heron	SC, SGCN, JV-WB	---	X	X	---	X
Blue-winged Teal	JV-WF	---	X	X	X	X
Bonaparte's Gull	---	---	---	---	---	X
Canada Goose	DNR	X	X	X	X	X
Caspian Tern	T, SGCN	---	---	X	---	X
Common Gallinule	T, SGCN	---	---	X	---	X
Common Merganser	---	---	---	X	X	X
Double-crested Cormorant	---	---	---	X	---	X
Dunlin	JV-S	---	---	X	---	X
Forster's Tern	T, SGCN	---	---	---	X	---
Gadwall	JV-WF	---	X	X	X	---
Glossy Ibis	---	---	---	X	---	---
Great Blue Heron	JV-WB	X	X	X	X	X
Great Egret	---	---	X	X	X	X
Greater Yellowlegs	---	---	X	X	X	X
Green Heron	---	---	---	X	X	X
Green-winged Teal	JV-WF	---	X	X	X	X

Species	Special Status ¹	Fennville Farm Unit	Fish Point SWA	Nayanquing Point SWA	St. Clair Flats SWA	Shiawassee River SGA
Hooded Merganser	---	---	X	X	X	X
Killdeer	JV-S	X	X	X	X	X
Least Bittern	T, SGCN	---	---	---	X	---
Least Sandpiper	---	---	---	X	X	X
Lesser Yellowlegs	---	---	X	X	X	X
Long-billed Dowitcher	---	---	---	---	X	X
Mallard	JV-WF, DNR	X	X	X	X	X
Mute Swan	---	---	---	X	---	---
Northern Pintail	JV-WF	---	---	X	---	X
Northern Shoveler	---	---	X	X	X	X
Pectoral Sandpiper	---	---	---	X	---	X
Pied-billed Grebe	JV-WB	---	---	X	---	X
Ring-billed Gull	---	X	X	X	X	X
Ring-necked Duck	JV-WF	---	---	X	---	X
Sandhill Crane	JV-WB	X	X	X	X	X
Semipalmated Plover	---	---	---	X	X	X
Semipalmated Sandpiper	---	---	---	X	---	X
Short-billed Dowitcher	JV-S	---	---	X	X	---
Snowy Egret	---	---	---	X	---	---
Solitary Sandpiper	---	---	---	X	X	X
Sora	JV-WB	---	---	X	---	---
Spotted Sandpiper	---	---	X	X	X	X
Stilt Sandpiper	---	---	---	---	X	---
Trumpeter Swan	SC, SGCN	---	---	X	---	---
Western Sandpiper	---	---	---	---	---	X
Whimbrel	---	---	---	X	X	---
White-rumped Sandpiper	---	---	---	---	X	---
Wilson's Phalarope	SC, SGCN, JV-S	---	---	---	---	X
Wilson's Snipe	JV-S	---	X	X	X	X
Wood Duck	JV-WF, DNR	X	X	X	X	X
Total	---	7	19	43	29	37

¹Special Status abbreviations: SC = State Special Concern; T = State Threatened; SGCN = species of greatest conservation need (Derosier et al. 2015); JV-WB = focal species of the Upper Mississippi and Great Lakes Joint Venture (JV) waterbird habitat conservation strategy (Soulliere et al. 2018); JV-WF = focal species of the JV waterfowl habitat conservation strategy (Soulliere et al. 2017); JV-S = focal species of the JV shorebird habitat conservation strategy (Potter et al. 2007); and DNR = Department of Natural Resources Wildlife Division feature species for the state.

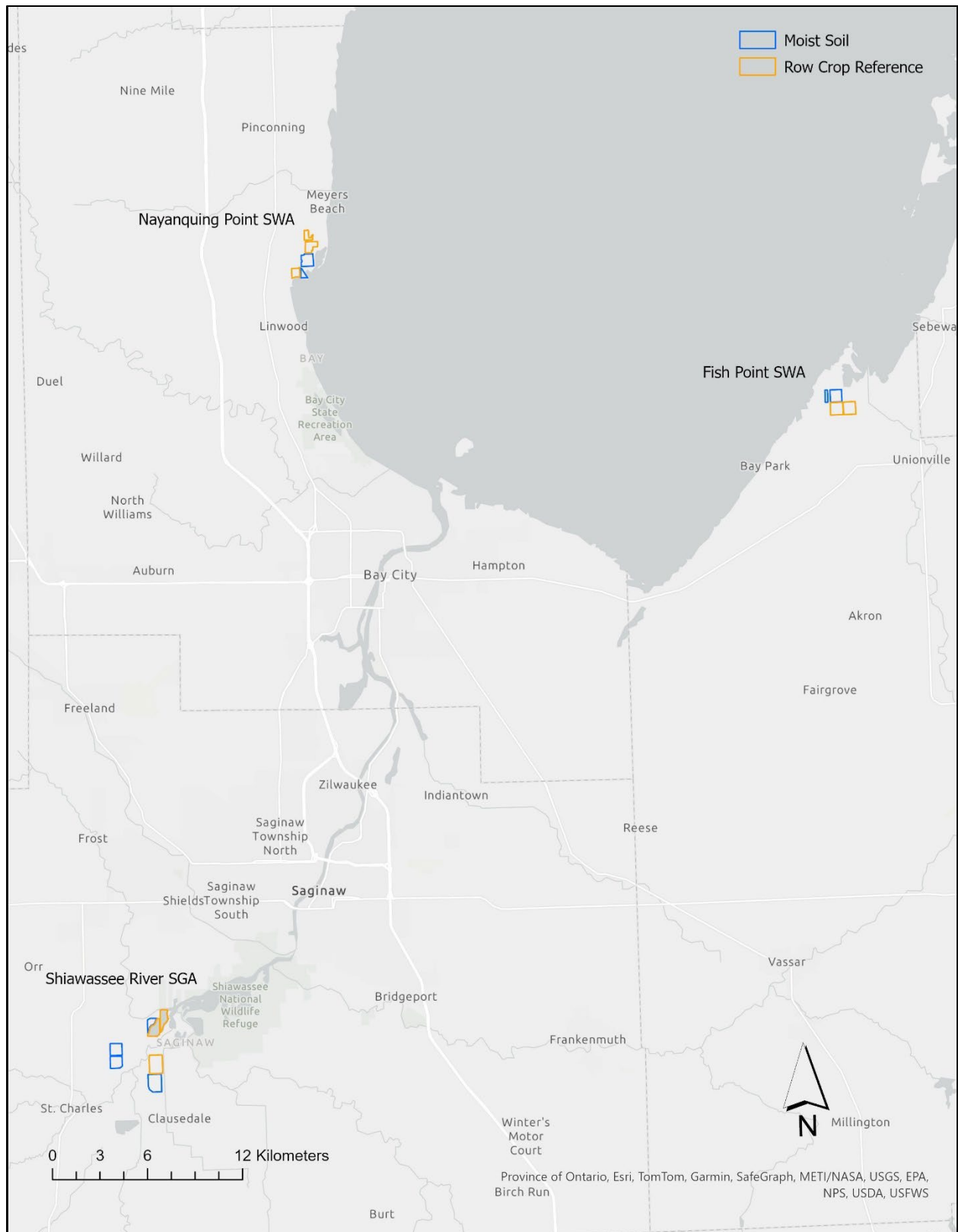


Figure 1. Moist soil and row crop reference units at Nayanquing Point SWA, Fish Point SWA, and Shiawassee River SGA surveyed for migrant waterbird species in 2025.

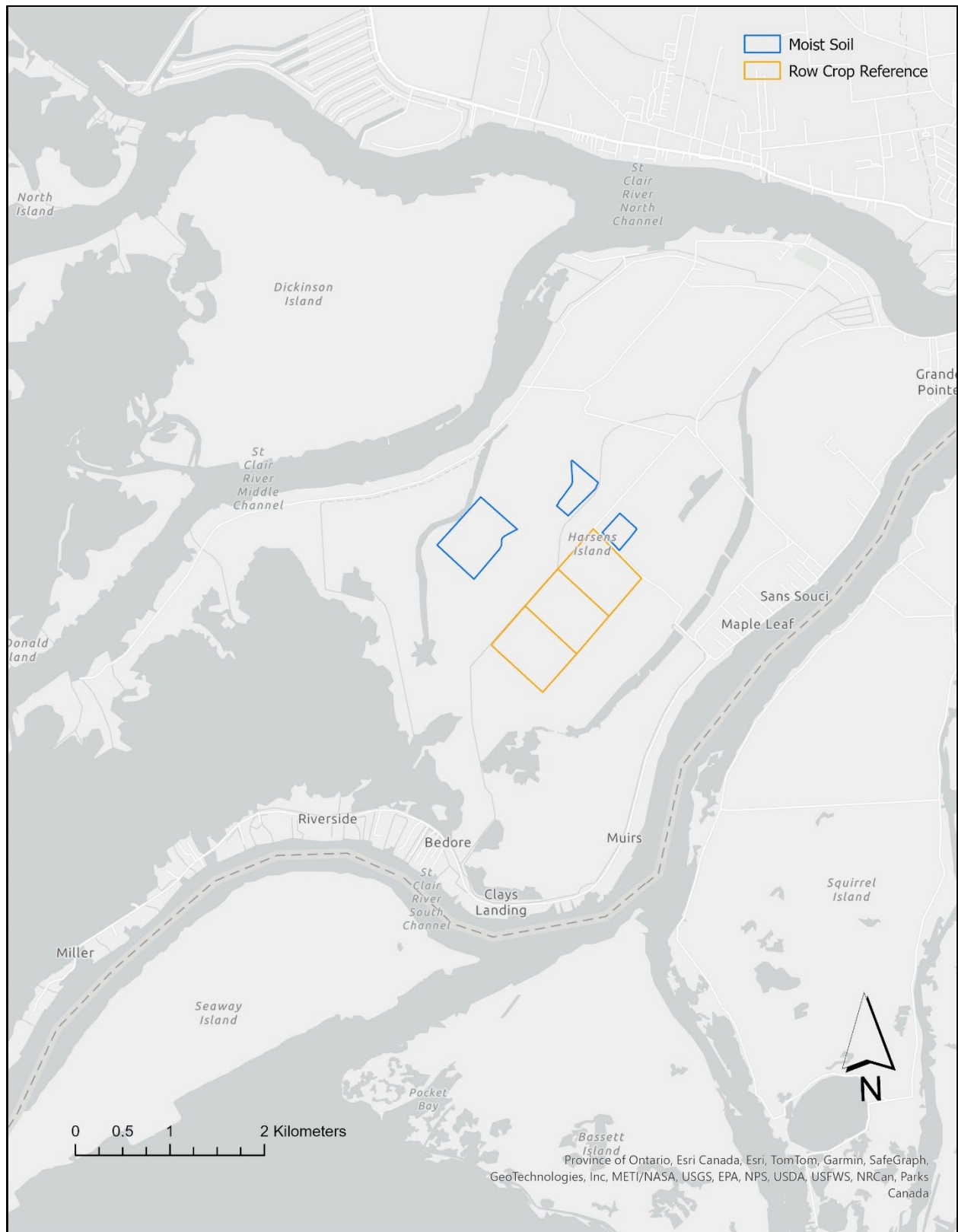


Figure 2. Moist soil and row crop reference units at St. Clair Flats SWA surveyed for migrant waterbird species in 2025.

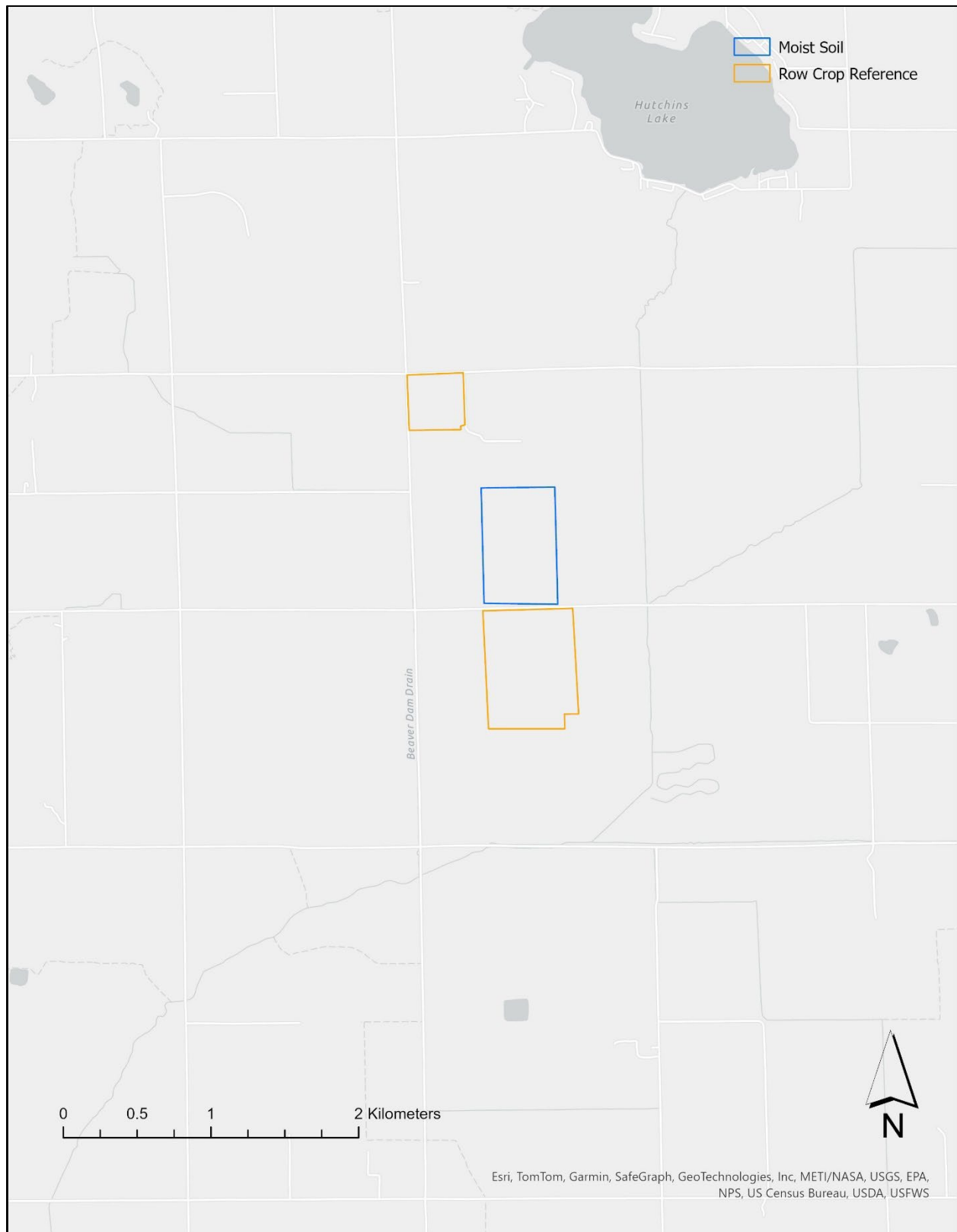


Figure 3. Moist soil and row crop reference units at Fennville Farm Unit of Allegan SGA surveyed for migrant waterbird species in 2025.

Species richness was greater in moist soil units, with 51 unique species recorded relative to 36 species in row crop reference units. Similarly, moist soil units supported more rare species (i.e., State Threatened, Endangered, Special Concern, and SGCN species), with 68 individuals of eight species recorded in moist soil units compared to eight individuals of just three species in row crop reference units. For major waterbird groups, mean densities (individuals per hectare) of coots and grebes, dabbling ducks, all ducks combined, shorebirds, and wading birds were greater in moist soil units during both the spring and early fall migration periods. Row crop reference units supported slightly greater densities of cranes and geese during spring and of diving ducks, gulls, and terns in early fall. During both migration periods, the largest differences were present among dabbling ducks, all ducks combined, and shorebirds, with moist soil units supporting greater densities of all three groups (Table 2). Please see Appendix B for mean densities of each species observed during waterbird surveys.

Table 2. Mean densities (individuals per hectare) and standard errors for major waterbird groups observed at moist soil and row crop reference units during both migration periods.

Group	Spring				Early Fall			
	Moist Soil		Row Crop Reference		Moist Soil		Row Crop Reference	
	Mean Density	SE	Mean Density	SE	Mean Density	SE	Mean Density	SE
Coots and Grebes	0.291	0.277	---	---	0.003	0.003	---	---
Cranes	0.909	0.495	1.183	0.616	0.372	0.129	0.154	0.044
Dabbling ducks	4.457	1.875	2.044	0.916	1.353	0.572	0.381	0.098
Diving ducks	0.088	0.041	0.031	0.015	0.006	0.005	0.013	0.013
Ducks combined ¹	4.643	1.931	2.133	0.935	1.464	0.660	0.394	0.098
Geese	1.774	0.438	2.293	0.949	0.445	0.430	0.053	0.044
Gulls and Terns	0.335	0.300	0.179	0.097	---	---	0.003	0.003
Marsh birds	0.022	0.014	0.001	0.001	---	---	---	---
Shorebirds	3.218	1.657	0.869	0.122	2.228	1.463	0.531	0.289
Swans	0.121	0.116	---	---	---	---	---	---
Wading birds	0.398	0.150	0.311	0.138	0.343	0.166	0.111	0.053

¹Includes dabbling ducks, diving ducks, and unidentified ducks.

Annual Vegetation Surveys

We completed 158 quadrat samples at moist soil units and 159 samples at row crop reference units. In total, we sampled 317 quadrats across all 25 units. Moist soil units had greater (> 5%) percent cover of *Setaria faberi* (Giant foxtail), *Setaria pumila* (Yellow foxtail), *Panicum capillare* (Witch grass), and *Phragmites australis* (Reed) compared to row crop reference units.

Combined percent cover of all *Setaria* spp., *Panicum* spp., and *Bidens* spp. were also greater in moist soil units. Conversely, percent cover of *Zea mays* (Corn), *Glycine max* (Soybean), and *Fagopyrum esculentum* (Buckwheat) were greater in row crop reference units. Fifteen (75%) of the 20 species or genera observed during surveys that are known to provide high nutritional value for waterfowl (Loges et al. 2021) were comparatively more abundant in moist soil units (Table 3).

Table 3. Mean percent cover and standard error for plant species observed during annual vegetation surveys at moist soil and row crop reference units. Listed waterfowl food values (High, Mod, Low) are derived from Loges et al. (2021) Appendix SM-6.

Scientific Name	Common Name	Moist Soil		Row Crop Reference		Waterfowl Food Value
		Mean Percent Cover	SE	Mean Percent Cover	SE	
<i>Abutilon theophrasti</i>	Velvet-leaf	2.188	1.862	1.375	0.758	---
<i>Agalinis tenuifolia</i>	Common false foxglove	0.185	0.132	0.042	0.042	---
<i>Agrostis stolonifera</i>	Creeping bent	0.620	0.588	---	---	---
<i>Amaranthus</i> spp.	Amaranth spp.	2.733	1.092	5.787	2.336	---
<i>Ambrosia artemisiifolia</i>	Common ragweed	4.109	2.281	1.505	0.617	Low
<i>Ambrosia trifida</i>	Giant ragweed	0.149	0.149	---	---	---
<i>Apocynum cannabinum</i>	Indian-hemp	0.176	0.154	0.201	0.111	---
<i>Artemisia biennis</i>	Biennial wormwood	0.238	0.238	0.005	0.005	---
<i>Asclepias incarnata</i>	Swamp milkweed	---	---	0.038	0.029	---
<i>Asclepias syriaca</i>	Common milkweed	0.026	0.026	---	---	---
<i>Avena sativa</i>	Oats	---	---	0.353	0.353	---
<i>Bidens cernua</i>	Nodding beggar-ticks	4.922	3.324	0.903	0.554	High
<i>Bidens frondosa</i>	Common beggar-ticks	---	---	0.254	0.173	High
<i>Bidens</i> spp. ¹	Beggar-ticks spp.	5.923	3.281	0.391	0.182	High
<i>Bromus inermis</i>	Smooth brome	0.498	0.493	1.256	1.256	---
<i>Calystegia sepium</i>	Hedge bindweed	---	---	0.049	0.049	---
<i>Carex</i> spp.	Sedge spp.	0.154	0.148	---	---	Mod
<i>Cephalanthus occidentalis</i>	Buttonbush	0.849	0.849	---	---	Low
<i>Chenopodium album</i>	Lambs-quarter	0.416	0.329	1.257	0.598	---
<i>Chenopodium</i> spp.	Goosefoot spp.	0.464	0.377	1.257	0.598	---
<i>Cirsium arvense</i>	Canada thistle (Field thistle)	0.090	0.083	---	---	---
<i>Conium maculatum</i>	Poison-hemlock	0.069	0.069	---	---	---
<i>Conyza canadensis</i>	Horseweed	0.589	0.483	0.251	0.150	---
<i>Crypsis schoenoides</i>	False-timothy	0.127	0.086	---	---	---
<i>Cyperus esculentus</i>	Yellow nutsedge	3.334	1.092	0.962	0.596	High
<i>Digitaria sanguinalis</i>	Hairy crab grass	0.969	0.641	1.214	0.672	Low
<i>Echinochloa crusgalli</i>	Barnyard grass	3.558	1.199	3.010	1.576	High
<i>Echinochloa</i> spp. ¹	Barnyard grass spp.	3.627	1.207	3.010	1.576	High
<i>Eleocharis acicularis</i>	Spike-rush	1.442	1.442	---	---	High
<i>Eleocharis</i> spp. ¹	Spike-rush spp.	1.572	1.436	---	---	High
<i>Elymus repens</i>	Quack grass	1.488	1.488	0.330	0.223	---
<i>Erechtites hieraciifolius</i>	Fireweed	0.124	0.084	---	---	---
<i>Fagopyrum esculentum</i>	Buckwheat	3.103	1.746	9.636	3.413	---
<i>Glyceria</i> spp.	Manna grass spp.	0.764	0.764	---	---	---
<i>Glycine max</i>	Soybean	2.771	2.771	14.943	7.751	High
<i>Hibiscus trionum</i>	Flower-of-an-hour	0.125	0.125	---	---	---
<i>Impatiens capensis</i>	Spotted touche-me-not	---	---	0.064	0.064	---
<i>Juncus compressus</i>	Rush	---	---	0.044	0.044	Low
<i>Juncus</i> spp. ¹	Rush spp.	0.068	0.050	0.044	0.044	Low

Scientific Name	Common Name	Moist Soil		Row Crop Reference		Waterfowl Food Value
		Mean Percent Cover	SE	Mean Percent Cover	SE	
<i>Leersia oryzoides</i>	Cut grass	1.588	1.006	0.533	0.533	High
<i>Lemna minor</i>	Common duckweed	0.241	0.214	---	---	Mod
<i>Lycopus americanus</i>	Common water horehound	0.201	0.167	---	---	---
<i>Lythrum salicaria</i>	Purple loosestrife	1.345	0.786	0.321	0.199	---
<i>Melilotus</i> spp.	Sweet-clover spp.	---	---	0.110	0.110	---
<i>Mimulus ringens</i>	Monkey-flower	0.025	0.025	---	---	---
<i>Myriophyllum</i> spp.	Milfoil spp.	---	---	0.984	0.984	Low
<i>Nuphar</i> spp.	Pond lilly spp.	---	---	0.110	0.110	Low
<i>Panicum capillare</i>	Witch grass	8.746	4.063	2.995	1.220	High
<i>Panicum dichotomiflorum</i>	Panic grass	2.663	1.235	0.093	0.093	High
<i>Panicum virgatum</i>	Switch grass	0.746	0.528	0.830	0.689	High
<i>Panicum</i> spp. ¹	Panic grass spp.	12.329	5.051	3.918	1.480	High
<i>Periscaria punctata</i>	Smartweed	0.208	0.208	---	---	Mod
<i>Persicaria amphibia</i>	Water smartweed	0.192	0.148	0.892	0.884	---
<i>Persicaria lapathifolia</i>	Nodding smartweed	0.368	0.332	0.783	0.443	High
<i>Persicaria maculosa</i>	Lady's thumb	0.208	0.208	---	---	---
<i>Persicaria</i> spp. ¹	Smartweed spp.	1.657	0.767	2.161	0.980	Low
<i>Phalaris arundinacea</i>	Reed canary grass	4.046	1.547	1.676	0.712	Low
<i>Phragmites australis</i>	Reed	6.623	3.671	0.022	0.017	---
<i>Physalis</i> spp.	<i>Physalis</i> spp.	0.048	0.048	---	---	---
<i>Phytolacca americana</i>	Pokeweed (Poke)	0.007	0.007	0.006	0.006	---
<i>Pilea pumila</i>	Clearweed	0.167	0.167	0.096	0.096	---
<i>Plantago major</i>	Common plantain	0.347	0.347	---	---	---
<i>Plantago</i> spp. ¹	Plantain spp.	0.353	0.347	---	---	---
Poaceae spp.	Grass spp.	0.611	0.611	---	---	---
<i>Polygonum aviculare</i>	Knotweed	0.092	0.073	---	---	---
<i>Portulaca oleracea</i>	Purslane (Pusley)	0.060	0.060	0.355	0.211	---
<i>Potamogeton</i> spp.	Pondweed spp.	1.650	1.650	---	---	High
<i>Potentilla anserina</i>	Silverweed	---	---	0.706	0.628	---
<i>Rosa multiflora</i>	Mutiflora rose (Japanese rose)	0.021	0.021	---	---	---
<i>Rubus</i> spp.	Blackberry spp.	0.174	0.174	---	---	---
<i>Rumex</i> spp.	Dock spp.	0.017	0.013	---	---	Mod
<i>Sanicula canadensis</i>	Black snakeroot	---	---	0.013	0.013	---
<i>Schoenoplectus pungens</i>	Threesquare	0.155	0.122	---	---	Low
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush	0.133	0.082	0.011	0.011	Low
<i>Schoenoplectus</i> spp. ¹	Bulrush spp.	0.461	0.283	0.011	0.011	Low
<i>Scleria verticillate</i>	Nut-rush	0.012	0.012	---	---	---
<i>Setaria faberi</i>	Giant foxtail	7.491	4.213	1.379	0.853	High
<i>Setaria pumila</i>	Yellow foxtail	6.404	3.546	0.415	0.336	High
<i>Setaria</i> spp. ¹	Foxtail spp.	13.895	6.326	2.436	1.097	High
<i>Sinapsis arvensis</i>	Charlock	0.007	0.007	2.285	2.108	---
<i>Solanum carolinense</i>	Horse-nettle	0.007	0.007	0.059	0.039	---

Scientific Name	Common Name	Moist Soil		Row Crop Reference		Waterfowl Food Value
		Mean Percent Cover	SE	Mean Percent Cover	SE	
<i>Solanum</i> spp. ¹	Nightshade spp.	0.007	0.007	0.066	0.039	---
<i>Solidago altissima</i>	Tall goldenrod	1.016	0.620	---	---	---
<i>Trifolium hybridum</i>	Alsike clover	0.357	0.357	0.055	0.055	---
<i>Typha</i> spp.	Cat-tail spp.	0.783	0.783	---	---	Low
<i>Urtica dioica</i>	Stinging nettle	0.035	0.035	---	---	---
<i>Vicia villosa</i>	Hairy vetch	---	---	0.008	0.008	---
<i>Xanthium strumarium</i>	Common cocklebur	2.771	1.250	0.819	0.389	---
<i>Zea mays</i>	Corn	12.024	4.494	38.893	8.572	High

¹For genera with plants identified at both species and genus levels, these values represent the combined percent cover, reflecting the mean percent cover of that genus.

Secretive Marsh Bird Surveys

We completed 117 marsh bird surveys at 41 points located within 12 marsh units (Figures 4-5). Surveys were completed approximately every two weeks between mid-May and mid-June, with 36 points having three visits each. Of the remaining five points, four were visited twice and one point had only a single visit. One marsh unit at Shiawassee River SGA included in the original sample frame was not surveyed during 2025 due to issues with access. We recorded seven primary species and six secondary species across all surveys. Eleven of these species have at least one special status designation, including three State Threatened species, four State Special Concern species, and five SGCN (Table 4). Although not a target species, we also recorded multiple observations of trumpeter swan (*Cygnus buccinator*; SC, SGCN) during surveys at Nayanquing Point SWA.

Table 4. Target species detected during 2025 surveys at Fish Point SWA, Nayanquing Point SWA, and Shiawassee River SGA. Scientific names are provided in Appendix A.

Common Name	Special Status ¹	Fish Point SWA	Nayanquing Point SWA	Shiawassee River SGA
American Bittern	SC, SGCN, JV, DNR	X	X	X
American Coot	JV	---	---	X
Black Tern	T, SGCN, JV	---	---	X
Common Gallinule	T, SGCN	X	X	X
Least Bittern	T, SGCN	X	X	X
Marsh Wren	SC	X	X	X
Pied-billed Grebe	JV	X	X	X
Sandhill Crane	JV	X	X	X
Sedge Wren	SC	---	X	---
Sora	JV	X	---	X
Swamp Sparrow	---	X	X	X
Virginia Rail	---	X	X	X
Yellow-headed Blackbird	SC, SGCN	---	X	---
Total	---	9	10	11

¹Special Status abbreviations: SC = State Special Concern; T = State Threatened; SGCN = species of greatest conservation need (Derosier et al. 2015); JV = focal species of the JV waterbird habitat conservation strategy (Soulliere et al. 2018); and DNR = Department of Natural Resources Wildlife Division feature species for the state.

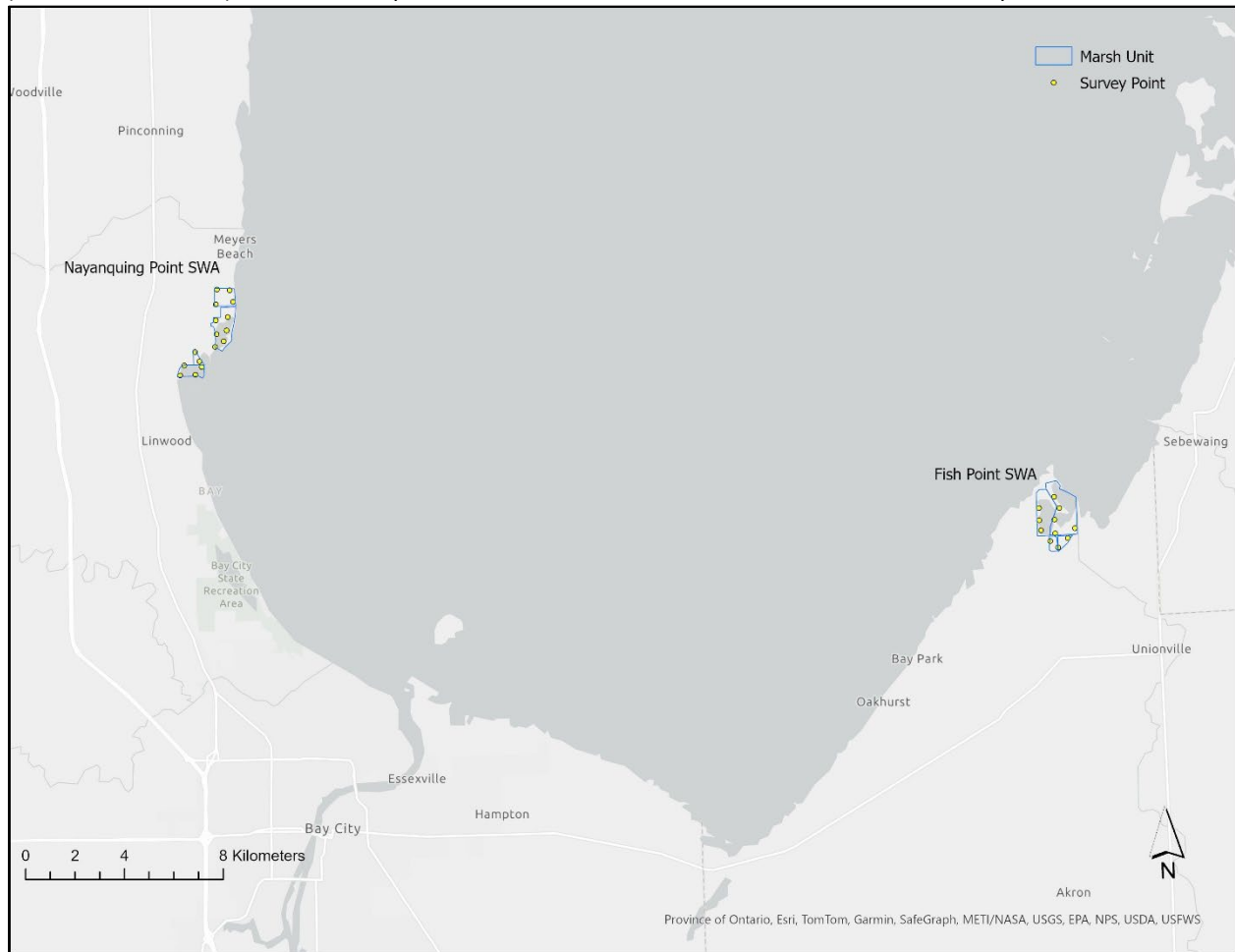


Figure 4. Marsh units and point count stations at Nayanquing Point SWA and Fish Point SWA surveyed for breeding secretive marsh birds in 2025.

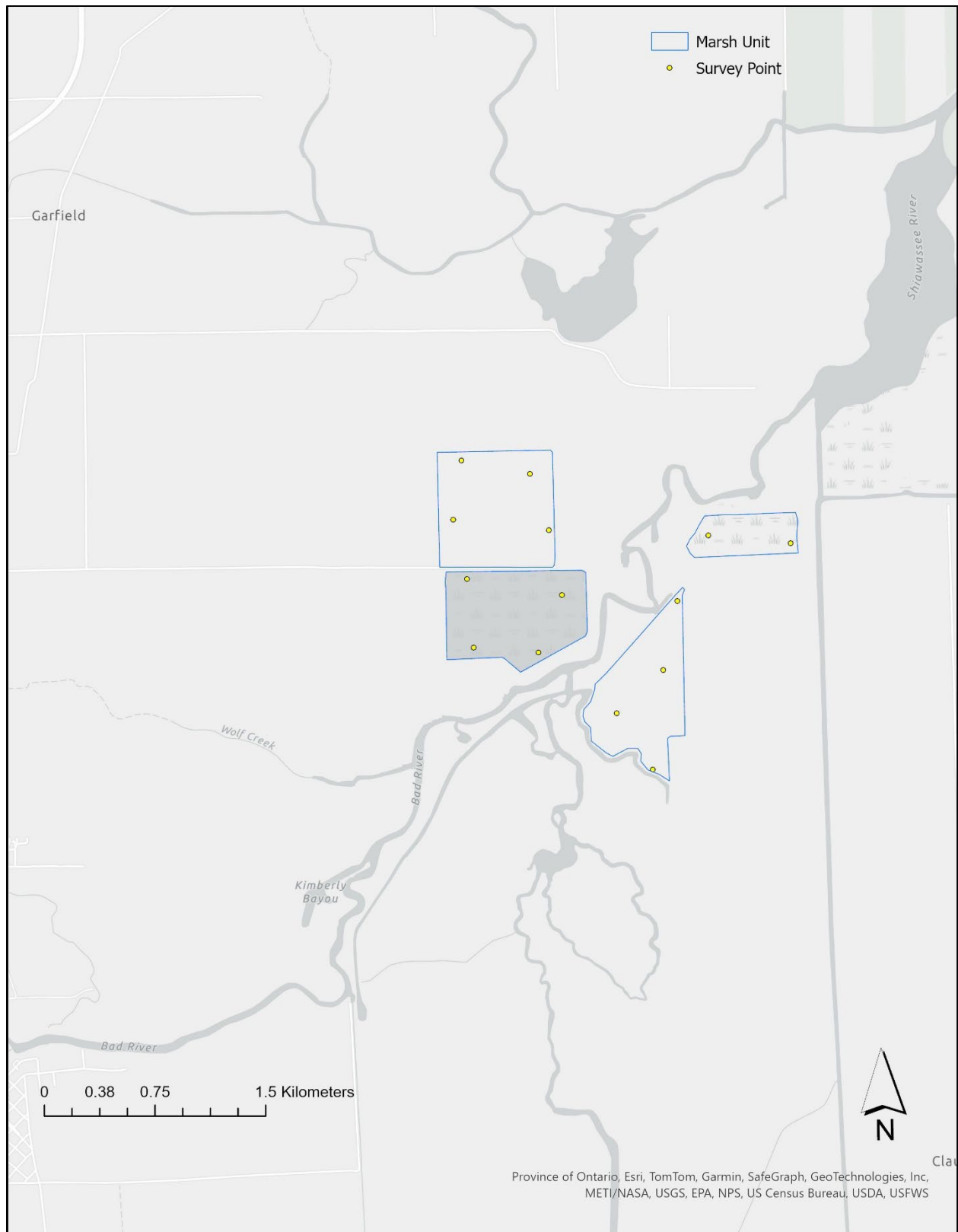


Figure 5. Marsh units and point count stations at Shiawassee River SGA surveyed for breeding secretive marsh birds in 2025.

Grassland Bird Surveys

We completed 62 grassland bird surveys in 2025, with two visits to all 31 survey points (Figures 6-7). We recorded 77 bird species across all surveys, yet 33 of these species were observed only as flyovers or were located outside of grassland unit boundaries in adjacent habitats. Of the 44 species observed within unit boundaries, nine have at least one special status designation, including one State Threatened species, two State Special Concern species, and one SGCN. We also recorded several featured species of the DNR Wildlife Division and focal species of the Upper Mississippi / Great Lakes Joint Venture (Table 5).

Table 5. Species detected during 2025 surveys at managed grassland units located at Nayanquing Point SWA and Shiawassee River SGA. Scientific names are provided in Appendix A.

Species	Special Status ¹	Nayanquing Point SWA	Shiawassee River SGA
Alder Flycatcher	---	X	---
American Crow	---	X	---
American Goldfinch	---	X	X
American Redstart	---	X	---
American Robin	---	X	X
Baltimore Oriole	---	---	X
Barn Swallow	---	X	X
Bobolink	JV-L, DNR	---	X
Brown Thrasher	---	---	X
Brown-headed Cowbird	---	X	X
Canada Goose	DNR	X	X
Chimney Swift	JV-L	---	X
Common Grackle	---	X	X
Common Yellowthroat	---	X	X
Eastern Kingbird	---	X	X
Eastern Meadowlark	SC, JV-L, DNR	---	X
Eastern Wood-Pewee	---	---	X
Field Sparrow	---	---	X
Fox Sparrow	---	X	---
Great-crested Flycatcher	---	---	X
Hooded Merganser	---	---	X
Horned Lark	---	---	X
Indigo Bunting	---	---	X
Killdeer	---	X	X
Least Flycatcher	---	---	X
Mallard	DNR	X	X
Northern Cardinal	---	---	X
Orchard Oriole	---	---	X
Peregrine Falcon	T, SGCN, DNR	X	---

Species	Special Status ¹	Nayanquing Point SWA	Shiawassee River SGA
Purple Martin	---	X	---
Red-winged Blackbird	---	X	X
Ring-necked Pheasant	DNR	X	X
Rose-breasted Grosbeak	---	---	X
Sandhill Crane	JV-W	X	---
Savannah Sparrow	---	X	X
Sedge Wren	SC	X	X
Song Sparrow	---	X	X
Swamp Sparrow	---	X	X
Tree Swallow	---	X	X
Tufted Titmouse	---	X	---
Vesper Sparrow	---	---	X
Warbling Vireo	---	X	X
Willow Flycatcher	---	X	X
Yellow Warbler	---	X	X
Total	---	28	36

¹Special Status abbreviations: SC = State Special Concern; T = State Threatened; SGCN = species of greatest conservation need (Derosier et al. 2015); JV-L = focal species of the JV landbird habitat conservation strategy (Soulliere et al. 2020); JV-W = focal species of the JV waterbird habitat conservation strategy (Soulliere et al. 2018); and DNR = Department of Natural Resources Wildlife Division feature species for the state.

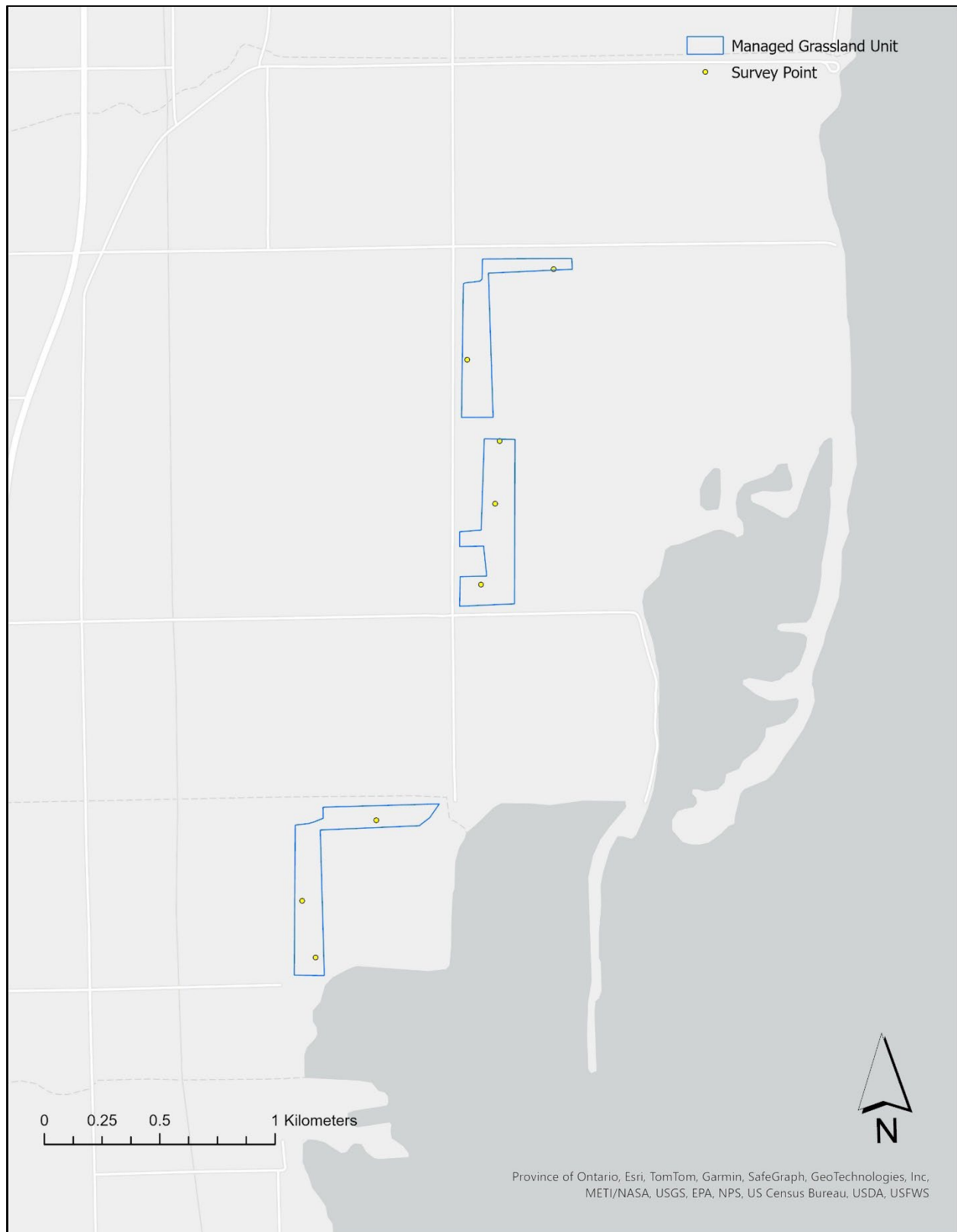


Figure 6. Managed grassland units and point count stations at Nyanquing Point SWA surveyed for breeding birds in 2025.

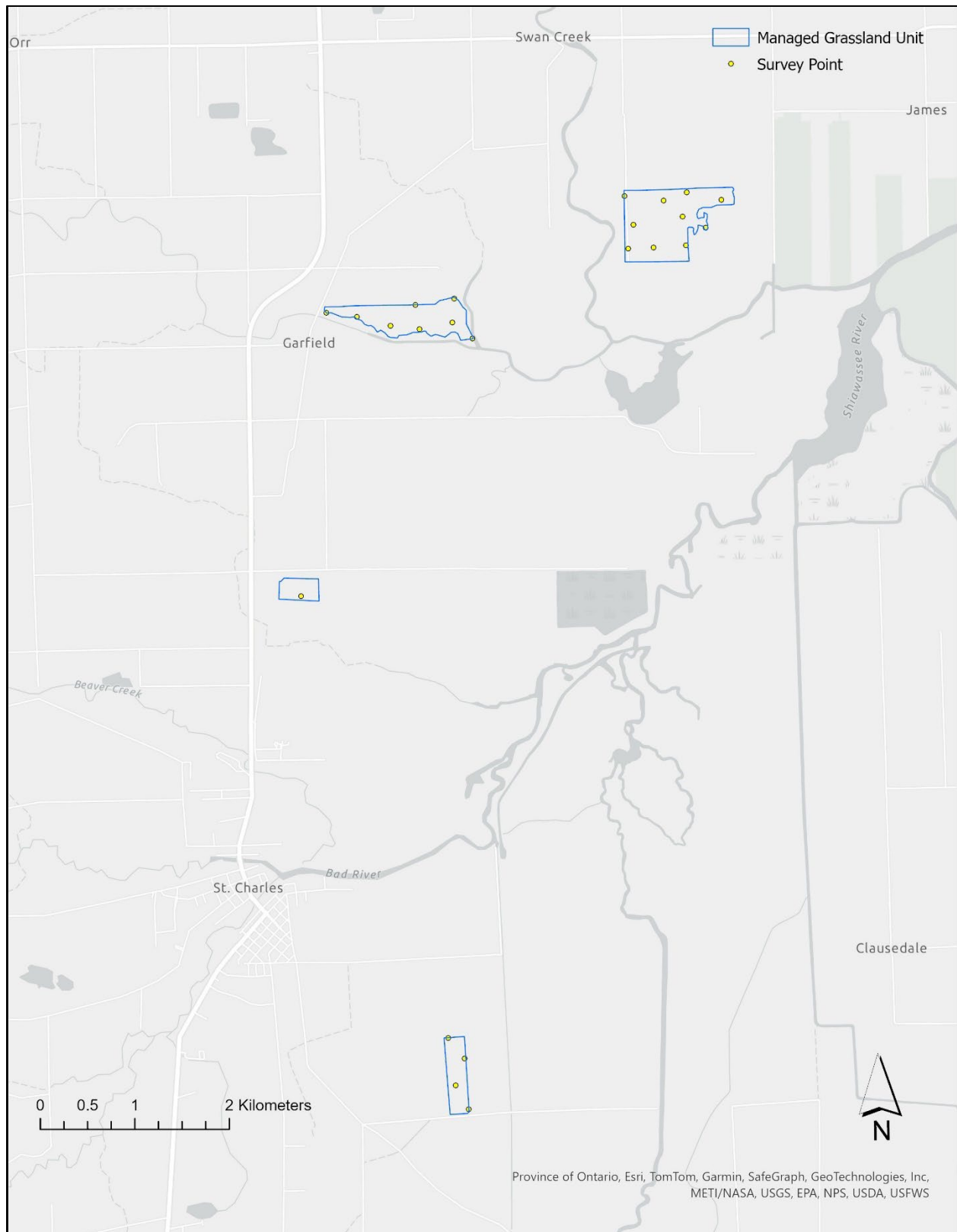


Figure 7. Managed grassland units and point count stations at Shiawassee River SGA surveyed for breeding birds in 2025.

Nesting Waterfowl Surveys

We completed a single rope drag survey at each managed grassland unit and found a total of seven mallard (*Anas platyrhynchos*) nests. We found five active nests and one depredated nest at Nayanquing Point SWA (Figure 8), and a single abandoned and presumed depredated nest at Shiawasse River SGA (Figure 9). All active nests were being incubated by females that flushed during the survey, with clutch sizes ranging from 4-10 eggs at the time of discovery. Five nests were located by rope dragging, and two by systematic walking through areas of higher shrub cover.



Active mallard nest found within a managed grassland unit at Nayanquing Point SWA. Photo by E. Branch.

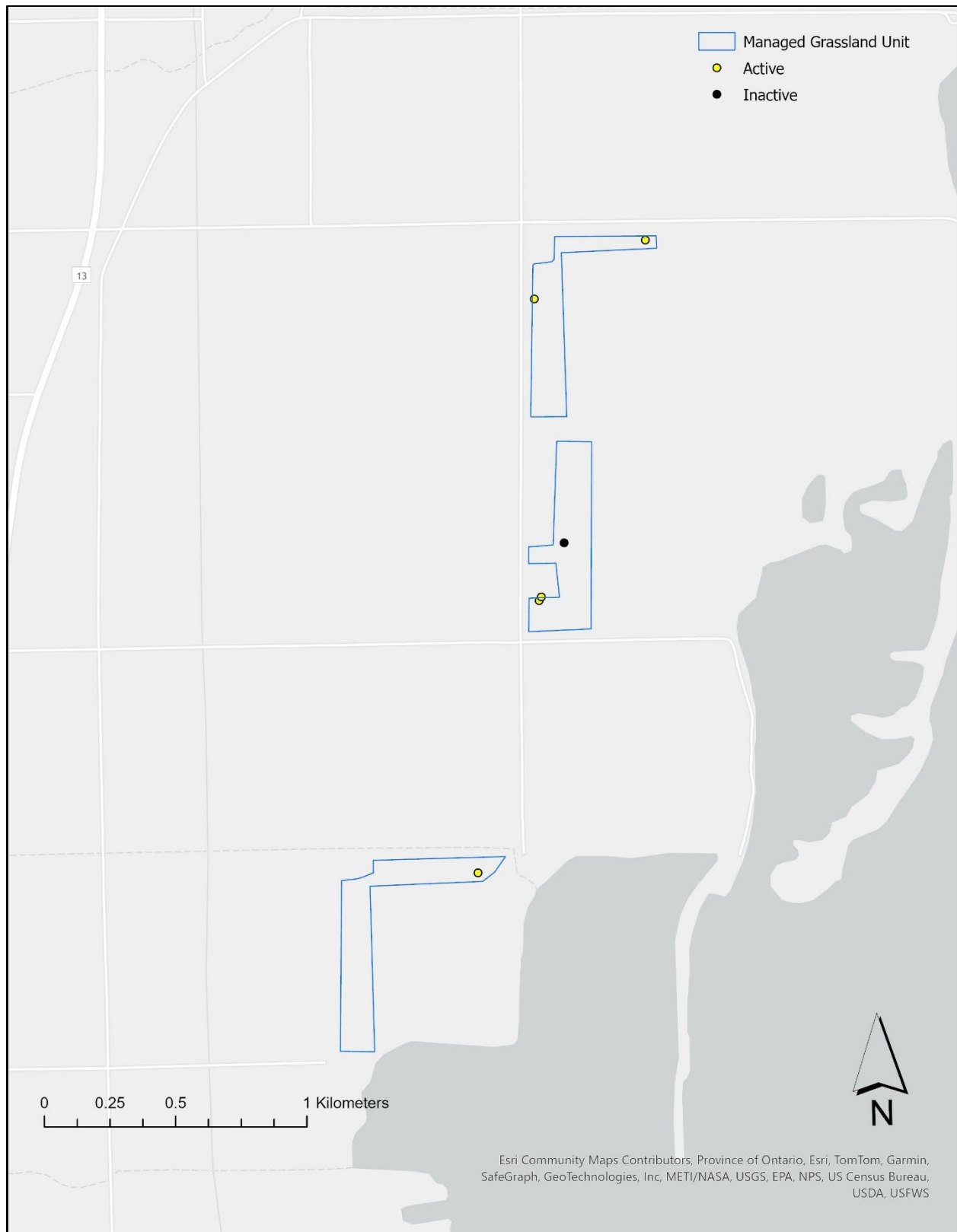


Figure 8. Active and inactive Mallard nests found within managed grassland units at Nayanquing Point SWA during 2025 surveys.

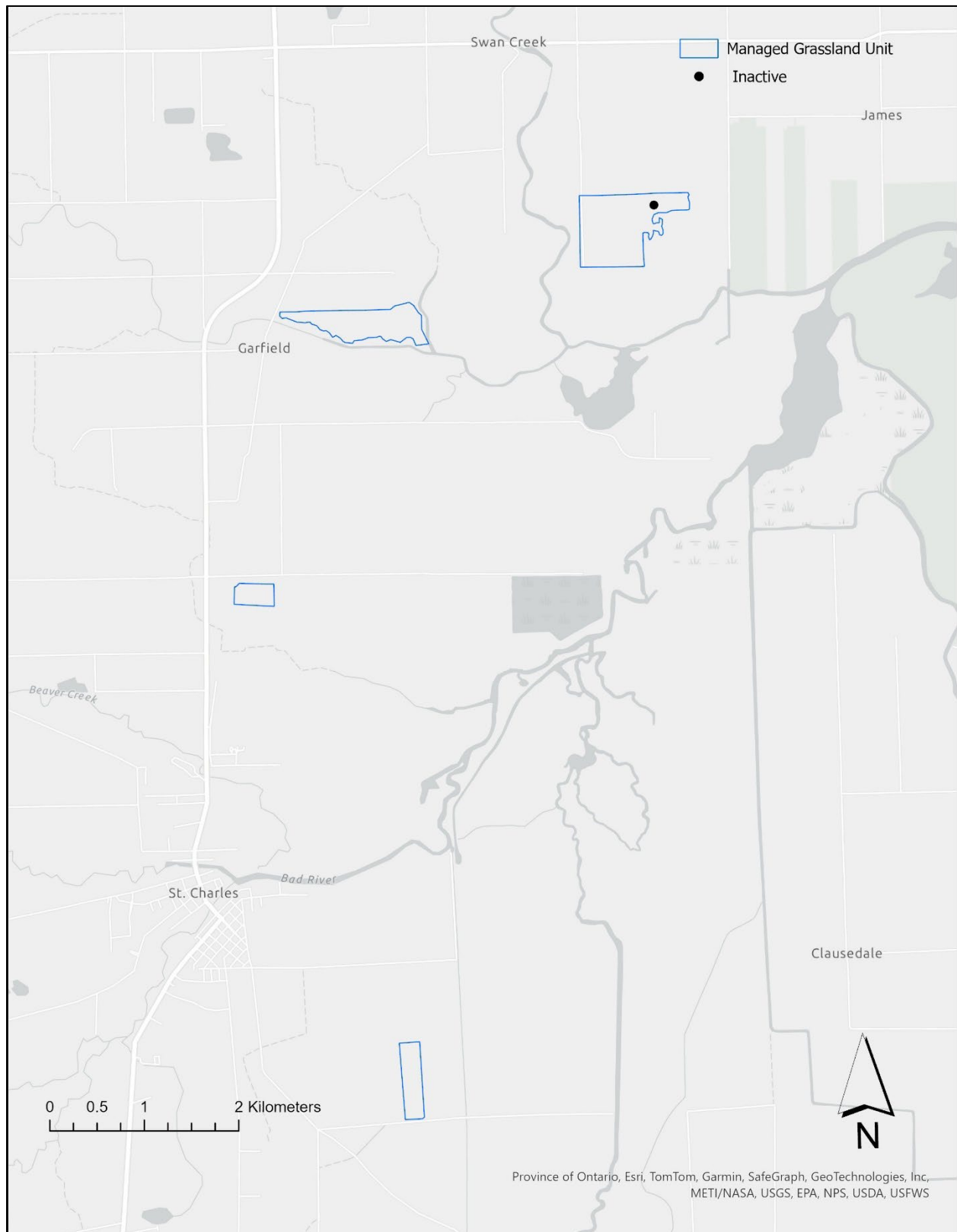


Figure 9. Location of the single inactive and depredated Mallard nest found within a managed grassland unit at Shiawassee River SGA during 2025 surveys.

DISCUSSION

Working in partnership with the DNR, we successfully implemented the first year of what is intended to be a long-term monitoring program. We conducted 483 surveys for migrant waterbirds, breeding secretive marsh birds, breeding grassland birds, and nesting waterfowl species in 2025. We recorded 95 species across all surveys, 34 of which have at least one special status designation, highlighting the valuable habitat that MWHAs provide for breeding and migrating birds. In addition to bird surveys, we completed 317 quadrat samples to describe vegetation response to moist soil management relative to traditionally managed row crop units.

Initial surveys indicated that moist soil units support a greater diversity of waterbird species, notably greater densities of ducks and shorebirds, and more than eight times as many SGCN, state listed, and State Special Concern species than traditionally managed row crop units. Furthermore, these units supported greater percent cover of 75% of observed plant species or genera known to provide high nutritional value for waterfowl. However, moist soil units also contained greater percent cover of several undesirable and potentially problematic species, such as *Lythrum salicaria* (Purple loosestrife), *Phalaris arundinacea* (Reed canary grass), *Phragmites australis* (Reed), *Typha* spp. (Cat-tail spp.), and *Xanthium strumarium* (Common cocklebur), and monitoring of these species is recommended. Secretive marsh bird surveys documented use of marsh units by 13 target species, 11 of which have at least one special status designation. Surveys within managed grassland units documented use of these areas by nesting mallards and provided substantial data on both rare species and the overall bird assemblages using these areas during the breeding season.

For units where priority management actions have begun to be implemented, results of 2025 surveys provide an early indication of bird and habitat response that can be used to inform future management decisions. For units where management has yet to be implemented, these surveys provide important baseline data that can be used to assess bird community and habitat response in future years. Repeated monitoring of these units across multiple years will permit more formal analyses of changes in the relative abundance of focal bird species, bird communities, and desirable and undesirable plant species. Ultimately, these data can be used to evaluate management outcomes, inform future management decisions, and track progress towards the fundamental objectives outlined in the 10-year strategic plan.

We recommend continued implementation of the current monitoring framework in 2026 and beyond, with a few adjustments. Based on results of year one surveys and discussions with DNR staff, we intend to adjust the timing of future spring and fall waterbird surveys to better align with peak waterfowl migration and timing of current DNR management. We suggest the monitoring plan continue to be reassessed annually to allow for adaptation as priorities, resources, and site conditions change.

LITERATURE CITED

- Conway, C.J. 2011. Standardized North American marsh bird monitoring protocol. *Waterbirds* 34:319-346.
- Derosier, A.L., S.K. Hanshew, K.E. Wehrly, J.K. Farkas, and M.J. Nichols. 2015. Michigan's Wildlife Action Plan. Michigan Department of Natural Resources, Lansing, MI.
- Gloutney, M.L., R.G. Clark, A.D. Afton, and G.J. Huff. 1993. Timing of Nest Searches for Upland Nesting Waterfowl. *The Journal of Wildlife Management* 57:597-601.
- Higgins, K.F., L.M. Kirsch, and I.J. Ball. 1969. A Cable-Chain Device for Locating Duck Nests. *The Journal of Wildlife Management* 33:1009-1011.
- Klett, A.T., H.F. Duebbert, C.A. Faanes, and K.F. Higgins. 1986. Techniques for Studying Nest Success of Ducks in Upland Habitats in the Prairie Pothole Region. United States Fish and Wildlife Service Resource Publication 158.
- Loges, B.W., B.G. Tavernia, A.M. Wilson, H.M. Hagy, J.D. Stanton, J.H. Herner-Thogmartin, T. Jones, and L. Wires. 2021. National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats. V2.1. Natural Resources Program Center, Fort Collins, Co.
- Michigan Bird Conservation Initiative. 2015. Michigan marsh bird survey protocol. Michigan Natural Features Inventory, Michigan State University Extension, Lansing, MI.
- Potter, B.A., R.J. Gates, G.J. Soulliere, R.P. Russell, D.A. Granfors, and D.N. Ewert. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Shorebird Habitat Conservation Strategy. U. S. Fish and Wildlife Service, Fort Snelling, MN.
- Ralph, C. J., J. R. Sauer, and S. Droege (eds.). 1995. Monitoring bird populations by point counts. General Technical Report PSW-GTR-149. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, CA.
- Soulliere, G. J., M. A. Al-Saffar, J. M. Coluccy, R. J. Gates, H. M. Hagy, J. W. Simpson, J. N. Straub, R. L. Pierce, M. W. Eichholz, and D. R. Luukkonen. 2017. Upper Mississippi River and Great Lakes Region Joint Venture Waterfowl Habitat Conservation Strategy – 2017 Revision. U.S. Fish and Wildlife Service, Bloomington, Minnesota, USA.
- Soulliere, G.J., M.A. Al-Saffar, R.L. Pierce, M.J. Monfils, L.R. Wires, B.W. Loges, B.T. Shirkey, N.S. Miller, R.D. Schultheis, F.A. Nelson, A.M. Sidie-Slettedahl, and D.J. Holm. 2018. Upper Mississippi River and Great Lakes Region Joint Venture Waterbird Habitat Conservation Strategy – 2018 Revision. U.S. Fish and Wildlife Service, Bloomington, Minnesota, USA.
- Soulliere, G.J., M.A. Al-Saffar, K.R. VanBeek, C.M. Tonra, M.D. Nelson, D.N. Ewert, T. Will, W.E. Thogmartin, K.E. O'Brien, S.W. Kendrick, A.M. Gillet, J.R. Herkert, E.E. Gnass Giese, M.P. Ward, and S. Graff. 2020. Upper Mississippi / Great Lakes Joint Venture Landbird Habitat Conservation Strategy – 2020 Revision. U.S. Fish and Wildlife Service, Bloomington, Minnesota, USA.
- Webb, E.B., L.M. Smith, M.P. Vrtiska, and T.G. LaGrange. 2010. Effects of local and landscape variables on wetland bird use during migration through the Rainwater Basin. *Journal of Wildlife Management* 74:109-119.
- Winter, M., S.E. Hawks, J.A. Shaffer, and D.H. Johnson. 2003. Guidelines for Finding Nests of Passerine Birds in Tallgrass Prairie. *The Prairie Naturalist* 35.

APPENDIX A: COMMON AND SCIENTIFIC NAMES OF BIRD SPECIES DETECTED AT MANAGED WATERFOWL HUNT AREAS IN 2025.

Common Name	Scientific Name
Alder Flycatcher	<i>Empidonax alnorum</i>
American Bittern	<i>Botaurus lentiginosus</i>
American Black Duck	<i>Anas rubripes</i>
American Coot	<i>Fulica americana</i>
American Crow	<i>Corvus brachyrhynchos</i>
American Goldfinch	<i>Spinus tristis</i>
American Redstart	<i>Setophaga ruticilla</i>
American Robin	<i>Turdus migratorius</i>
American Wigeon	<i>Mareca americana</i>
Baltimore Oriole	<i>Icterus galbula</i>
Barn Swallow	<i>Hirundo rustica</i>
Black Tern	<i>Chlidonias niger</i>
Black-bellied Plover	<i>Pluvialis squatarola</i>
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>
Blue-winged Teal	<i>Spatula discors</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>
Brown Thrasher	<i>Toxostoma rufum</i>
Brown-headed Cowbird	<i>Molothrus ater</i>
Canada Goose	<i>Branta canadensis</i>
Caspian Tern	<i>Hydroprogne caspia</i>
Chimney Swift	<i>Chaetura pelagica</i>
Common Gallinule	<i>Gallinula galeata</i>
Common Grackle	<i>Quiscalus quiscula</i>
Common Merganser	<i>Mergus merganser</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Double-crested Cormorant	<i>Nannopterum auritum</i>
Dunlin	<i>Calidris alpina</i>
Eastern Kingbird	<i>Tyrannus tyrannus</i>
Eastern Meadowlark	<i>Sturnella magna</i>
Eastern Wood-Pewee	<i>Contopus virens</i>
Field Sparrow	<i>Spizella pusilla</i>
Forster's Tern	<i>Sterna forsteri</i>
Fox Sparrow	<i>Passerella iliaca</i>
Gadwall	<i>Mareca strepera</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Great Blue Heron	<i>Ardea herodias</i>
Great Egret	<i>Ardea alba</i>
Great-crested Flycatcher	<i>Myiarchus crinitus</i>
Greater Yellowlegs	<i>Tringa melanoleuca</i>

Common Name	Scientific Name
Green Heron	<i>Butorides virescens</i>
Green-winged Teal	<i>Anas crecca</i>
Hooded Merganser	<i>Lophodytes cucullatus</i>
Horned Lark	<i>Eremophila alpestris</i>
Indigo Bunting	<i>Passerina cyanea</i>
Killdeer	<i>Charadrius vociferus</i>
Least Bittern	<i>Botaurus exilis</i>
Least Flycatcher	<i>Empidonax minimus</i>
Least Sandpiper	<i>Calidris minutilla</i>
Lesser Yellowlegs	<i>Tringa flavipes</i>
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>
Mallard	<i>Anas platyrhynchos</i>
Marsh Wren	<i>Cistothorus palustris</i>
Mute Swan	<i>Cygnus olor</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
Northern Pintail	<i>Anas acuta</i>
Northern Shoveler	<i>Spatula clypeata</i>
Orchard Oriole	<i>Icterus spurius</i>
Pectoral Sandpiper	<i>Calidris melanotos</i>
Peregrine Falcon	<i>Falco peregrinus</i>
Pied-billed Grebe	<i>Podilymbus podiceps</i>
Purple Martin	<i>Progne subis</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Ring-billed Gull	<i>Larus delawarensis</i>
Ring-necked Duck	<i>Aythya collaris</i>
Ring-necked Pheasant	<i>Phasianus colchicus</i>
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
Sandhill Crane	<i>Antigone canadensis</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Sedge Wren	<i>Cistothorus stellaris</i>
Semipalmated Plover	<i>Charadrius semipalmatus</i>
Semipalmated Sandpiper	<i>Calidris pusilla</i>
Short-billed Dowitcher	<i>Limnodromus griseus</i>
Snowy Egret	<i>Egretta thula</i>
Solitary Sandpiper	<i>Tringa solitaria</i>
Song Sparrow	<i>Melospiza melodia</i>
Sora	<i>Porzana carolina</i>
Spotted Sandpiper	<i>Actitis macularius</i>
Stilt Sandpiper	<i>Calidris himantopus</i>
Swamp Sparrow	<i>Melospiza georgiana</i>
Tree Swallow	<i>Tachycineta bicolor</i>
Trumpeter Swan	<i>Cygnus buccinator</i>
Tufted Titmouse	<i>Baeolophus bicolor</i>

Common Name	Scientific Name
Vesper Sparrow	<i>Pooecetes gramineus</i>
Virginia Rail	<i>Rallus limicola</i>
Warbling Vireo	<i>Vireo gilvus</i>
Western Sandpiper	<i>Calidris mauri</i>
Whimbrel	<i>Numenius phaeopus</i>
White-rumped Sandpiper	<i>Calidris fuscicollis</i>
Willow Flycatcher	<i>Empidonax traillii</i>
Wilson's Phalarope	<i>Phalaropus tricolor</i>
Wilson's Snipe	<i>Gallinago delicata</i>
Wood Duck	<i>Aix sponsa</i>
Yellow Warbler	<i>Setophaga petechia</i>
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>

APPENDIX B: MEAN DENSITY (INDIVIDUALS PER HECTARE) AND STANDARD ERROR FOR EACH WATERBIRD SPECIES DETECTED AT MOIST SOIL AND ROW CROP REFERENCE UNITS DURING BOTH MIGRATION PERIODS.

Common Name	Spring				Early Fall			
	Moist Soil		Row Crop Reference		Moist Soil		Row Crop Reference	
	Mean Density	SE	Mean Density	SE	Mean Density	SE	Mean Density	SE
American Bittern	0.003	0.003	0.001	0.001	---	---	---	---
American Black Duck	---	---	---	---	0.001	0.001	---	---
American Coot	0.276	0.264	---	---	---	---	---	---
American Wigeon	0.031	0.024	0.007	0.007	---	---	---	---
Black-bellied Plover	0.006	0.006	0.004	0.004	0.012	0.012	---	---
Black-crowned Night-Heron	0.010	0.007	0.004	0.003	0.005	0.003	0.005	0.003
Blue-winged Teal	0.307	0.095	0.145	0.060	0.061	0.035	0.026	0.018
Bonaparte's Gull	---	---	---	---	---	---	0.002	0.002
Canada Goose	1.774	0.438	2.293	0.949	0.445	0.430	0.053	0.044
Caspian Tern	0.291	0.291	0.002	0.002	---	---	---	---
Common Gallinule	0.004	0.003	---	---	---	---	---	---
Common Merganser	0.012	0.012	---	---	0.005	0.005	0.013	0.013
Double-crested Cormorant	0.014	0.009	0.025	0.025	0.018	0.012	---	---
Dunlin	1.446	1.381	0.003	0.003	---	---	---	---
Forster's Tern	0.023	0.023	---	---	---	---	---	---
Gadwall	0.697	0.518	0.034	0.027	0.023	0.023	---	---
Glossy Ibis	0.006	0.006	---	---	---	---	---	---
Great Blue Heron	0.168	0.050	0.060	0.014	0.079	0.015	0.072	0.035
Great Egret	0.188	0.116	0.221	0.124	0.209	0.148	0.033	0.016
Greater Yellowlegs	0.131	0.071	0.043	0.013	0.062	0.034	0.006	0.004
Green Heron	0.001	0.001	---	---	0.032	0.018	0.001	0.001
Green-winged Teal	1.105	0.547	0.307	0.153	---	---	0.003	0.003
Hooded Merganser	0.041	0.015	0.025	0.015	---	---	---	---
Killdeer	0.686	0.134	0.615	0.087	0.598	0.360	0.314	0.185
Least Bittern	0.012	0.012	---	---	---	---	---	---
Least Sandpiper	0.163	0.128	0.057	0.031	0.861	0.812	0.079	0.076
Lesser Yellowlegs	0.201	0.118	0.029	0.013	0.246	0.140	0.046	0.040
Long-billed Dowitcher	0.005	0.005	---	---	0.012	0.012	---	---
Mallard	1.148	0.645	1.351	0.811	0.294	0.187	0.041	0.015
Mute Swan	0.106	0.105	---	---	---	---	---	---
Northern Pintail	0.142	0.093	---	---	---	---	---	---
Northern Shoveler	0.712	0.377	0.017	0.010	---	---	---	---
Pectoral Sandpiper	0.026	0.019	0.005	0.005	0.065	0.064	0.007	0.007
Pied-billed Grebe	0.015	0.013	---	---	0.003	0.003	---	---
Ring-billed Gull	0.021	0.012	0.178	0.097	---	---	0.002	0.002
Ring-necked Duck	0.035	0.025	0.005	0.005	---	---	---	---
Sandhill Crane	0.909	0.495	1.183	0.616	0.372	0.129	0.154	0.044

Common Name	Spring				Early Fall			
	Moist Soil		Row Crop Reference		Moist Soil		Row Crop Reference	
	Mean Density	SE	Mean Density	SE	Mean Density	SE	Mean Density	SE
Semipalmated Plover	0.100	0.087	---	---	0.058	0.040	0.003	0.003
Semipalmated Sandpiper	---	---	---	---	0.105	0.105	0.035	0.035
Short-billed Dowitcher	---	---	0.008	0.008	0.029	0.029	---	---
Snowy Egret	0.012	0.012	---	---	---	---	---	---
Solitary Sandpiper	0.021	0.012	0.006	0.004	0.072	0.042	0.023	0.011
Sora	0.003	0.003	---	---	---	---	---	---
Spotted Sandpiper	0.073	0.038	0.064	0.023	0.007	0.006	0.010	0.008
Stilt Sandpiper	---	---	---	---	0.012	0.012	---	---
Trumpeter Swan	0.015	0.012	---	---	---	---	---	---
Unidentified Dabbling Duck	0.030	0.021	0.034	0.032	---	---	---	---
Unidentified Diving Duck	---	---	---	---	0.001	0.001	---	---
Unidentified Duck	0.098	0.064	0.058	0.044	0.105	0.105	---	---
Unidentified Heron	---	---	---	---	---	---	0.001	0.001
Unidentified Ringed Plover, Sandpiper or Stint	0.069	0.064	0.003	0.002	0.041	0.030	0.005	0.005
Unidentified Shorebird	0.030	0.028	0.001	0.001	---	---	---	---
Unidentified Teal	0.005	0.005	0.045	0.031	0.012	0.012	---	---
Unidentified Yellowlegs	0.168	0.114	0.004	0.003	0.010	0.009	---	---
Western Sandpiper	0.001	0.001	---	---	---	---	---	---
Whimbrel	0.007	0.007	0.002	0.002	---	---	---	---
White-rumped Sandpiper	---	---	0.002	0.002	0.012	0.012	---	---
Wilson's Phalarope	0.001	0.001	---	---	---	---	---	---
Wilson's Snipe	0.085	0.037	0.023	0.012	0.027	0.015	0.003	0.003
Wood Duck	0.281	0.105	0.103	0.059	0.962	0.385	0.310	0.092