Tewin Lands

Natural Heritage

Existing Conditions Report

Prepared for: Taggart Investments and Algonquins of Ontario

April 25, 2024

KILGOUR & ASSOCIATES LTD.
www.kilgourassociates.com

Project Number: 1199

READER'S NOTE

Introduction

This Natural Heritage Existing Conditions Report is part of a set of technical reports which have been prepared as part of Phase 1 of the Tewin study process. The Tewin Study Area ("Study Area") lands were identified as a future urban development area in the new City of Ottawa Official Plan (2023). The Study Area is located in southeast Ottawa, generally bordered by Leitrim Road to the north, Farmers Way to the east, Thunder Road to the south, and Anderson Road and Ramsayville Road to the west. The Study Area is outlined in **Figure 1** below. These technical reports are intended to establish an understanding of the existing physical, social and ecological conditions that characterize the Study Area. Where appropriate, these reports also identify preliminary opportunities to help guide the next phase of the master planning process.

This information will be used to identify opportunities and strategic considerations that will inform the Tewin community design process going forward, as well as frame the preparation of additional site-specific technical studies and recommendation reports. Development at Tewin will explore new approaches to planning, design and development, including alternative strategies and solutions that can successfully implement the key community objectives.

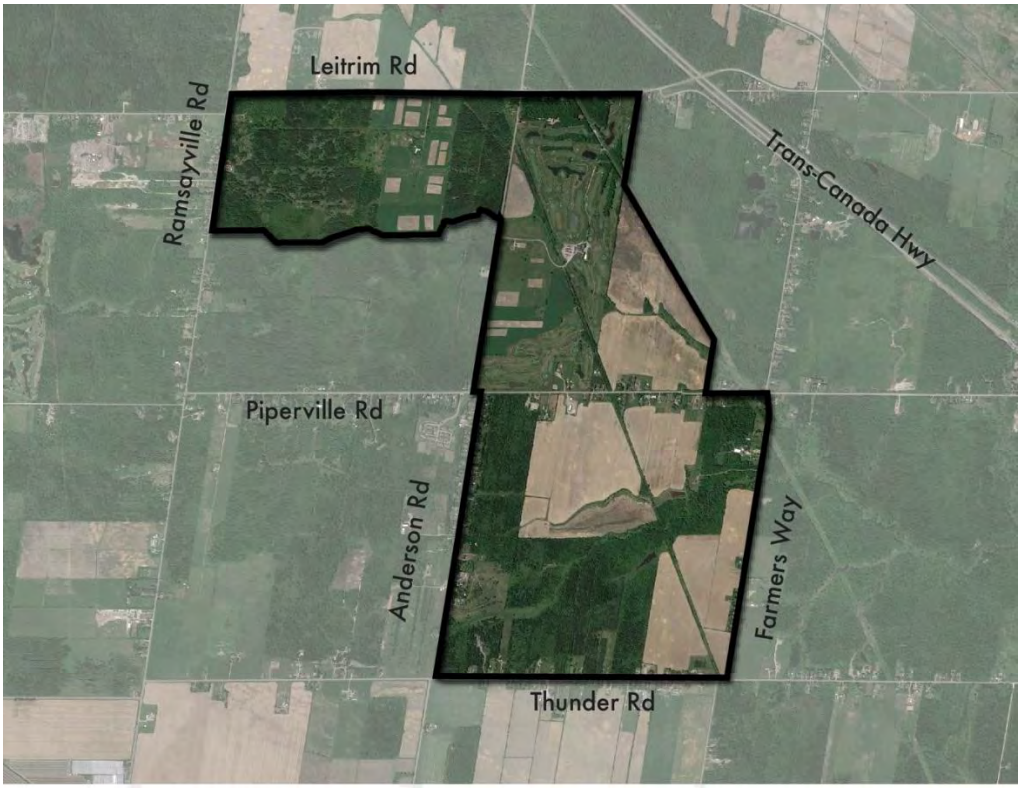


Figure 1: The Tewin Study Area is identified in black outline

Integrated Master Plan & Municipal Class EA Process

The ambition and scale of Tewin requires ongoing internal and external consultation. The purpose of the integrated Master Plan and Municipal Class EA process is to consolidate the various technical and community planning elements of the project to promote coordinated community engagement through streamlined and aligned decision making. This format will ensure critical partners, consultants and stakeholders are brought together at major milestones to identify and track challenges and opportunities through the development process.

The integrated Master Plan and Municipal Class EA process will include a public consultation strategy and technical study review timeline that achieves the requirements of the Master Plan and Municipal Class EA concurrently. The statutory Municipal Class EA meetings will be timed to align with the development of the community objectives, urban framework, preferred plans, and the draft secondary plan. Additional public and targeted consultations will be planned to complement the statutory consultation requirements. The development of the One Planet Action Plan (OPAP) will occur in parallel, with the final OPAP available at the time of final secondary plan Council approval. One Planet Living endorsement will follow Council approval of the secondary plan.

Tewin Overview and Community Vision

Tewin is planned to be a community of approximately 45,000 people and thousands of jobs. It will be more compact and dense than existing suburbs in Ottawa, with new urban areas integrated alongside valuable natural areas. Tewin will be an inclusive community, anchored in Algonquin wisdom and placekeeping principles, and welcoming to all. The community will have a meaningful mix of land uses and support active mobility, to achieve a complete, future-ready community. The Tewin Project Team and City of Ottawa have committed to exploring appropriate options, alternatives and standards to enable Tewin to become a model of best practices in sustainable and inclusive community design in the North American context.

The integrated Master Plan and Municipal Class EA process will bring together various technical and community planning considerations.

The key objectives for Tewin are to create a community that is:

- Anchored in Algonquin wisdom, principles and placekeeping;
- A benchmark for community design, demonstrating achievement of the 5 Big Moves identified in the Ottawa Official Plan;
- Mobility-oriented and supportive, promoting a broad range of active forms of movement, where personal vehicles are optional;

- Characterized by a meaningful mix of housing, community amenities, jobs and services in order to achieve a complete, future-ready community;
- Designed to protect and integrate alongside valuable natural areas and agricultural lands; and
- Affordable, inclusive, healthy, welcoming and accessible to all.

Tewin Intent: A Forward-Thinking Framework

Development at Tewin will explore new approaches to planning, design and development, finding successful options and alternatives to implement the key community objectives, in some cases likely going beyond what current development standards would allow for. The Tewin Project Team and the City of Ottawa have articulated these in the "Tewin Intent" which sets out the following:

1. Bold and Innovative Thinking:

Tewin is about creating a new kind of community, a future-focused model for smart, healthy and sustainable development. It will be a people-centred place that seeks to create the conditions for well-being. The Tewin Project Team will be open to bold ideas, innovative approaches, creative solutions, efficient use of land and resources, emerging technologies, smart city infrastructure that advances the City's goals and objectives, and other future-forward ideas and opportunities that will enable Tewin to reach its full potential.

2. Integrating Algonquin Values and Principles:

Algonquin principles, values and teachings will guide the planning, consultation, design and development process for Tewin. The integration of Algonquin principles and design intentions will ensure the community is nature-based and sensitive to Mother Earth while creating capacity-building and economic development opportunities for the Algonquin people.

3. Sustainability and Resilience:

Tewin will be a model community that will position Ottawa as a leader in integrated sustainable design with the goal of being a resilient and holistic community. Tewin will be guided by the One Planet Living framework and Algonquin values of respect for the earth. The Community Design Plan will respond to the City's High Performance Development Standard and Climate Change Master Plan, and will result in a Community Energy Plan. A Community Energy Plan and performance-based sustainability metrics that address climate mitigation and adaptation, and the other categories of the High Performance Development Standards will be established from the start and monitored over time.

4. Systems-Based Environmental Planning:

Tewin's organization and functions will be designed to respect nature and integrate natural features and landscapes into its form, character, and spirit. To that end, the Tewin Project Team is committed to pursuing a systems-based approach to natural heritage protection, environmental management, and water management in a way that is inclusive and integrated and encourages stewardship and a positive relationship with the natural world. Natural features are regarded as opportunities rather than constraints, will be woven into the fabric of the community, and will be central to its design and character.

5. Alternative Design Solutions:

Designing a community of the future requires progressive and forward-thinking infrastructure solutions. The Tewin Project Team is committed to being solutions-oriented and will consider alternative design and engineering standards that prioritize natural systems, pedestrians, cyclists and transit users, and which efficiently use available land and resources.

Surface water management strategies that achieve quality, conveyance and storage objectives will be based on the fundamentals of natural cycles, green/soft infrastructure, and multi-use opportunities that complement the human realm. Infrastructure design will consider the needs of those involved in the construction, operation and maintenance of municipal services to find opportunities to efficiently service the community and showcase sustainable practices while meeting the community's needs.

A framework for assessing alternative design standards will be established to consider and review alternatives against existing standards within the context of goals and objectives for the City and Tewin.

6. Cost-Effectiveness and Efficiency:

Tewin will demonstrate best practices in efficient and compact development. As a dense, mixed-use community of scale, Tewin will achieve a critical mass of people and jobs to support new infrastructure investments. The Tewin Project Team is committed to exploring opportunities to optimize the community's efficiency through a range of strategies, including prioritizing space-efficient modes of transportation, use of technology, green infrastructure, innovative construction practices, shared-use agreements, and mixed-use forms of development that will promote the efficient use and optimization of land; housing affordability; and supporting the long-term financial viability of the community and city resources.

7. Integrated Planning Process:

We are committed to advancing Tewin through a comprehensive and integrated planning and environmental assessment process where possible or applicable. The process will bring together various planning, environmental, transportation,

urban design, infrastructure, economic, financial, social and technical considerations. The process will be underpinned by engagement with the Algonquin people, other stakeholders, and the public.

8. Collaboration and Problem Solving:

The Tewin Project Team and City of Ottawa Project Team are committed to working collaboratively together to move Tewin forward in an expedited way. We will plan with a spirit of collaboration and joint problem-solving to ensure that the development of Tewin meets the best interests of the City of Ottawa and the Algonquins of Ontario.

9. Communication and Transparency

The Tewin Project Team and the City of Ottawa Project Team commit to open and transparent communication throughout the project. This will require proactively sharing information between the groups as decisions are made and to ensure relevant communication materials are distributed in a timely manner.

The Tewin Project Team and the City of Ottawa Project Team will ensure that all parties, including City Council, residents, and other stakeholders, are provided with pertinent details. Effective information sharing will ensure the project achieves outcomes that are, to the greatest extent possible, known by all involved.

Existing Conditions Technical Reports

A range of specialized consultants have been studying the physical environment of the Study Area to support community design, servicing strategies and the future development of Tewin. This data has been collected and reported on in a set of Existing Conditions and Opportunities Reports, of which this document is one. The full suite of reports includes the following:

- **Stage 1 Archaeological Assessment Tewin Lands** dated July 14, 2023, and prepared by WSP Canada Inc.
- **Tewin Existing Conditions and Preliminary Opportunities Report** dated April 2024 and prepared by Urban Strategies
- **Fluvial Geomorphology Study - Tewin Lands: Existing Conditions Summary Report - Bear Brook and Ramsay Creek Watersheds** dated April 2024 and prepared by GEO Morphix Ltd.
- **Tewin Lands: Existing Conditions Hydrogeological Study** dated April 2024 and prepared by Dillon Consulting
- **Existing Conditions - Geotechnical: Tewin Lands** dated April 2024 and prepared by Paterson Group

- **Tewin Lands: Natural Heritage Existing Conditions Report** dated April 2024 and prepared by Kilgour and Associates
- **Tewin Lands: Cumulative Hydrologic Impact Assessment** dated April 2024 and prepared by J.F. Sabourin and Associates
- **Tewin Lands: 2021-22 Field Monitoring Report** dated April 2024 and prepared by J.F. Sabourin and Associates
- **Tewin Lands – Existing Conditions Water Budget** dated May 2024 and prepared by J.F. Sabourin and Associates
- **Tewin Mobility Existing Conditions** dated 2024 and prepared by CGH Transportation
- **Tewin Public and Stakeholder Engagement Plan** dated April 2024 and prepared by Urban Strategies

Framework for Identifying Preliminary Opportunities

Given the unique scale, vision and project goals for Tewin, as well as the shared commitment to exploring new ways of advancing the community design process as expressed in the Tewin Intent, the Phase 1 reports for Tewin include a discussion of potential opportunities to be explored in subsequent stages of the integrated Master Plan and Municipal Class EA process. The identification of preliminary constraints and opportunities, as well as a preliminary community structure, is required in Phase 1 of the integrated Master Plan and Municipal Class EA process as per specific Terms of Reference that were established for each of the Tewin planning, environmental and transportation studies.

The opportunities introduced within these reports are based on a series of key policy directions and strategic considerations, including:

- **Ottawa's new Official Plan**, which promotes the creation of complete, transit-supportive communities;
- **Algonquin values and principles**, underscored by respect for nature, integration of water, and planning the natural environment to achieve long-term vitality over many generations;
- **The Tewin Intent**, which promotes innovative thinking and alternative, performance-based solutions;
- **One Planet Living**, a holistic framework for achieving environmental resiliency, sustainable development, and reduced carbon emissions;
- **Provincial policy** direction focused on supporting housing development and facilitating growth, in order to address the province's housing supply challenges; and,

- **An integrated, systems-based approach** to planning at Tewin that brings together diverse planning, environmental, technical and economic considerations.

EXECUTIVE SUMMARY

This report documents existing natural heritage ecological conditions within the Tewin Lands, based on desktop reviews, previous ecological work performed in the area, and field studies undertaken in 2022. This report includes records of provincially and federally protected species at risk (SAR) and provides professional opinions on the potential presence of SAR and their habitats, fish and fish habitats, and areas of ecological value that may interact with future development of the Tewin Lands. This Ecological Environment Existing Conditions Report may support future environmental studies for development applications.

The Tewin Lands are bordered by Leitrim Road, undeveloped forested lands, and agricultural lands to the north; Farmers Way, undeveloped forested lands, agricultural lands, and Highway 417 to the east; Thunder Road, undeveloped forested lands, and agricultural lands to the south; and Anderson Road, Ramsayville Road, agricultural lands, rural residential properties, and undeveloped forested lands to the west. The Tewin Lands are characterized primarily by forested areas, agricultural fields, areas of wetland cover, and a golf course, with some rural residential and commercial properties around the periphery. The area falls within the Bear Brook and Ramsay Creek subwatersheds and contains numerous unevaluated wetlands, municipal drains, and areas of floodplain.

An Ecological Land Classification (ELC) of the Tewin Lands study area was initially delineated using publicly available, high quality aerial photographs (geoOttawa, Google Earth Pro, RVCA, and SNC mapping portals). For accessible portions (i.e., held by the Tewin landowners' group), field studies of vegetation communities were completed through the spring and summer of 2022. For areas that could not be accessed directly (e.g., privately-owned properties), ELC delineations relied exclusively on aerial imagery.

A total of 38 distinct ELC units (ecosites, vegetation types, or other), encompassing both terrestrial (upland) and wetland communities, were delineated within the Tewin Lands. Twenty-five of these ELC units are terrestrial and thirteen are wetland classifications. Some terrestrial ecosites, however, were more accurately characterized as "transitional", rather than being fully described as either terrestrial or wetland. These were primarily tree plantations that were naturalizing towards a wetland state. The Tewin Lands include areas of unevaluated wetlands, including treed swamps, thicket swamps, and marshes. No wetland features on or directly adjacent to the constitute Provincially Significant Wetland (PSW). The South Bear Brook Wetland (east of the Tewin lands), however, was recently evaluated by the City of Ottawa and found to constitute PSW. The western boundary of the South Bear Brook PSW is located ~500m east (and downstream) of the Tewin lands.

Seven tree species from the broader region were noted as having cultural significance to the Algonquin peoples including: Eastern White Cedar, White Birch, Sugar Maple, Trembling Aspen, American Basswood,

White Spruce, and Tamarack. The first five of these species were documented as widespread or dominant species in at least one ecosite within the Tewin Lands. American Basswood and Tamarack were not recorded as dominant species in any of the ecosites.

Wildlife surveys across the Tewin Lands addressed breeding birds generally as well as nightjars, anurans, and fish, where suitable aquatic conditions were present. Anuran and nightjar surveys were conducted from roadsides. Fish community inventories directly in the study area were completed as part of high-level headwater drainage feature assessment (HDFA) of the Tewin Lands. Water quality measures and benthic community assessments of the broader Ramsay Creek and Bear Brook catchments within and beyond the Tewin Lands were conducted to assess how the aquatic environment within the Tewin Lands relates and contributes to overall watersheds.

A total of 67 bird species were detected in the Tewin Lands. The most commonly observed species include: American Crow, American Goldfinch, American Robin, Black-capped Chickadee, Cedar Waxwing, Common Yellowthroat, Ovenbird, Song Sparrow, Veery, White-throated Sparrow, and Yellow Warbler. No Eastern Whip-poor-wills or Common Nighthawks were detected during night surveys, but six listed species at risk (SAR) birds were detected during morning surveys. Eastern Wood-pewee was relatively widespread across suitable habitats in the Tewin Lands. Bobolink and Eastern Meadowlark were observed on the golf course and the adjacent farm field. Wood Thrush was detected in the forest along the southern edge of the Tewin Lands. Grasshopper Sparrow was also relatively rare within the area, with a single observation on the golf course. Barn Swallow was consistently observed over the farm field east of the golf course. This species was recently downlisted from Threatened to Special Concern under the Endangered Species Act.

A total of four anuran species were observed during evening aural surveys. Swamps and woodlands throughout the study area supported either Spring Peeper or Wood Frog at Call Code Level 3 (i.e., full chorus) during the first survey: only one location at the south end of Tewin Lands supported both species at that level. Green Frogs and American Bullfrogs were only heard in smaller numbers (i.e., <5 at any sampling station).

Across the Tewin Lands, various ecosite or land cover elements/features are sufficiently present above defined size thresholds to meet the definition of "candidate" Significant Wildlife Habitats (SWH) including:

- Raptor Wintering Areas
- Bat Maternity Colonies
- Turtle Wintering Areas
- Deer Yarding Areas
- Deer Winter Congregation Areas
- Waterfowl Nesting Areas
- Bald Eagle/Osprey Habitat
- Woodland Raptor Nesting Habitat
- Turtle Nesting Areas
- Woodland Amphibian Breeding Habitats
- Amphibian Movement Corridors
- Deer Movement Corridors.

Note, however, that underlying supporting ecosites each generally provide multiple habitats meeting the definition of significance. Three potential habitats meet the MNRF's criteria for "confirmed" SWH, based on the results of the 2022 field studies including:

- Woodland Area-sensitive Breeding Bird Habitat
- Wetland Amphibian Breeding Habitats

- Areas for Special Concern and Rare Wildlife Species.

For these areas, relevant species were identified as using some portion of the available potential habitat. The species surveys employed for this report, however, were intended to observe general presence only, and were not designed to delineate detailed boundaries of habitat usage.

For lands within an urban area (including Tewin), policies associated with the City of Ottawa Official Plan define Significant Woodland as woodland areas 0.8 ha in size or larger that are 60 years of age and older at the time of evaluation. While forested areas across most of the Tewin Lands generally consist of early successional regrown or plantations on former agricultural area, ten features ranging in size from 0.83 ha to 10.35 ha are more than 60 years old. The features comprise a variety of ELC units, including deciduous forest (FOD6-3), mixed forest (FOMM6-1, FOMM9-2), naturalizing conifer plantation (FOCM6-1), mixed swamps (SWM, SWMM2-1), deciduous swamp (SWDM4-3), and thicket swamp (SWTM5-8).

Considering all forested ecosites across the Tewin Lands, and trees that occur elsewhere, the current existing cover across the Tewin Lands is estimated to be 31.9%.

The assessment of headwater drainage features and areas within the Tewin Lands involved a high-level overview of riparian areas adjacent major channels. Early successional forested areas west of Anderson Road included wetland areas through which there are numerous former farm drains, most of which were dry by late spring. Only one such drain supported fish. Active agricultural fields west of Anderson Road included long, linear drainage ditches conveying water only during the spring period. The Anderson Links Golf course and adjacent agricultural fields were crossed by municipal drains providing permanent fish habitat as discussed below. Small headwater features along their corridors, however, consisted only of shallow swales from the adjacent fields, conveying spring meltwater runoff. These features were all dry by mid-May. Agricultural fields south of Piperville Road have agricultural drains between them that provide similar headwater functionality as those north of Piperville Road. Forested areas south of Piperville Road contained only two small side channels that connect to the Johnson Municipal Drain.

Water quality data, benthic community and fish community data indicate that drainage features in the Tewin Lands are generally of degraded quality (reflecting local land uses), but of sufficient quality to support the full life cycle of resident fish species.

Surface waters in the Tewin Lands study area classify as hard with naturally high concentrations of calcium and magnesium, with basic pH, and with dissolved oxygen levels that easily support aquatic life including fish. Surface water samples within and surrounding the Tewin Lands regularly contained concentrations of total phosphorus, total iron, total chromium, and total cadmium that exceeded provincial water quality objectives (PWQOs). Total phosphorus concentrations were highest in water from the Johnston Municipal Drain near Ramsayville Road and from a tributary to Bear Brook in the southern portion of the Tewin Lands near Farmers Way. Surface water samples from other sampling stations also had total phosphorus concentrations exceeding guidelines, but infrequently. Metals including silver, cobalt, thallium, and copper exceeded guidelines in some water samples.

Six of the surveyed watercourses in the Tewin Lands were detected using temperature loggers as cool-warm systems while four were warmwater. One of the sections of the Bear Brook Municipal Drain found adjacent to Hall Road was dry or mostly dry during July and August of 2022.

Benthic communities were assessed in several sampling stations synoptic with water quality sampling. Larval stoneflies, which typically indicate the presence of cold groundwater water, were found in a benthic community sampled in Bear Brook at Piperville Road. Benthic communities, however, were typically dominated by larval midges (Chironomidae), but contained a diversity of taxa including those tolerant of degraded water quality and those that are fully aquatic types reflecting that they live in permanently wet features.

Fish community assessments conducted in 2022, and previously by South Nation Conservation Authority, found no invasive fish species nor fish species that are currently listed under the *Endangered Species Act* or the *Species at Risk Act*. Only one "sport fish" species (Rock Bass) was captured from eight different stations within or downstream of the Tewin Lands. All fish captured other than the Rock Bass were common baitfish to Eastern Ontario and all are tolerant to warm surface water. Overall, the species of fish most captured in the Bear Brook Watershed were the Creek Chub, Central Mudminnow, and Pumpkinseed Sunfish.

Water quality data, benthic community and fish community data indicate that drainage features in Ramsay Creek within and downstream of the Tewin Lands are generally of degraded quality (reflecting local land uses), but of sufficient quality to support the full life cycle of resident fish species.

Water from Ramsay Creek classifies as "very hard" (on the Tewin Lands) and as "hard" downstream of the Tewin Lands, while water from tributaries to Ramsay Creek classify as "medium-hard" based on concentrations of calcium and magnesium. Ramsay Creek water is basic, while dissolved oxygen concentrations are sufficient to support aquatic life including fish. Surface water samples had concentrations of total phosphorus, total iron, and total chromium frequently exceeding water quality objectives. Ramsay Creek at Leitrim Road had total phosphorus concentrations that were 20 times higher than the PWQO. Metals including cobalt and vanadium also exceeded their respective PWQO at some sampling stations. Ramsay Creek is a cool- to warm-water system on Tewin Lands, and a warm-water system downstream of the Tewin Lands.

The benthic community within Ramsay Creek is typical for freshwater ecosystems in the area. Thirteen taxonomic families were identified and over 50% of the individuals are permanently aquatic indicating that the section of the Ramsay Creek surveyed is a permanent watercourse. However, worms and midges, which are known to be tolerant to degradation conditions, were the most abundant.

No invasive fish species or fish species that are currently listed under the *Endangered Species Act* or the *Species At Risk Act* Ramsay Creek have been observed Ramsay Creek. White Suckers were the only "sport fish" captured. All fish captured are common baitfish to Eastern Ontario and are all tolerant to warm waters. Overall, the species of fish most captured in the sections of Ramsay Creek surveyed were the White Sucker, Creek Chub, and Fathead Minnow. Some physical barriers (i.e., culvert and beaver dams) are present in Ramsay Creek which may prevent fish from using it as a migration corridor.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

List of Acronyms and Abbreviations

BBS	Breading Bird Survey
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
ECCC	Environment and Climate Change Canada
ELC	Ecological Land Classification
ESA	*Endangered Species Act*
EWPW	Eastern Whip-poor-will
FTP	Final Temperature Preferendum
HDF	Headwater drainage features
JSFA	J.F. Sabourin and Associates Inc.
KAL	Kilgour & Associates Ltd.
MECP	Ministry of Environment, Conservation, and Parks
MMP	Marsh Monitoring Protocol
MNRF	Ministry of Natural Resources and Forestry
NESS	Natural Environment Systems Strategy
NHIC	Natural Heritage Information Centre
OBBA	Ontario Breeding Bird Atlas
OBBN	Ontario Benthos Biomonitoring Network
OMNR	Ontario Ministry of Natural Resources
OWES	Ontario Wetland Evaluation System
PWQO	Provincial Water Quality Objectives
RVCA	Rideau Valley Conservation Authority
SAR	Species At Risk
SARA	*Species At Risk Act*
SARO	Species at Risk in Ontario
SD	Standard Deviation
SNC	South Nation Conservation
SWH	Significant Wildlife Habitat
TSS	Total Suspended Solids
UILT	Upper Incipient Lethal Temperature

1.0 INTRODUCTION

Natural heritage refers to wetlands, forests, river and creek valleys, hills and other natural features and functions in an area, as well as all the different plants and animals that use those areas[1]. Natural heritage features provide many benefits, including habitat for plants and animals, flood and erosion control, and processes for cleaning and storing water. A natural heritage system can be thought of as a linked network of natural areas.

Land development, including urban expansion, has the potential to interact with natural heritage areas and their ability to provide ecosystem services. This report describes individual elements currently associated with the Tewin Lands, how they combine into systems, and where individual elements and systems have special significance in the regional context (e.g., plants or animals that may be protected as species at risk under federal and/or provincial legislation, or forests that may qualify as "Significant Woodlands") as part of City's natural heritage system. This report is intended to inform a systems-based approach in optimizing mitigation approaches associated with various development options.

1.1 Study Sections

This report provides Natural Heritage Existing Conditions for both the Tewin Lands and Ramsay Creek downstream of the main study area (Figure 1) per the following sections:

- The Tewin Lands: Section 2.0
  - The review of existing environmental conditions in the Tewin Lands study area is intended to inform land development planning. The current study is based on desktop reviews, previous ecological work performed in the area, and field studies undertaken by Kilgour & Associates Ltd. (KAL) in 2022. This report includes records of provincially and federally protected species at risk (SAR) and provides professional opinions on the potential presence of SAR, SAR habitat, fish habitat, and areas of ecological value that may interact with future development of the Tewin Lands. This Ecological Environment Existing Conditions Report may support future environmental studies to support development applications.

- Ramsay Creek – Section 3.0
  - While Ramsay Creek itself is situated almost entirely outside (to the north) of the Tewin Lands, the headwater Ramsay Creek lies within the northern portions of the Tewin Lands. This report documents existing ecological conditions within the upper reaches of Ramsay Creek to advise future planning decisions with the Tewin Lands.

- Summary Of Preliminary Opportunities: System-Based Approach To Sustainable Natural Heritage – Section 4.0
  - Development within the Tewin Lands will interact with existing natural heritage systems. This report discusses approaches and regulatory considerations for reducing / expanding, protecting / removing, or altering / enhancing natural heritage features in the Tewin Lands considering both new residential areas and the surrounding ecological landscape.

[1] https://www.grandriver.ca/en/our-watershed/natural-heritage-systems.aspx

Figure 1 Lands

KILCOUR & Associates

Legend

Tewin Boundary

Core Study Area

Municipal Drain

Natural Creek

N

0 1500 m

Project: 1199
Map File: TEWIN199- 2211d
MTM Zone 9
(NAD 83)
Printed on: 2022-12-08

2.0 TEWIN LANDS

2.1 Introduction

The purpose of this section of the report is to describe ecological conditions in the Tewin Lands. The subsections that follow include:

- 2.2 Description of the Tewin Lands;
- 2.3 Methods used to characterize the ecological conditions; and,
- 2.4 Observations and Interpretation.

2.2 Description of the Study Area

The Tewin Lands (Figure 2) are characterized primarily by forested areas, agricultural fields, areas of wetland cover, and a golf course, with some rural residential and commercial properties around the periphery. The Tewin Lands fall within the Bear Brook and Ramsay Creek subwatersheds and contains numerous unevaluated wetlands, municipal drains, and areas of floodplain.

The Tewin Lands are bordered by:

- Leitrim Road, undeveloped forested lands, and agricultural lands to the north;
- Farmers Way, undeveloped forested lands, the South Bear Brook Wetland PSW, agricultural lands, and Highway 417 to the east;
- Thunder Road, undeveloped forested lands, and agricultural lands to the south; and,
- Anderson Road, Ramsayville Road, agricultural lands, rural residential properties, and undeveloped forested lands to the west.

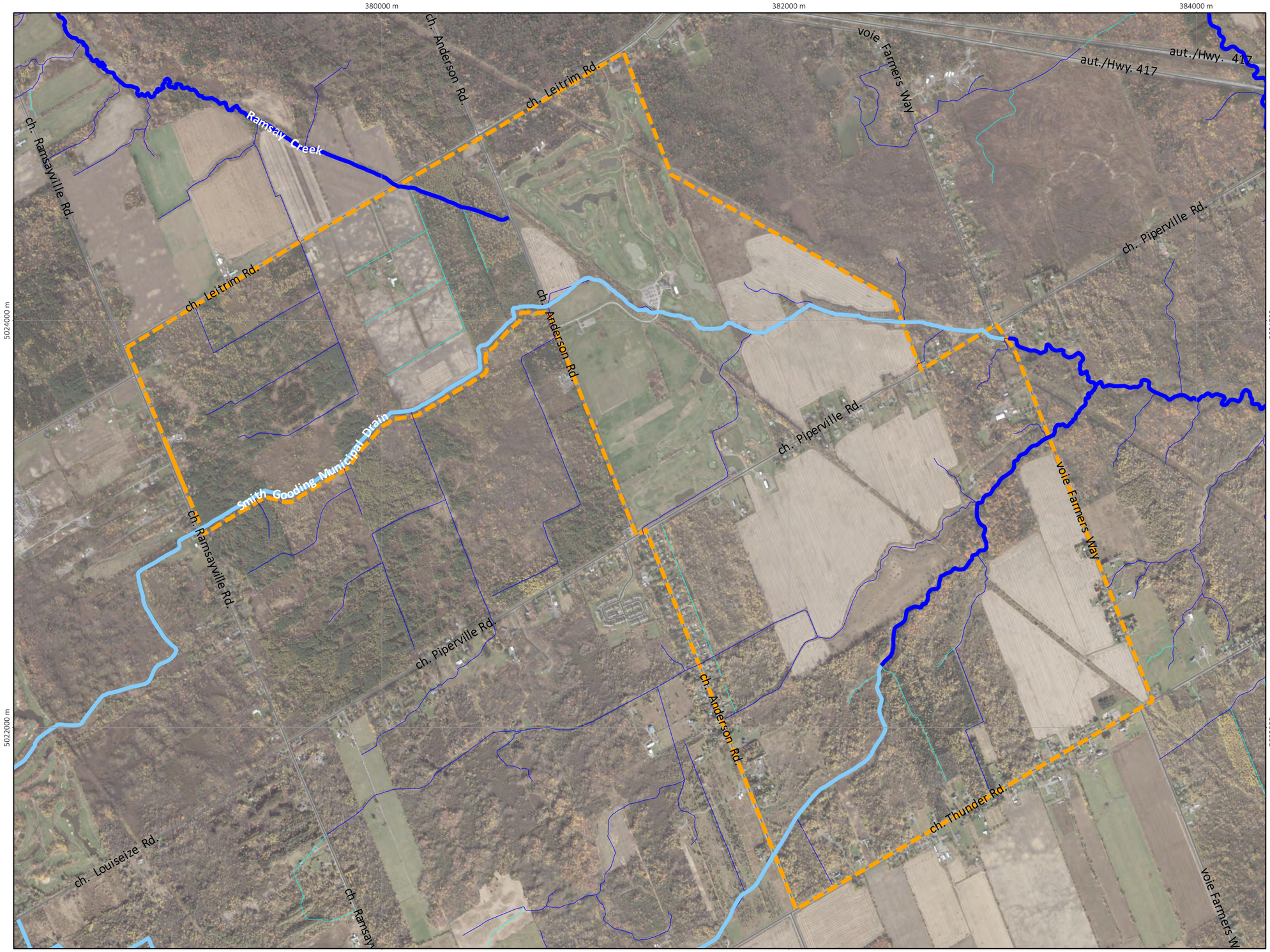


Figure 2 Location and Context of the Core Study Area

Legend

- Core Study Area
- Municipal Drain
- Natural Creek

"Major Channels"

- Intermittent
- Permanent

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2211d
MTM Zone 9
(NAD 83)
Printed on: 2022-12-08

KILGOUR & Associates

2.3 Methods

Characterization of the ecological conditions of the Tewin Lands involved both desktop review of existing data and field inventory. Each of those tasks is described below.

2.3.1 Desktop and Background Data Review

Colour digital aerial photographs from Google Earth Pro and the City of Ottawa were used initially to identify natural environment features in the area through a desktop review. Additional background information in this report was obtained from a combination of studies and reports performed within the general area of the Tewin Lands to review relevant information and to guide field studies. The review of existing information also included database queries of occurrence and observation records of species listed under the Ontario *Endangered Species Act* (ESA) and the federal Species at Risk Act (SARA) to identify the potential for SAR occurrences in the vicinity of the Tewin Lands. Existing information was obtained from online reference sources and data sets provided by regulators and other members of the project team. Data sources include:

- Species at Risk in Ontario (SARO; Ministry of Environment, Conservation, and Parks (MECP, 2022);
- Species at Risk Public Registry (Government of Canada, 2022);
- Natural Heritage Information Centre (NHIC; Ministry of Natural Resources, and Forestry (MNRF, 2022a);
- Land Information Ontario (MNRF, 2022b);
- Aquatic Species at Risk Map (Fisheries and Oceans Canada, 2022);
- Ontario Reptile and Amphibian Atlas (Ontario Nature, 2019);
- Ontario Breeding Birds Atlas (Birds Canada et al., 2009);
- Ontario Butterfly Atlas (Toronto Entomologists' Association, 2022);
- eBird (Cornell Lab of Ornithology, 2022a);
- iNaturalist (California Academy of Sciences and National Geographic Society, 2022);
- Bumble Bee Watch (Wildlife Preservation Canada et al., 2022);
- Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Ontario (Humphrey and Fotherby, 2019);
- Recovery Strategy for the Eastern Small-footed Myotis (*Myotis leibii*) in Ontario (Humphrey, 2017);
- Fish ON-Line (MNRF, 2022c);

- Range Map Extents for SAR in Canada (Environment and Climate Change Canada (ECCC), 2022);
- Natural Area Data and Evaluation Records prepared for the Regional Municipality of Ottawa-Carleton, 1997 (Brownell and Blaney, 1997);
- Fluvial Geomorphology Study: Tewin Lands Secondary Plan (GEO Morphix, 2022);
- South Nation Conservation (SNC) Fish and Benthic Community Assessments Data (Date Accessed: March 2022);
- SNC Water Chemistry Data for Bear Brook (Date Accessed: March 2022);
- J.F. Sabourin and Associates Inc. (JSFA) Water Temperature Data (Date Accessed: October 2022); and,
- GEO Morphix Ltd. (GEO Morphix) Water Temperature Data (Date Accessed: December 2022).

2.3.2 Landcover Field Studies

2.3.2.1 Terrestrial and Aquatic Landscape Features

Terrestrial natural features areas are delineated and defined by landcover characteristics associated with the distribution of plant species and forms, soil types and, to some extent, geology. These may include landscapes such as forests, thickets, and open meadows. Where such features include elevated water tables and/or hydric soil conditions, they will form wetland landscapes, correspondingly comprising features such as swamps, thicket swamps, or marshes. Within the City of Ottawa, vegetation communities of both terrestrial and wetland ecosites are identified using Ecological Land Classification (ELC) for Southern Ontario (City of Ottawa, 2015).

Terrestrial areas identified through ELC may subsequently be considered as "significant" (e.g., Significant Woodlands) based on additional criteria (as discussed in section 2.4.2), but the initial delineation of the land cover feature areas is completed by ELC. Wetland areas, however, may be delineated based on either ELC or Ontario Wetland Evaluation System (OWES).

Where development is proposed within or adjacent to wetlands that could qualify as "provincially significant", wetland significance is determined based on OWES (City of Ottawa, 2021b). Wetland areas associated with the Tewin Lands, appear to have lesser potential to qualify as "significant" compared to wetland areas to the east, and would be more difficult to conserve (City of Ottawa, 2021b). There are extensive networks of agricultural ditching connecting to the Smith-Gooding and the Johnston Drains and much of the adjacent land was cleared in the past for agriculture. Clearing of the existing ditches by property owners would likely reduce substantially the extent of the wetlands in that area (City of Ottawa 2021b). Accordingly, wetland areas within the Tewin Lands were delineated and defined in this study using ELC as they have been considered as unlikely to be deemed as provincially significant (City of Ottawa 2021b). Regardless, the boundaries of the areas delineated as wetlands can be expected to be comparable under either system; for the purposed of initial descriptions, only the naming conventions would apply differently.

2.3.2.2 Ecological Land Classification

Ecological Land Classification (ELC) for the Tewin Lands encompassed a combination of desktop and field-based exercises. Desktop exercises focused on portions of the Tewin Lands for which permission to access had not been received (e.g., private residential properties), while field-based classification was completed by foot surveys of accessible lands throughout the study area.

Both desktop and field delineations employed standard ELC methods for Ontario (Lee et al., 1998). This method provides a consistent approach to identify, describe, name, and map vegetation communities and/or physiographic features on the landscape based on soils and plant species composition. This method results in a standardized description of each vegetation community to determine the natural diversity and variability of communities within a site, and to provide insight into available habitat and the type of species that may be present. More specifically, the classifications from ELC provide a basis for determining whether potential habitat for a given SAR or other ecological value may be present. The ELC methodology used here encompasses both terrestrial and wetland habitats.

For the desktop delineations, publicly available, high quality aerial photographs (geoOttawa, Google Earth Pro, RVCA, and SNC mapping portals) were reviewed to identify variation in land cover, topography, and vegetation structure and thereby map polygons to reflect distinct ELC units (City of Ottawa, 2022; Google LLC, 2022; RVCA, 2022; SNC, 2020). ELC units were classified to the most detailed level possible based on the aerial imagery (i.e., usually to the level of ecosite). For portions of the study area to which access had not been granted (e.g., privately-owned properties) ELC delineations relied exclusively on aerial imagery.

For accessible portions of the study area, field delineations of vegetation communities took place on June 7-10, August 22, and September 7, 2022. Plant communities were identified and delineated across the study area. Within each community, dominant plant species were recorded. Soil samples were taken using a 120 cm long soil auger to characterize community substrates. For wetland communities, the presence of standing water and/or depth of the water table were noted, where applicable. Vegetation communities were classified to the most detailed level possible, based on a combination of vegetation and soil characteristics (i.e., ecosite or type).

Representative photos of each ELC unit were taken and are included with the community descriptions in Section 2.4.1 of this report.

2.3.3 Terrestrial Field Studies

2.3.3.1 Breeding Birds

Morning breeding bird surveys were performed using point counts following the Ontario Breeding Bird Atlas Guide for Participants (Birds Canada et al., 2001; Birds Canada et al., 2021). Breeding bird surveys are to be completed from survey stations[2] that, combined, provide suitable viewing of all habitats on a site on calm weather days with light wind (≤ 3 on the Beaufort Scale[3]) and no precipitation. Per the Ontario

[2] In this report, the term "Station" or "Survey Station" is used to denote a location or place that has been georeferenced, and that repeated sampling has or could occur. This is in contrast to the term "location", which would represent a more general geolocation where casual observations may have been made.

[3] The Beaufort Wind Force Scale is an empirical measure that relates wind speed to observed conditions at sea or land. The scale is as follows: **0**: calm, smoke rises vertically, wind speed <1 km/hr; **1**: light air, smoke drift indicates wind direction, leaves and

Breeding Bird Atlas, two rounds of surveys take place between sunrise and five hours after sunrise between May 24 and July 10. An additional (third) bird survey is required under MNRF protocols for at-risk bird species that nest in field habitats (e.g., MNRF's *Bobolink Survey Methodology*, 2011). Since the Tewin Lands have the potential to provide habitat for at-risk grassland bird species (e.g., Bobolink, *Dolichonyx oryzivorus*; and Eastern Meadowlark, *Sturnella magna*), three rounds of breeding bird surveys were conducted. Breeding bird surveys were conducted during the morning of May 31, June 8, June 13, June 14, and June 30, 2022. Due to the number of survey stations and the required time windows during which to survey, Surveys 1 and 2 were spread over two mornings A total of 11 breeding bird survey stations were established in representative habitats within the study area (Figure 3). All incidental observations (birds and/or other wildlife) were recorded while moving between survey points, as well as during other visits to the study area. Birds were identified by sight (i.e., direct visual observation) and/or sound (i.e., song or call).

Bird species were classed as regionally rare based on an analysis of data from the Atlas of Breeding Birds of Ontario (Cadman et al., 1987) based on Hill's Site Regions, now Ecoregions. The *Ontario Wetland Evaluation System: Southern Manual* (MNRF, 2014a) also assisted with classifying regionally significant breeding birds in the area (region 6). The federal and provincial significance of bird species were classed based on species' listings under Schedule 1 of SARA and the ESA, and species tracked by NHIC (MNRF, 2022a) for non-SAR species considered provincially significant.

2.3.3.2 Nightjars

Night-time bird surveys to confirm the presence/absence of at-risk nightjars (Eastern Whip-poor-will (*Antrostomus vociferus*) and Common Nighthawk (*Chordeiles minor*)) and their potential breeding territories were conducted following the *Draft Survey Protocol for Eastern Whip-poor-will in Ontario* (MNRF, 2014b). This protocol calls for a minimum of three separate night-time surveys between May 18 and June 30 (breeding season), with two occurring in late May or the first week of June during a week preceding or just after a full moon, and a third survey in the next full moon period (middle/end of June).

Eastern Whip-poor-will usually forage in the semi-darkness of early morning and dusk, on nights when the moon is more than half full, they are likely to forage all night long under the brighter conditions. Their broods are timed such that the young hatch approximately 10 days before the full moon when the parents have more time (i.e., moonlight) to catch food for them (Cornell Lab of Ornithology, 2022b; Kaufman, 2019). As such, this species is more detectable during a full moon period. Common Nighthawk are most often observed at dusk and dawn when flying high over forests or feeding on flying insects over water. Common Nighthawk are also identifiable by their distinctive call and "loud booming", noise produced by the rushing of air through the birds' primary feathers as it dives (Cadman et al., 2007).

Following the protocol, surveys were completed within a week of the full moon while the moon was visible above the horizon (>50% illuminated). Surveys started at least 30 minutes after sunset and ended while the moon was still visible. Surveys were conducted under field conditions with no precipitation, little or

wind vanes are stationary, wind speed = 1.1 – 5.5 km/hr; **2**: light breeze, wind felt on exposed skin, leaves rustle, wind vanes begin to move, wind speed = 5.6-11 km/hr; **3**: gentle breeze, leaves and small twigs constantly moving, light flags extended, wind speed – 12-19 km/hr.

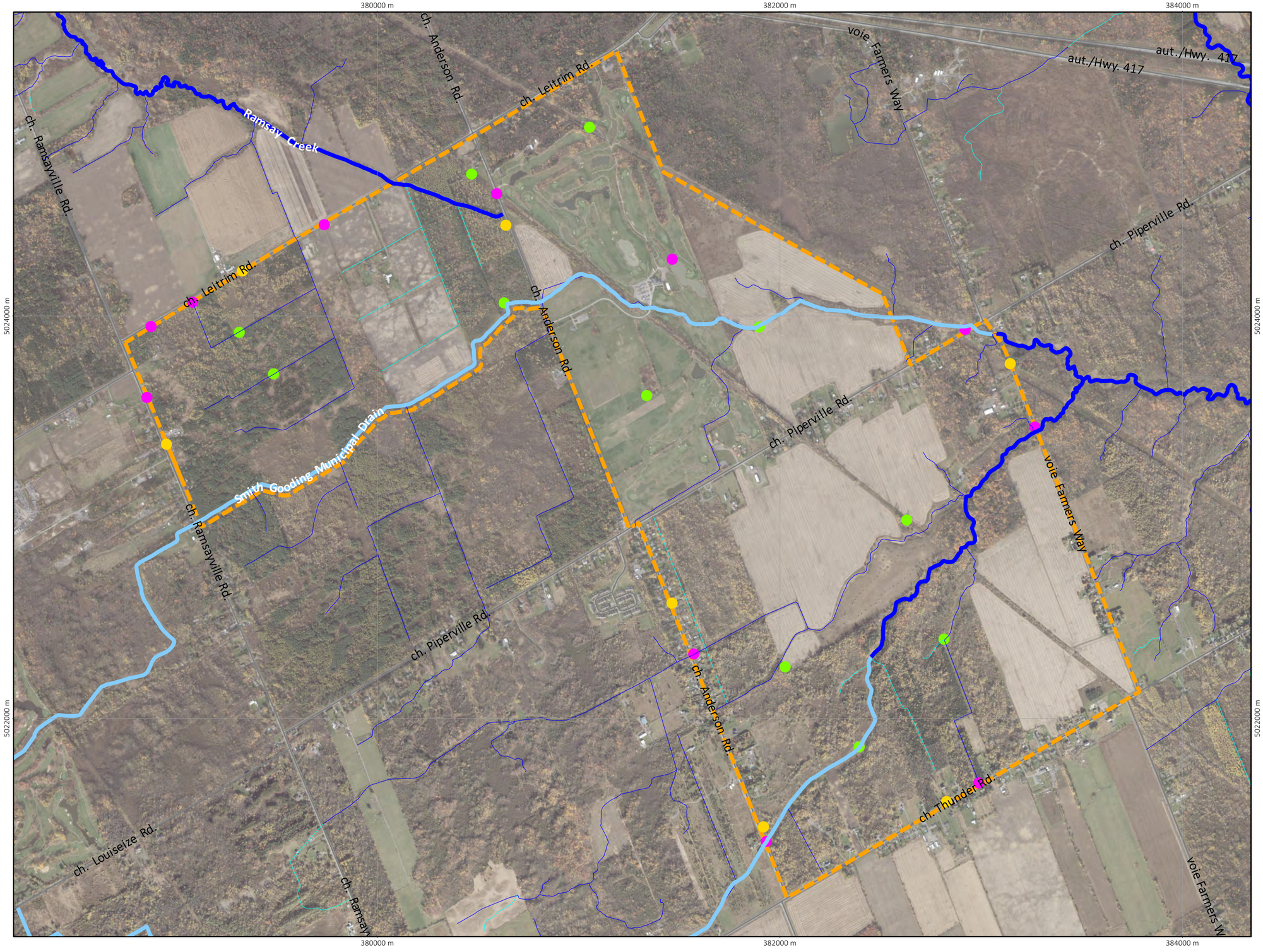


Figure 3 Map showing the locations of breeding bird, nightjar, and anuran survey stations

Legend

- Core Study Area
- Municipal Drain
- Natural Creek

"Major Channels"

- Intermittent
- Permanent

Wildlife Survey Stations

- BBS Survey Station
- EWPW Survey Station
- MMP Survey Station

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2211d
MTM Zone 9
(NAD 83)
Printed on: 2022-12-08

KILGOUR & Associates

no wind, clear skies, temperature of 10°C or above, and good visibility (low cloud cover). The timing of Eastern Whip-poor-will surveys is also optimal for detecting Common Nighthawk, as the species is generally best heard calling in the late evening. Nightjar surveys were conducted from seven stations on May 19, June 13, and June 14, 2022 (Figure 3). As per MNRF (2014b), each point count station has a fixed radius of 300 m so that absolute numbers of birds could be counted within a reasonable hearing range (note that calling Eastern Whip-poor-will can be heard up to 1 km away under ideal conditions). Surveyors were careful not to walk directly through suitable nightjar habitat when accessing survey stations to avoid stepping on any potential Eastern Whip-poor-will or Common Nighthawk eggs, which are cryptically coloured and laid on the forest floor. Surveys were undertaken by two surveyors to triangulate the position of a calling individual.

2.3.3.3 Anurans

Anuran (frog and toad) surveys were performed following the Marsh Monitoring Program (Birds Canada et al., 2008). This protocol calls for multiple survey stations at a site to capture spatial and habitat variability. Accordingly, anuran surveys were performed at 11 stations throughout the study area (Figure 3). The Marsh Monitoring Program advises that each station be visited a minimum of three times at night, no less than 15 days apart, during the spring and early summer.

Following this protocol, the timing of the three anuran surveys is based on nighttime air temperature:

- Early breeders (Western Chorus Frog, Wood Frog, and Spring Peeper): above 5°C;
- Mid-season breeders (Northern Leopard Frog, Pickerel Frog, Mink Frog, American Toad, and Grey Treefrog): above 10°C; and,
- Late breeders (Green Frog and Bullfrog): above 17°C.

Anuran surveys took place on April 12, May 24, June 28, and July 4, 2022, beginning one half hour after sunset and ended before 12:00 am on evenings with appropriate temperatures and light wind (≤3 on the Beaufort Scale. Note that the July 4 survey was required to access one survey station that had not been accessible during the previous June 28 survey. Additional observations of amphibians were made throughout the spring and summer during other field visits.

2.3.4 Aquatic Habitat Field Studies

2.3.4.1 Headwater Drainage Features Assessment

Headwater drainage features (HDFs) are non-permanently flowing drainage features that are important for maintaining healthy watersheds (Toronto Region Conservation Authority and Credit Valley Conservation Authority, 2014). Headwater drainage features may not have defined beds or banks and can include first-order and zero-order intermittent and ephemeral channels, swales, and connected headwater wetlands. Conservation Authorities are concerned with land development activities that can alter and/or eliminate headwater drainage features (Toronto Region Conservation Authority and Credit Valley Conservation Authority, 2014). Such activities could have broad implications for water quality and downstream aquatic habitats. HDFs are reviewed through a headwater drainage feature assessment (HDFA).

The consideration and protection of headwater features was originally managed by local conservation authorities. Following the passage of Bill 23 in Ontario, the regulatory oversite of headwater features by conservation authorities has been reduced through changes to the *Conservation Authorities Act*. Regardless, headwater features are included in the definition of surface water features within the City of Ottawa Official Plan (City of Ottawa, 2021a) and are currently regulated as such by the City.

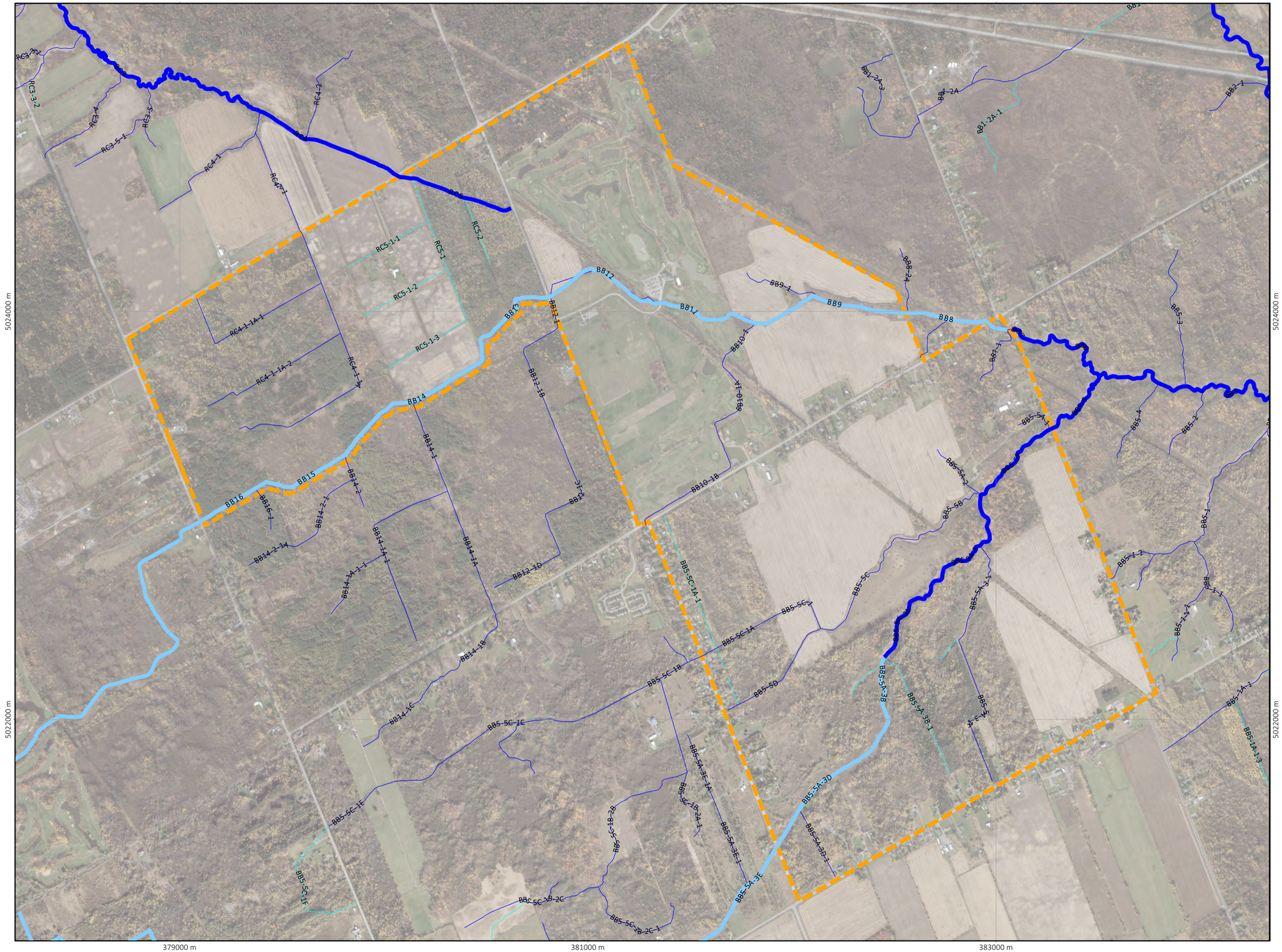
The methodology for a headwater drainage features assessment (HDFA) is identified in the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (herein the "HDFA Protocol"; Credit Valley Conservation Authority and Toronto Region Conservation Authority, 2014). Per the HDFA Protocol, a HDFA is intended to focus on headwater features as defined above and is not to be applied to the evaluation of permanent watercourses. Municipal drains and natural creeks on the site, as well as other channelized features considered likely to be permanent or near permanent (herein "major channels"), were identified for inclusion within a separate hydrological review of the area (GEO Morphix, 2022; Figure 4). Accordingly, the initial HDFA within this report does not consider these major channels. Water quality, and fish and benthic communities and within these major channels is addressed per Sections 2.3.4.2 through 2.3.4.5 of this report.

At the time of this report, SNC provided raw data files of routinely collected data for water features around the site potentially supportive of an HDFA (Appendix A). Studies undertaken by SNC included observations of water quality and studies of fish and benthic communities conducted from "Headwater Drainage Feature Sites" distributed throughout the broader Tewin area (Appendix A). Most of these sites (and all the sites within the Tewin Lands), however, were located exclusively within major channels – typically at major road crossings. As such, observations from these study sites are not directly applicable to an HDFA, although the data are still relevant to the review of major channels on the site. Accordingly, SNC fish and water quality data are included in the Fish Habitat Characterization discussed within Section 2.4.3.4.

A high level HDFA was initiated across the study area in spring 2022. Under the full HDFA Protocol, each small headwater feature is to be identified, mapped, and characterized. For this study, however, the areas adjacent major channels (the areas in which HDFs would be situated) were reviewed only to determine their general functioning as headwater areas, i.e., without providing a detailed catalogue of each feature.

The planned buildout of Tewin will likely take place over several decades. Individual HDFs, being defined as ephemeral features, are likely to change substantially over that time frame. Each development phase will ultimately be supported by detailed studies of natural heritage (e.g., Environmental Impact Studies) that will detail the specific HDFs as they exist prior to the direct initiation of development. HDFs across

Figure 4 Map showing the major channels identifying headwater areas



Legend

- Core Study Area
- Municipal Drain
- Natural Creek

"Major Channels"

- Intermittent
- Permanent

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2211d
MTM Zone 9
(NAD 83)
Printed on: 2022-12-08

KILGOUR & Associates

the site, however, will likely form and function year to year in generally consistent manners based on the surrounding riparian condition. For example, along a given major channel, HDFs may consist of ephemeral drainage points from adjacent farmlands, which would be unlikely to significantly impact reach hydrology beyond the spring freshet, or they may be associated with broad, contiguous adjacent wetland areas that could influence reach hydrology throughout the year. The aim of this initial HDFA is to dete rmine the context within which HDFs will form and function.

For this study, the general density, and types of HDFs occurring adjacent to major channels were identified in the first 'round' of study (site visit) during spring freshet in early April (April 4-6, 2022). Subsequent, post-freshet site visits (May 25-26 and May 30, 2022) then noted where HDFs had dried after the spring freshet and determined, for those that were still wetted, if they contained fish. The overall goal of the HDFA work was to identify the general presence and abundance of HDFs that could contribute source water, allochthonous inputs, and/or expanded areas of fish habitat (i.e., beyond the banks of the major channels).

While the vegetation cover and the potential presence of wetland were noted in the areas directly adjacent major channels during the April surveys, the ELC work (Section 2.3.2) served to better describe the extent of forest and wetland cover beyond the channel banks and across the broader site.

2.3.4.2 Water Chemistry

A desktop review of available water quality data was conducted to understand the existing conditions within, upstream, and downstream of the Tewin Lands. This review was further supported by the collection and analysis water samples in 2022 throughout the area. Historical surface water chemistry data were provided by South Nation Conservation (SNC). Additional water samples were collected upstream, within, and downstream of the Tewin Lands to complement the existing surface water chemistry data. A detailed list of the sample stations and data used for the report can be found in Appendix B (Water Chemistry) and is illustrated in Figure 5. Water samples were collected using an adjustable-swing water sampler and submitted to Eurofins Environment Testing Canada Inc. (Ottawa, Ontario).

SNC previously monitored water quality in Bear Brook near the Tewin Lands at three locations: adjacent to Hall Road (downstream of the Tewin Lands; 2020 to 2021), adjacent to Boundary Road (further downstream of the Tewin Lands; 1998 to 2021), and upstream of the Tewin Lands at Hawthorne Road (in 2021; Figure 5). The water samples collected were part of SNC's monitoring program through the Provincial Water Quality Monitoring Network to help determine baseline information on watershed health and to help identify stresses impacting the aquatic environment. Surface water sampling characterized nutrient levels (e.g., phosphorus and nitrogen), metals, and general water quality parameters (e.g., temperature, pH, conductivity, chloride, etc.).

Available water chemistry data (Appendix B2) were compared with Provincial Water Quality Objectives (PWQO) values for Ontario where applicable (Ministry of Environment and Energy (MOEE), 1994b). For certain metals (i.e., aluminum, cadmium, copper, lead, etc.), PWQO values were determined using the hardness or alkalinity values measured in that sample. Through comparison with PWQO values, tributaries were identified as Policy 1 watercourses (water quality better than PWQOs, quality to be maintained at or above the PWQO) or Policy 2 watercourses (water quality does not currently meet PWQOs but shall not be further degraded and with aims to upgrade the water quality to the Objectives; (MOEE, 1994a).

Figure 5 ace
water c ggers

KILCONA & Associates

Legend

Core Study Area

Municipal Drain
Natural Creek

"Major Channels"
Intermittent
Permanent

Water Quality Station
KAL(Water Chemistry)
SNC (Water Chemistry)
JFSA (Water Temperature)

N

0 1500 m

Project: 1199
Map File: TEWIN199- 2211d
MTM Zone 9
(NAD 83)
Printed on: 2022-12-08

2.3.4.3 Water Temperature

Water temperature data were recorded (using continuous temperature loggers) at several stations in and around the Tewin Lands by both J.F. Sabourin and Associates Inc. (JFSA; Tewin Lands project Hydrologists) and GEO Morphix Ltd. (GEO Morphix; Tewin Lands project Geomorphologists). There are data from a total of 14 stations across the study area and in nearby watercourses (Figure 5).

JFSA-installed loggers recorded water temperature every 5 minutes between April 20 and September 20, 2022. GEO Morphix-installed loggers recorded water temperature every 15 minutes between April 8 and October 6th, 2022. Using the temperature data, the thermal regimes of the watercourses were characterized by plotting the relationships between daily maximum water temperature and daily maximum air temperature in each watercourse. These 'nomograms' can be used to classify stream waters in Ontario from cold to cool to warm based on a model developed by Chu et al. (2009). Data were screened to include only water temperatures recorded when temperature loggers were fully submerged (i.e., logger depth of over 10 cm).

2.3.4.4 Benthic Community Assessment

Benthic macroinvertebrates differ in their tolerance to various aquatic conditions. Having generally limited mobility through broader aquatic communities, their community composition in a given location thus reflects the integrated the effects of the stressors to which they are exposed to there. The number of taxa present in a sample (i.e., taxonomic richness) can reflect the health of the community where stations having low taxonomic richness might be indicative of degraded environmental conditions as only a small number of taxa can persist (e.g., tolerant to pollution).

Ontario Benthos Biomonitoring Network (OBBN) is the provincial standard protocol for sampling, processing, and analyzing invertebrates sampled in local waterbodies (Jones et al., 2007). SNC is a partner of the OBBN and used this protocol to collect benthic community samples at four locations within the Tewin Lands and from an additional nine locations nearby from 2019 to 2021 (Figure 6). Samples were preserved with alcohol (at least 70% concentration in sample) or formalin (~5% in sample) and the macroinvertebrates were identified to taxonomic family. Additional benthic invertebrate samples were collected on November 1, 2022, to augment the SNC data. Benthic community samples were collected following the OBBN sampling protocols (Jones et al., 2007) which involves a travelling kick and sweep method covering 10 meters in 3 minutes using a D-net at five stations within the Tewin Lands, all part of the Bearbrook Watershed. Samples were transferred to a 500 µm sieve bucket, rinsed into 2 L sample jars, and preserved with approximately 500 mL of 70% ethanol.

Supporting physical data were also collected from each sampling station. Field forms documented the relevant site description (e.g., channel morphology, surrounding riparian vegetation, substrate content, etc.) and time of day of the collection, while site photographs documented the view of each sampling station in the following ways: (1) upstream; (2) downstream; and (3) across. Sediment samples were collected and analyzed for grain size and total organic carbon (TOC). Additionally, a calibrated YSI Pro multiprobe water quality meter was used in the field during the time of sample collection to record water temperature, pH, conductivity, and dissolved oxygen concentrations.

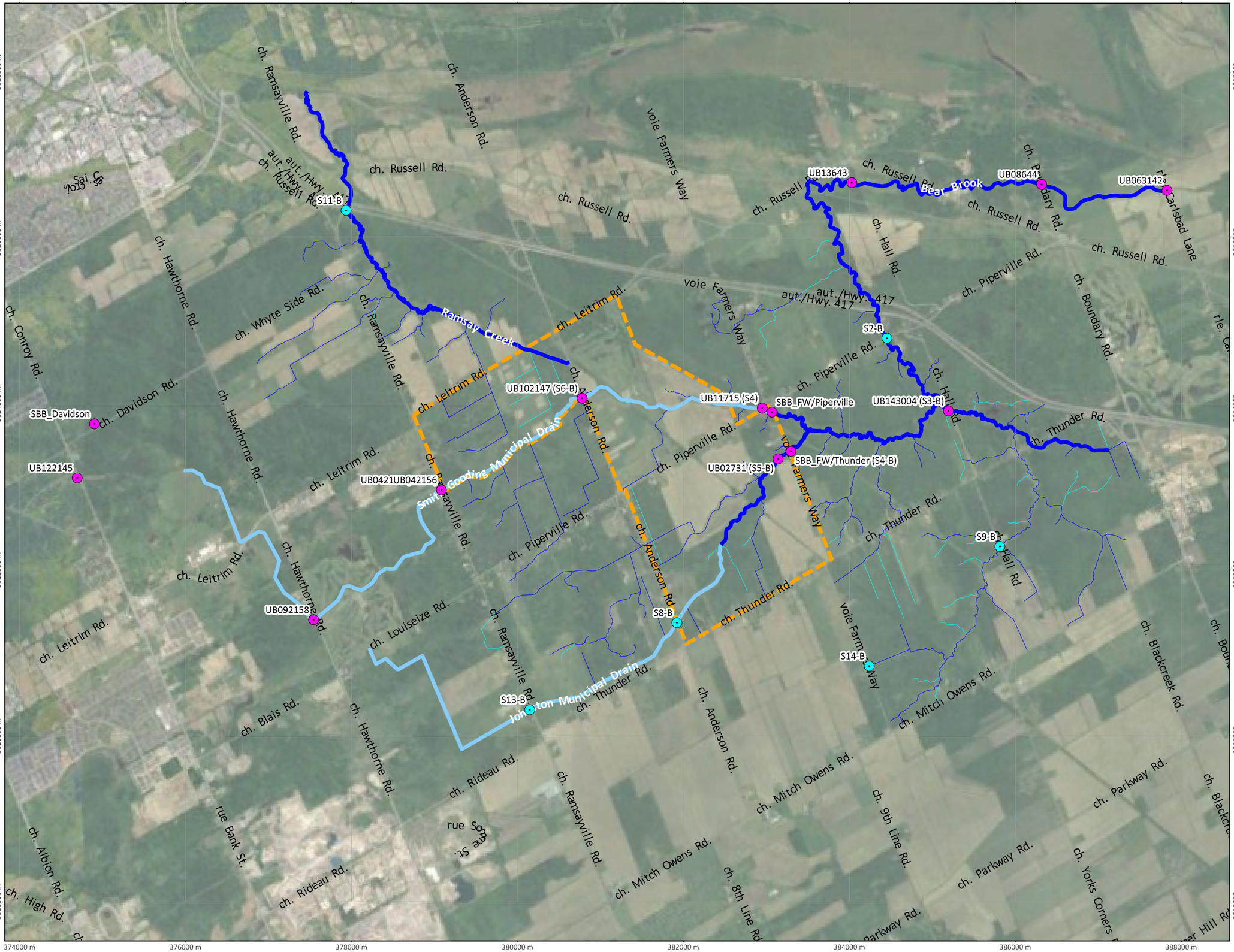


Figure 6 Map showing the benthic community assessment within and near the study area

Legend

- Study Area
- Municipal Drain
- Natural Creek

"Major Channels"

- Intermittent
- Permanent

Benthic Stations

- KAL
- SNC

N

0 2000 m

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-24

KILGOUR & Associates

Benthic macroinvertebrate samples were processed using the whole-sort or teaspoon method of OBBN (Jones et al., 2007). Sample jars were emptied onto a 250-µm sieve and rinsed to wash off residual ethanol. From the sieve, samples were emptied into a large white sorting tray, with a separate tray for each sampling station. With eyes closed, a random spoonful of sample was taken from the tray and transferred into a smaller clear petri dish. Petri dishes were observed under a dissection microscope and macroinvertebrates were identified to taxonomic order per OBBN protocol (Jones et al., 2007). This process was repeated until 300 organisms were identified and tallied per sample. If 300 organisms were reached within a sample before the entire sample was processed, then the weight of the sorted and unsorted portion of the sample were each taken to calculate the percent of the sample sorted and to estimate the total abundance per sample without processing the entire sample. If an entire sample was sorted and had less than 300 organisms, the total weight of the sorted sample was taken.

The proportion (percent) of the permanent aquatic organisms identified for each sampling stations were calculated which can help indicate if the section of the surveyed watercourse is a permanent and stable aquatic ecosystem. For this study, Oligochaeta (aquatic earthworms), Hirudinea (leeches), Isopoda (sow bugs), Bivalvia (molluscs), Amphipoda (side-swimmers), Hydracarina (water mites), Hemiptera (true bugs), Coleoptera (beetles), and Gastropoda (snails) were considered to be permanent aquatic organisms.

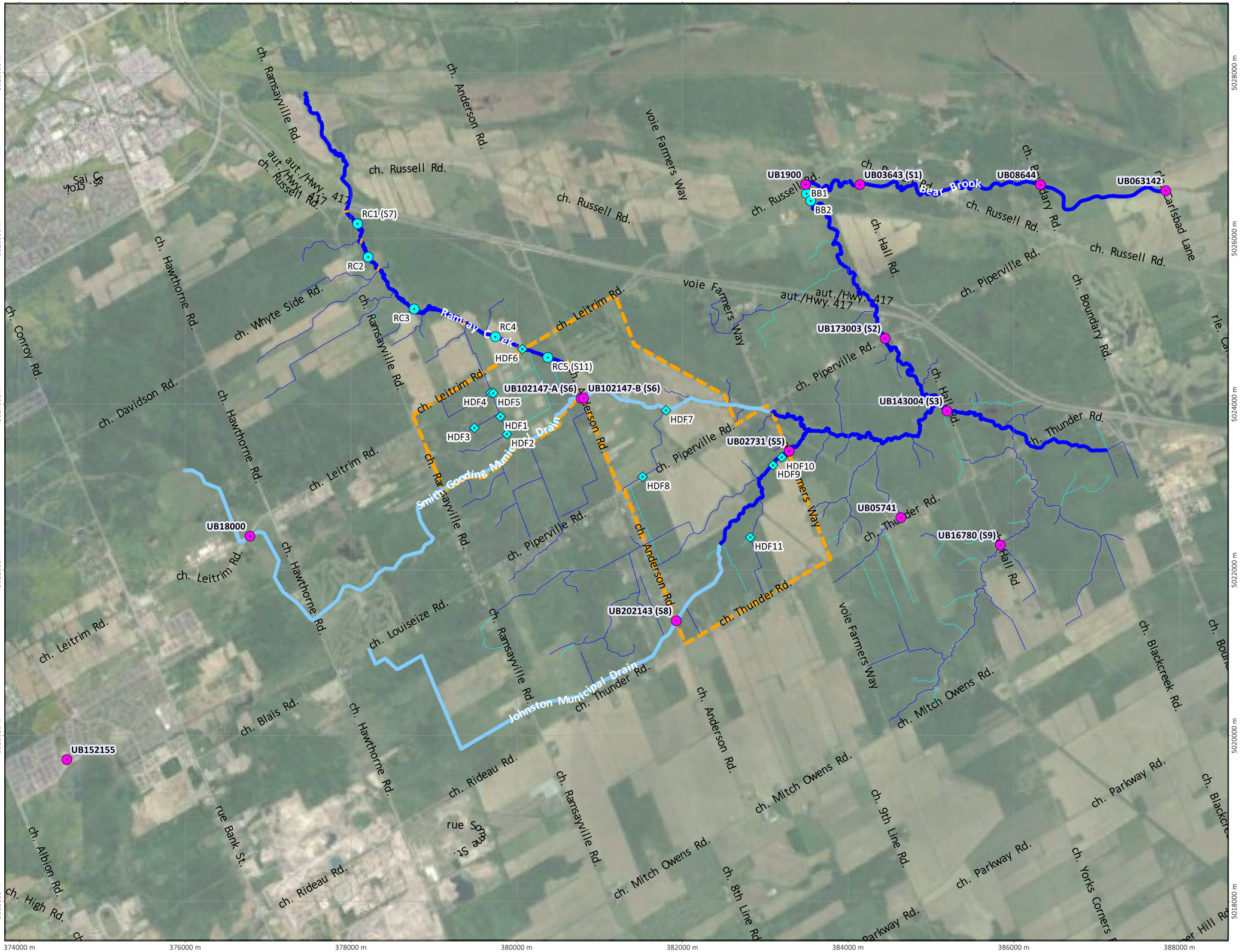
The percentage of gravel, sand, silt, and clay in the inorganic fraction of the sediment samples were also determined by a combination of dry sieving and gravimetric hydrometry following (Bouyoucos, 1962).

2.3.4.5 Fish Community Assessment

Both a desktop review and field surveys were conducted in 2022 to characterize the fish community within, upstream, and downstream of the Tewin Lands. Fish communities were characterized within Bear Brook, Ramsay Creek, the Bear Brook Municipal Drain, the Smith-Good Municipal Drain, and the Johnston Municipal Drain (Figure 7). To complement the fish community assessments, data collected by GEO Morphix during their rapid geomorphological field assessments was used to characterize the fish habitat of the watercourses surveyed (GEO Morphix, 2022). Some of the field observations collected were bankfull channel geometry, bed and bank material composition structure, and observation of erosion. GEO Morphix also characterized the stream form, process, and evolution using the Rapid Geomorphological Assessment (RGA) (MOE, 2003; VANR, 2007). Using the RGA tool, the calculated index produces values that indicate whether the channel is “in regime/stable” (score less than 0.20), “in transition/stressed” (score of 0.21-0.40), or “adjusting” (score greater than 0.41). Finally, GEO Morphix used the Rapid Stream Assessment Technique (RSAT) which assesses the ecological function of the watercourse (Galli, 1996). The resulting value can indicate if the watercourse is maintaining an “excellent” (value between 35 and 42), a “good” (value between 25 and 34), a “fair” (value between 13 and 24), or a poor (less than 13) degree of stream health.

SNC provided raw data on previously conducted fish community assessments in the main channels within or in the vicinity of the Tewin Lands in 2020 (August and September) and in 2021 (June). SNC used a combination of fish sampling techniques, including minnow traps, fyke nets, and backpack electrofishing, to document the resident fish community in Bear Brook and its tributaries, the Bear Brook Municipal Drain, the Smith-Gooding Municipal Drain, and the Johnston Municipal Drain. Three of these survey locations are located within the Tewin Lands while eight of the locations are located downstream of the Tewin Lands but still within Bear Brook (Figure 7). Two other fish sampling stations were in the Smith-

Figure 7 Map showing fish community assessment stations within and near the study area



Legend

- Study Area
- Municipal Drain
- Natural Creek

"Major Channels"
- Intermittent
- Permanent

Fishing Stations
- HDFA Fishing Station
- KAL Fishing Reach - (Creeks/Drains)
- Reach End
- SNC Fishing Station

N

0 2000 m

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-24

KILGOUR & Associates

Gooding Municipal Drain upstream of the Tewin Lands. Captured fish were enumerated and identified to species before being released. Fishing effort was recorded for each survey station and was used to calculate catch per unit effort (CPUE). The level of effort expended for fyke netting and minnow trapping was not available.

To compliment the fish community surveys conducted by SNC in watercourses within and surrounding the Tewin Lands, a fish community inventory was carried out downstream of the study area in Bear Brook (Figure 7). Fish were collected using a backpack electrofisher (Halltech Environmental, Guelph) to survey the resident fish community in two reaches. Captured fish were enumerated and identified to species before being released. Effort was recorded for each reach and used to calculate catch per unit effort (CPUE). Supporting information collected during the fish surveys included in situ water quality parameters recorded using a handheld meter (YSI Pro Plus; temperature, dissolved oxygen, and specific conductivity), depth, and wetted width of the channel. Site photographs were taken to visualize each sampling station. Fish community data collected during the 2022 spring HDFAs were also included in the fish community assessment here.

2.4 Observations and Interpretations

2.4.1 Land Cover

A total of 38 distinct ELC units (ecosites, vegetation types, or other), encompassing both terrestrial (upland) and wetland communities, were delineated for the Tewin Lands (Figure 8). Twenty-five of these ELC units are terrestrial and thirteen are wetland classifications. Some terrestrial ecosites, however, were more accurately characterized as "transitional", rather than being fully described as either terrestrial or wetland. Following the ELC ecosite descriptions, areas with dominant vegetation coverage comprised of linear, monocultural rows of non-wetland-specific coniferous trees are defined as plantations. Plantations (including naturalizing plantations) are formally classified as terrestrial ecosites. Soil conditions and understory plant cover within thirty of these areas across the Tewin Lands, however, indicated that those areas are naturalizing towards a wetland state. These areas were thus noted as being "transitional".

Each ELC unit, along with its general characteristics and the dominant vegetation therein, is described below. Representative photographs are included below, where possible. The ELC designations described below are used in subsequent analyses to identify potential habitat that may be used by species of interest (i.e., SAR) potentially occurring within the Tewin Lands. A full list of vegetation observed In the study area can be found in Appendix C.

In reviewing plant species within the delineated ecosites, seven tree species from the broader region were noted as having cultural significance to the Algonquin peoples:

- Eastern White Cedar (*Thuja occidentalis*)
- White Birch (*Betula papyrifera*)
- Sugar Maple (*Acer saccharum*)
- Trembling Aspen (*Populus tremuloides*)
- American Basswood (*Tilia americana*)
- White Spruce (*Picea glauca*)
- Tamarack (*Larix laricina*)

Five of these species were documented as widespread or dominant species in at least one ecosite within the Tewin Lands. American Basswood and Tamarack were not recorded as dominant species in any of the ecosites described below.

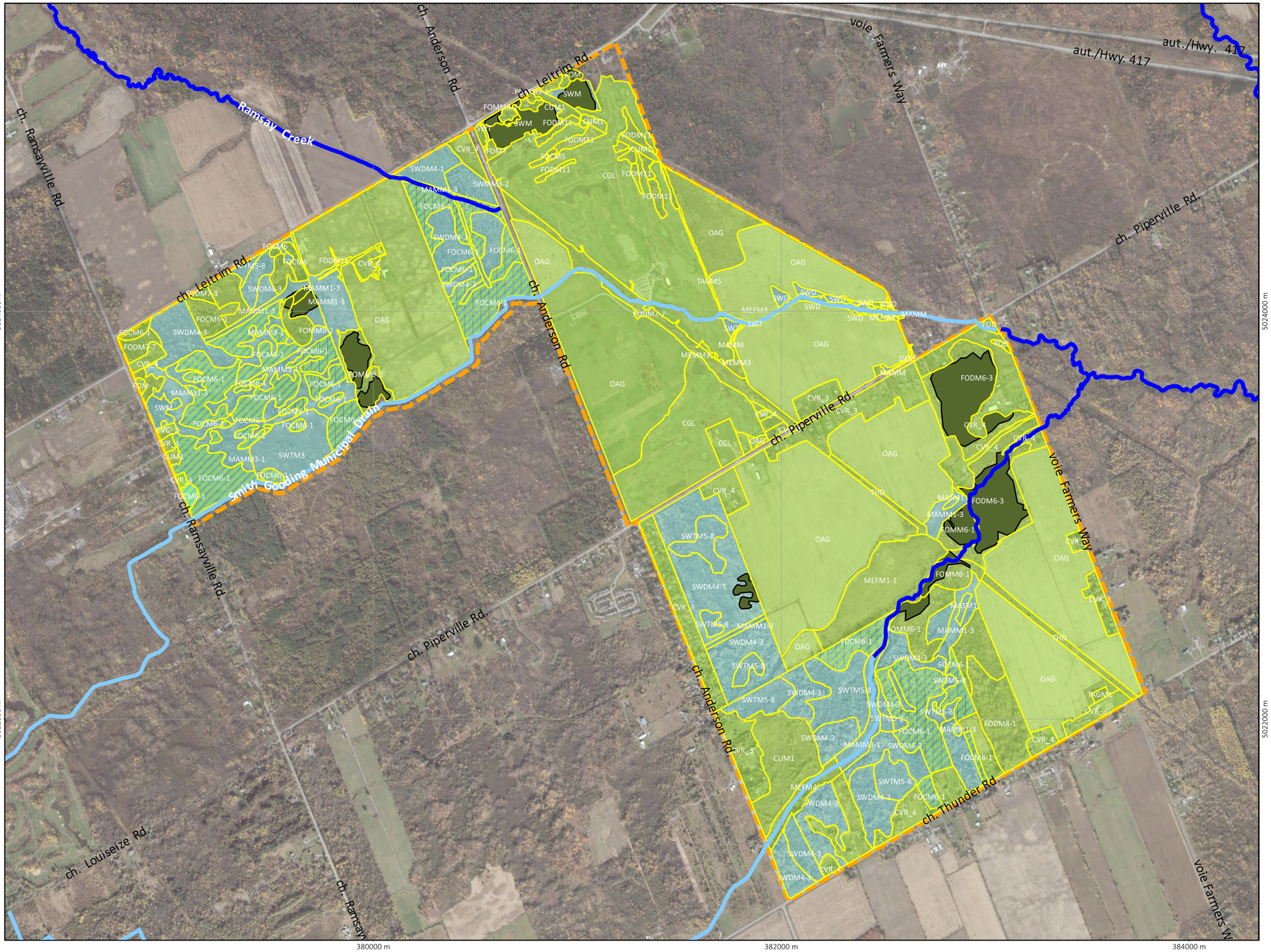


Figure 8 Map showing Ecological Land Classifications for the Core Study Area, 2022

Legend

Study Area

ELC

Terrestrial

Transitional

Wetland

Mature Woodland (>0.8 ha)

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-24

KILGOUR & Associates

2.4.1.1 Terrestrial ELC Units

Naturalized Coniferous Plantation Ecosite (FOCM6)

A Naturalized Coniferous Plantation Ecosite (FOCM6) was located in the northwest corner of the Tewin Lands, immediately south of Leitrim Road (Figure 9). The canopy comprised White Spruce (*Picea glauca*) exclusively. The subcanopy was predominantly absent throughout the community. Groundcover was relatively sparse and comprised occasional Woodland Horsetail (*Equisetum sylvaticum*) and patches of mosses, interspersed with a thick layer of leaf litter.

Figure 9 Naturalized Coniferous Plantation Ecosite (FOCM6) (photo taken June 7, 2022)

Dry – Fresh White Pine Naturalized Coniferous Plantation Type (FOCM6-1)

A Dry – Fresh White Pine Naturalized Coniferous Plantation Type (FOCM6-1) was widespread within the Tewin Lands, particularly in the northwest corner, south of Leitrim Road (Figure 10). The canopy comprised mature Eastern White Pine (*Pinus strobus*), with occasional Trembling Aspen (*Populus tremuloides*). The subcanopy was relatively open, with Alder Buckthorn (*Rhamnus alnifolia*), Glossy Buckthorn (*Rhamnus frangula*), and occasional Green Ash (*Fraxinus pennsylvanica*) saplings. Groundcover was dominated by Sensitive Fern (*Onoclea sensibilis*) and Woodland Horsetail over a thick layer of leaf litter. The moisture regime in this community was variable, with some polygons of this ELC unit appearing relatively dry, while others were situated on moist soils with understory vegetation representing wetland indicator species. Such areas were described as "transitional", indicating that successional processes appear to support treed swamp characteristics.

Figure 10 Dry – Fresh White Pine Naturalized Coniferous Plantation Type (FOCM6-1) (photo taken June 8, 2022)

Deciduous Forest Ecosite (FOD)

Deciduous Forest (FOD) ecosites were located in discrete patches, predominantly on the north edge of the Tewin Lands and in the vicinity of the Anderson Links Golf Course, on portions of the Tewin Lands to which access was not permitted (Figure 11). Aerial imagery indicated a treed canopy comprising deciduous species, while imagery in combination with available information on hydrology, topography, and adjacent community characteristics indicated a terrestrial (upland) community at this location.

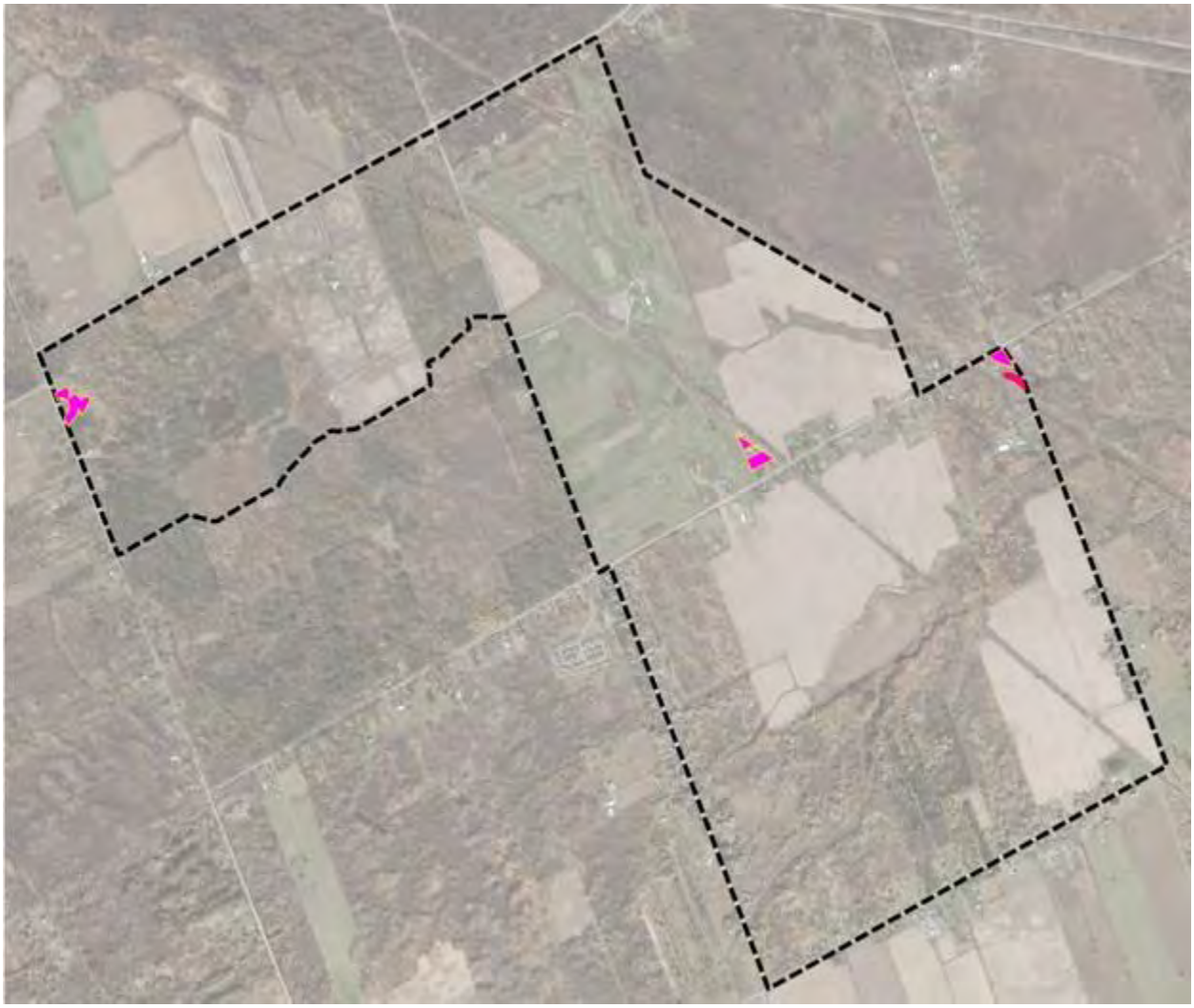


Figure 11 Location of Deciduous Forest Ecosite (FOD)

Fresh – Moist Sugar Maple – Yellow Birch Deciduous Forest Type (FODM6-3)

A Fresh – Moist Sugar Maple – Yellow Birch Deciduous Forest Type (FODM6-3) was situated on the east edge of the Tewin Lands (Figure 12). The ecosite – which included the largest (i.e., 8 and 10 ha), mature (i.e., > 60 years of age) stands of trees in the study area – was dominated by Sugar Maple (*Acer saccharum*) and Yellow Birch (*Betula alleghaniensis*), with occasional American Beech (*Fagus grandifolia*), and Balsam Fir (*Abies balsamea*). The subcanopy was relatively open and characterized by American Beech and Sugar Maple saplings, with occasional Striped Maple (*Acer pensylvanicum*) and Hobblebush (*Viburnum latanoides*). Groundcover comprised abundant Wild Sarsaparilla (A*ralia nudicaulis*), with Twinflower (*Linnea borealis*), Canada Mayflower (*Maianthemum canadense*) and Jack-in-the-Pulpit (*Arisaema triphyllum*).

Figure 12 Fresh – Moist Sugar Maple – Yellow Birch Deciduous Forest Type (FODM6-3) (photo taken August 22, 2022)

Fresh – Moist Green Ash – Hardwood Lowland Deciduous Forest Type (FODM7-2)

A Fresh – Moist Green Ash – Hardwood Lowland Deciduous Forest Type (FODM7-2) was situated as an isolated patch in the southeast corner of the Tewin Lands (Figure 13). The area was characterized by a canopy of Green Ash and Red Maple (*Acer rubrum*). The subcanopy was dense and characterized by abundant Glossy Buckthorn and occasional White Meadowsweet (*Spiraea alba*). Groundcover was dominated by Sensitive Fern and Lady Fern (*Athyrium filix-femina*), with occasional Intermediate Wood Fern (*Dryopteris intermedia*) and Woodland Horsetail.

Figure 13 Fresh – Moist Green Ash – Hardwood Lowland Deciduous Forest Type (FODM7-2) (photo taken August 22, 2022)

Fresh -Moist Willow Lowland Deciduous Forest Type (FODM7-3)

A Fresh – Moist Willow Lowland Deciduous Forest Type (FOD7-3) was situated in the northwest corner of the Tewin Lands (Figure 14). The area was characterized by a canopy dominated by White Willow (*Salix alba*). The subcanopy was dense, with abundant Glossy Buckthorn and occasional Wild Red Raspberry (*Rubus idaeus*). Groundcover comprised abundant Sensitive Fern, with Sweet-scented Bedstraw (*Galium triflorum*), Woodland Horsetail and species of grasses.

Figure 14 Fresh – Moist Willow Lowland Deciduous Forest Type (FODM7-3)

Fresh – Moist Manitoba Maple Lowland Deciduous Forest Type (FODM7-7)

A Fresh – Moist Manitoba Maple Lowland Deciduous Forest Type (FODM7-7) was situated primarily along a linear feature in the northeast corner of the Tewin Lands (Figure 15). It was characterized by a canopy dominated by Manitoba Maple (*Acer negundo*). The subcanopy was characterized by Highbush Cranberry (*Viburnum trilobum*) and Wild Red Raspberry. Groundcover comprised Canada Goldenrod (*Solidago canadensis*), Sensitive Fern and Lady Fern, with species of asters and grasses.

Figure 15 Fresh – Moist Manitoba Maple Lowland Deciduous Forest Type (FODM7-7) (photo taken June 7, 2022)

Fresh – Moist Poplar Deciduous Forest Type (FODM8-1)

A Fresh – Moist Poplar Deciduous Forest Type (FODM8-1) was situated in the southeast corner of the Tewin Lands (Figure 16). It was characterized by an upper canopy of predominantly Trembling Aspen, with Red Maple, American Elm (*Ulmus americana*) and White Birch (*Betula papyrifera*) forming a lower canopy layer. The subcanopy was characterized by Glossy Buckthorn. Groundcover was dominated by Sensitive Fern, with occasional Flat-topped White Aster (*Doellingeria umbellata*).

Figure 16 Fresh – Moist Poplar Deciduous Forest Type (FODM8-1) (photo taken August 22, 2022)

Naturalized Deciduous Hedgerow Ecosite (FODM11)

Naturalized Deciduous Hedgerow Ecosites (FODM11) were widespread within the Tewin Lands, including areas to which access had not been granted (Figure 17). Aerial imagery indicated linear features crossing anthropogenic landcover areas, such as along the edges of agricultural fields, separating rural residential properties from adjacent lands, or along drainage features. These spatially narrow features were characterized by a canopy of deciduous tree species.

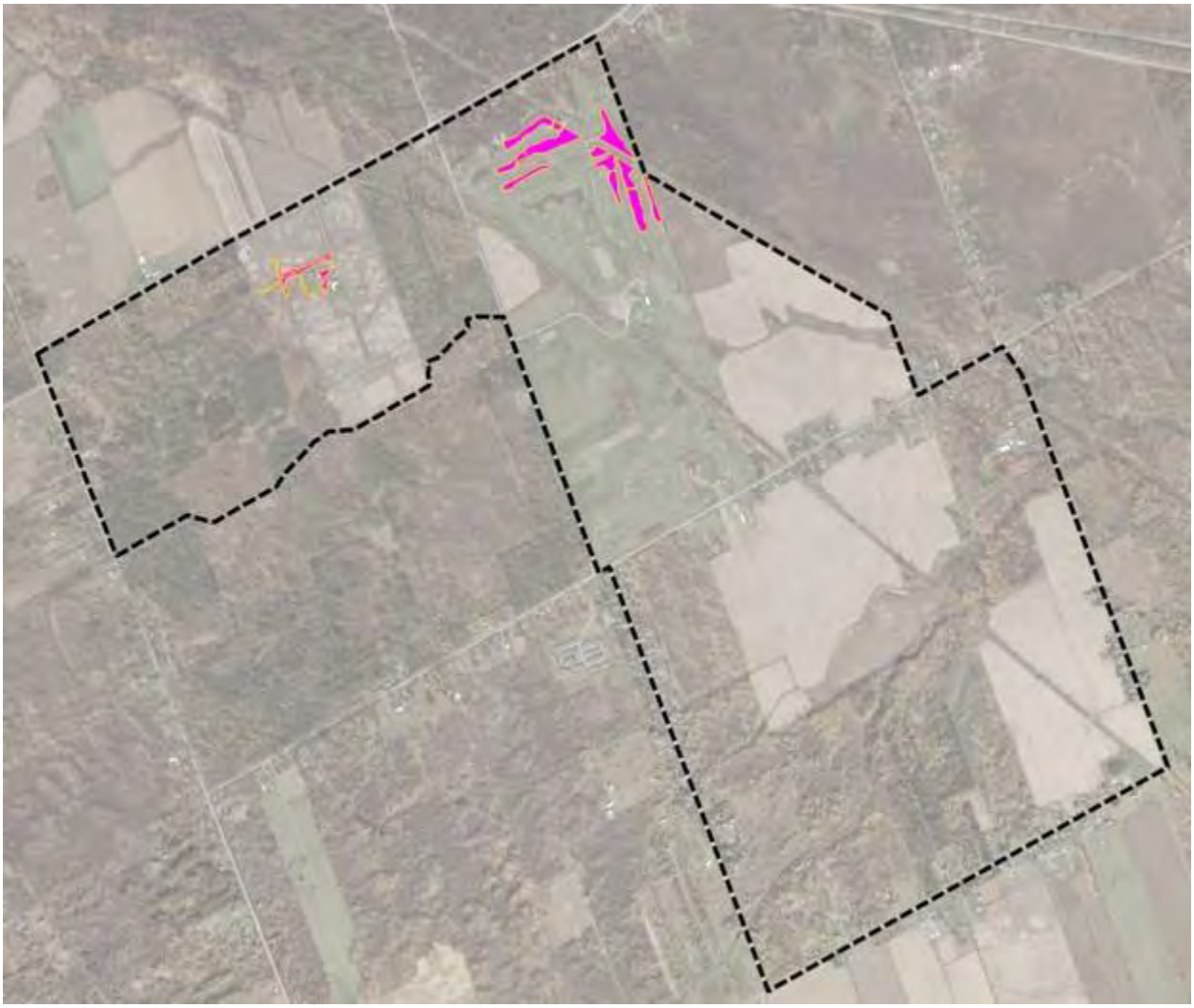


Figure 17 Location of Naturalized Deciduous Hedgerow Ecosite (FODM11)

Deciduous Woodland Ecosite (WOD)

A Deciduous Woodland Ecosite (WOD) was located along the east edge of the Tewin Lands, an area to which access was not permitted (Figure 18). Aerial imagery indicated a relatively open, treed canopy comprising deciduous species. Within woodland ecosites, tree cover comprises less than 60% but greater than 35% cover. Imagery in combination with available information on hydrology, topography, and adjacent community characteristics indicated a terrestrial (upland) community at this location.

Figure 18 Location of Deciduous Woodland Ecosite (WOD)

Deciduous Thicket Ecosite (THD)

Deciduous Thicket Ecosites (THD) occurred in scattered patches throughout the eastern side of the Tewin Lands, a portion of the Tewin Lands to which access was not permitted (Figure 19). Aerial imagery indicated a relative open upper canopy, with a densely vegetated subcanopy comprising deciduous shrub species. Imagery, in combination with available information on hydrology, topography, and adjacent community characteristics indicated a terrestrial (upland) community at this location.

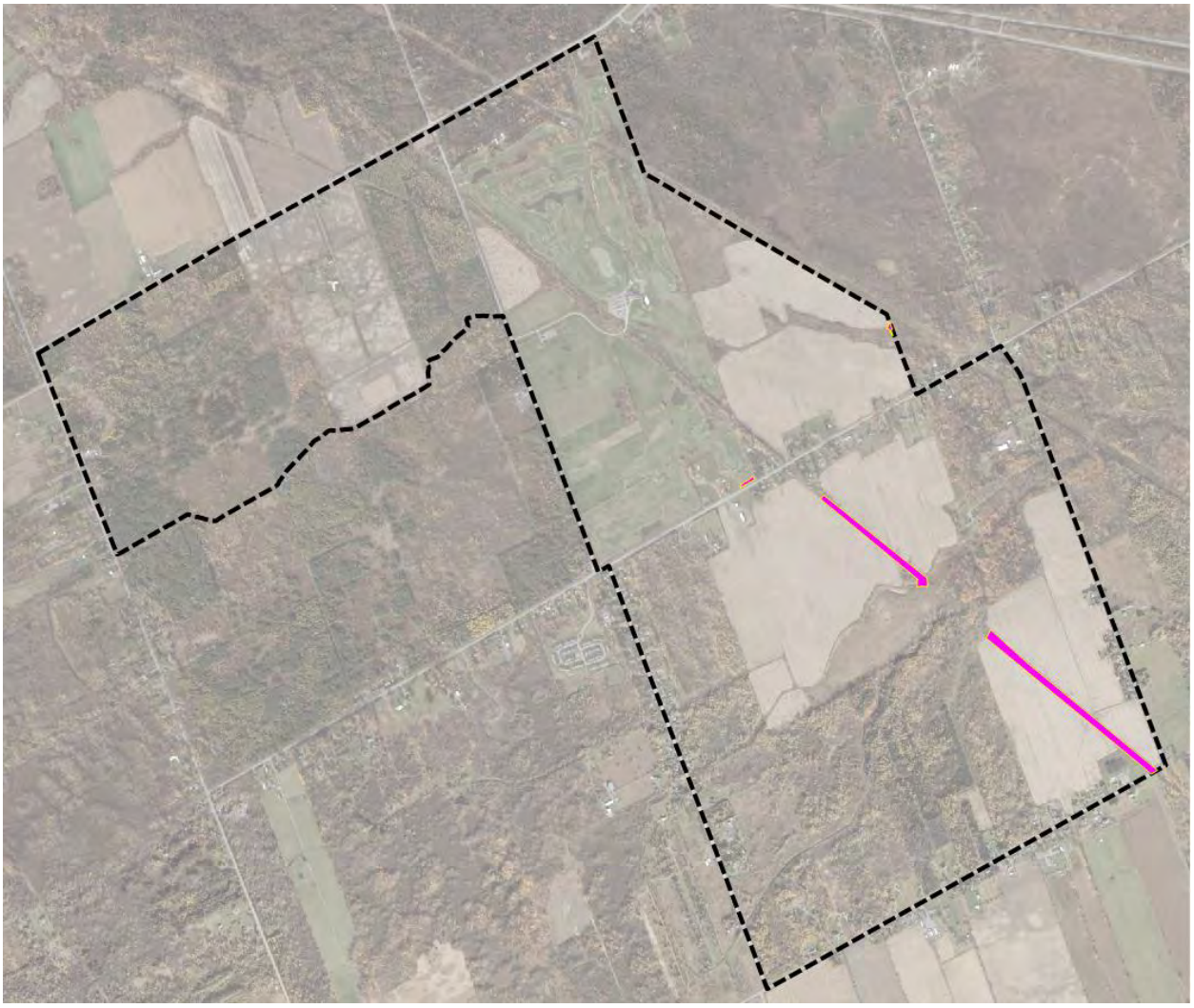


Figure 19 Location of Deciduous Thicket Ecosite (THD)

Mixed Forest Ecosite (FOM)

Two Mixed Forest Ecosite (FOM) were located along the northern edge of the Tewin Lands on properties to which access was not permitted (Figure 20). Aerial imagery indicated a treed canopy comprising a mixture of deciduous and coniferous species, while imagery in combination with available information on hydrology, topography, and adjacent community characteristics indicated a terrestrial (upland) community at this location.

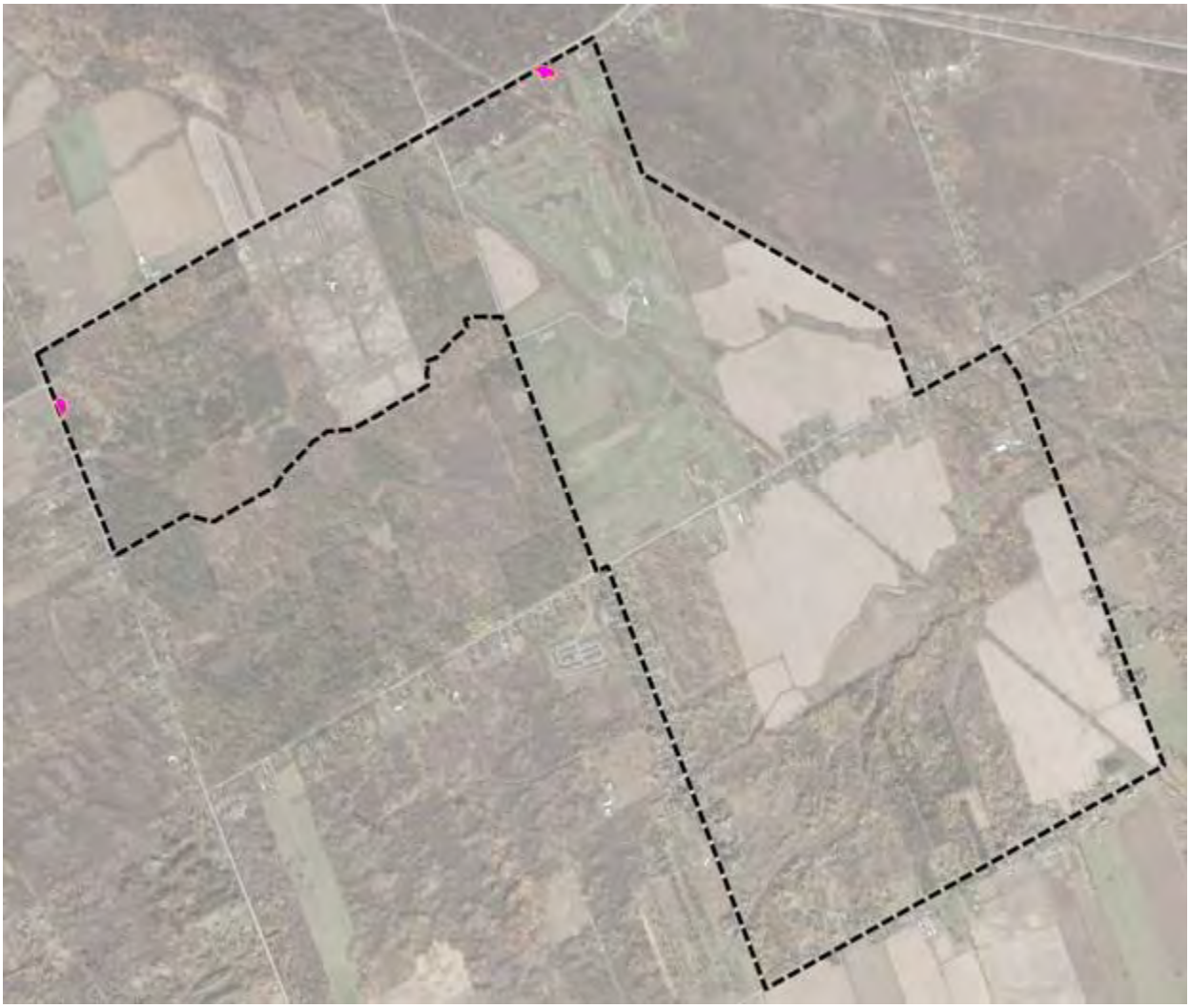


Figure 20 Location of Mixed Forest Ecosite (FOM)

Fresh – Moist Sugar Maple – Hemlock Mixed Forest Type (FOMM6-1)

A Fresh – Moist White Cedar – Hardwood Mixed Forest Type (FOMM6-1) was located in the southeast corner of the Tewin Lands (Figure 21). The canopy was characterized by Sugar Maple, with Eastern White Cedar (*Thuja occidentalis*), American Beech, Yellow Birch, and Eastern Hemlock (*Tsuga canadensis*). The subcanopy was characterized by Striped Maple, with American Beech and Sugar Maple saplings. Groundcover comprised Intermediate Wood Fern, Wild Sarsaparilla, Canada Mayflower, and Indian Cucumber-root (*Medeola virginiana*).

Figure 21 Fresh – Moist Sugar Maple Hemlock Mixed Forest Type (FOMM6-1) (photo taken June 10, 2022)

Fresh – Moist White Cedar – Hardwood Mixed Forest Ecosite (FOM7)

A Fresh – Moist White Cedar – Hardwood Mixed Forest Ecosite (FOM7) was located in the northeast corner of the Tewin Lands, a portion of the study area to which access was not permitted (Figure 22). Aerial imagery indicated a treed canopy comprising a mixture of deciduous and coniferous species, while imagery in combination with available information on hydrology, topography, and adjacent community characteristics indicated a terrestrial (upland) community at this location.

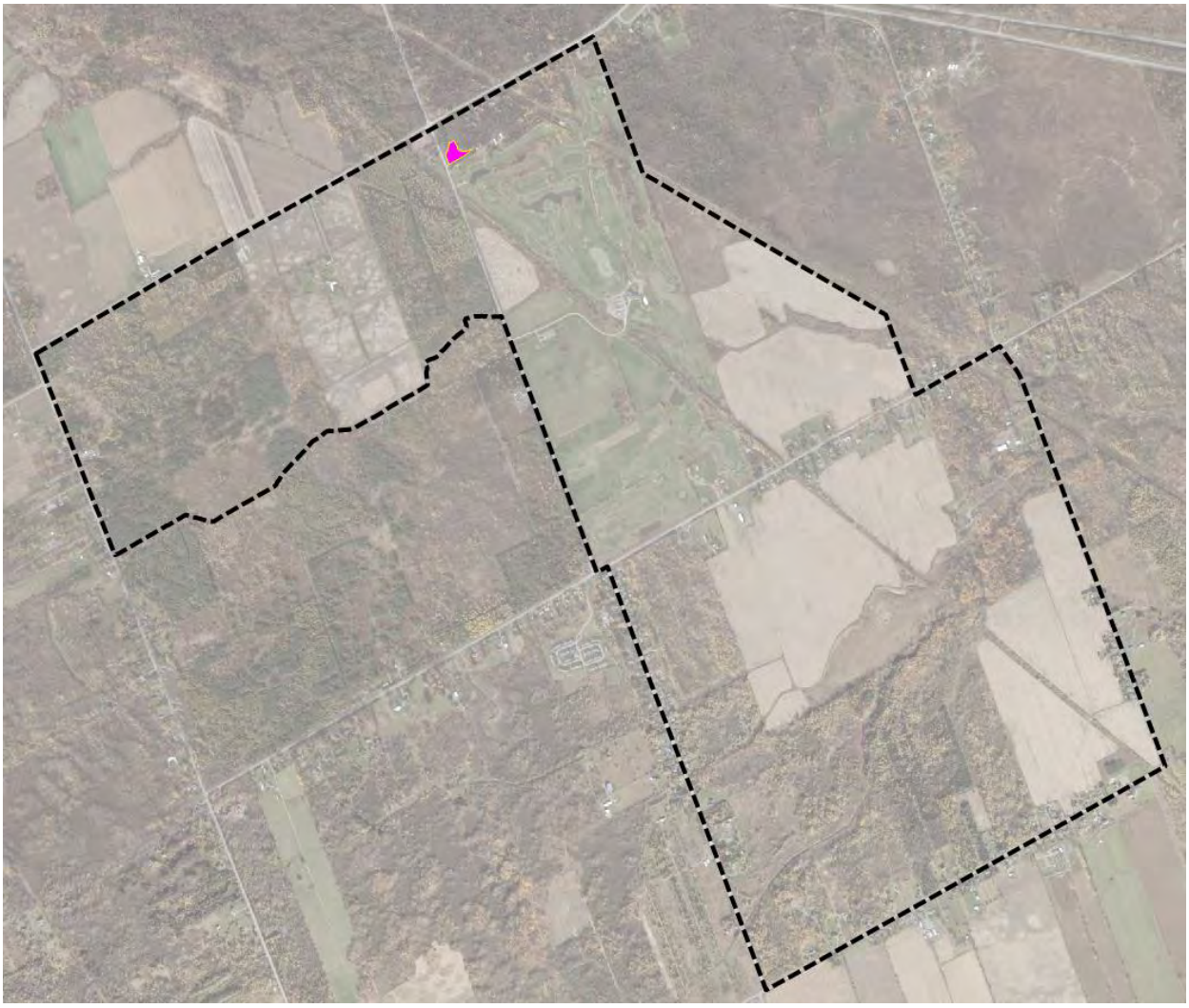


Figure 22 Location of Fresh – Moist White Cedar – Hardwood Mixed Forest Ecosite (FOM7)

Fresh – Moist White Pine – Sugar Maple Mixed Forest Type (FOMM9-2)

A Fresh – Moist White Pine – Sugar Maple Mixed Forest Type (FOMM9-2) was located in the northeast corner of the Tewin Lands, immediately south of Leitrim Road (Figure 23). The canopy was dominated by Eastern White Pine, with Sugar Maple, White Birch, and Trembling Aspen. The subcanopy was characterized by Sugar Maple saplings and Glossy Buckthorn. Groundcover was dominated by Sensitive Fern throughout the area.

Figure 23 Fresh – Moist White Pine – Sugar Maple Mixed Forest Type (FOMM9-2) (photo taken June 8, 2022)

Fresh – Moist White Spruce – Hardwood Mixed Forest Type (FOMM10-2)

A Fresh – Moist White Spruce – Hardwood Mixed Forest Type (FOMM10-2) was located in the northwest corner of the Tewin Lands (Figure 24). The canopy was characterized by White Spruce and Trembling Aspen. The subcanopy was characterized by Glossy Buckthorn and a species of dogwood (*Cornus* sp.). Groundcover comprised a dense carpet of Sensitive Fern, with occasional Woodland Horsetail, Wood Fern, and species of aster.

Figure 24 Fresh – Moist White Spruce – Hardwood Mixed Forest Type (FOMM10-2) (photo taken June 8, 2022)

Goldenrod Forb Meadow Type (MEFM1-1)

A Goldenrod Forb Meadow Type (MEFM1-1) was located near the east edge of the Tewin Lands, south of Piperville Road (Figure 25). It was characterized as an open, forb-dominated meadow area, with abundant Canada Goldenrod and species of grasses. Other widespread forbs included Sheep Sorrel (*Rumex acetosella*), Canada Thistle (*Cirsium arvense*), Common Milkweed (*Asclepias syriaca*), Wild Strawberry (*Fragaria virginiana*), and Common Dandelion (*Taraxacum officinale*). Occasional shrub cover included Wild Red Raspberry and White Meadowsweet.

Figure 25 Goldenrod – Forb Meadow Type (MEFM1-1) (photo taken June 9, 2022)

Fresh – Moist Open Graminoid Meadow Ecosite (MEFM4)

A Fresh – Moist Open Graminoid Meadow Ecosite (MEFM4) was located near a drainage feature on the east edge of the Tewin Lands (Figure 26). It was characterized as an open, grassy meadow area, dominated by Canada Bluejoint (*Calamagrostis canadensis*). Widespread forbs included Red Clover (*Trifolium pratense*), Tufted Vetch (*Vicia cracca*), and Alfalfa (*Medicago sativa*).

Figure 26 Fresh – Moist Open Graminoid Meadow Ecosite (MEFM4)

Fresh – Moist Mixed Tallgrass Prairie Ecosite (MEMM3)

A Fresh – Moist Mixed Tallgrass Prairie Ecosite (MEMM3) characterized a portion of the Tewin Lands to which access was not permitted (Figure 27). This unit was used to describe open meadow areas along hydro corridors and other disturbed or regenerating open areas. Aerial imagery indicated these areas were grass-dominated and relatively open, with scattered cover of planted and generally maintained trees and shrubs. The areas supported occasional buildings and other structures.

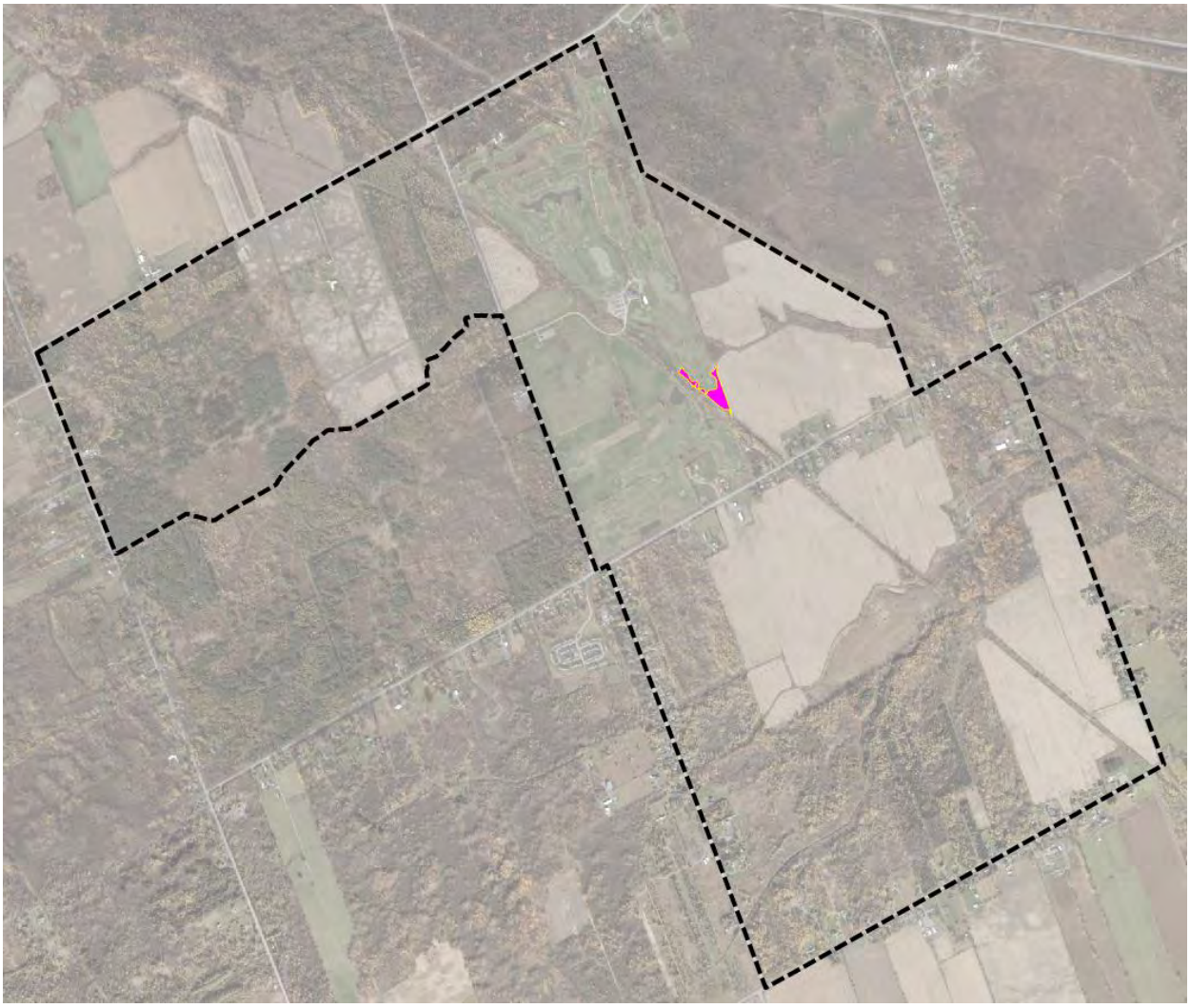


Figure 27 Location of Fresh – Moist Mixed Tallgrass Prairie Ecosite (MEMM3)

Constructed Green Lands (CGL)

A Constructed Green Lands (CGL) unit characterized a portion of the Tewin Lands to which access was not permitted (Figure 28). This unit was used to describe the Anderson Links Golf Course and other areas of parks and green spaces within the study area. Aerial imagery indicated these areas were grass-dominated and relatively open, with scattered cover of planted and generally maintained trees and shrubs. The areas supported occasional buildings and other structures.

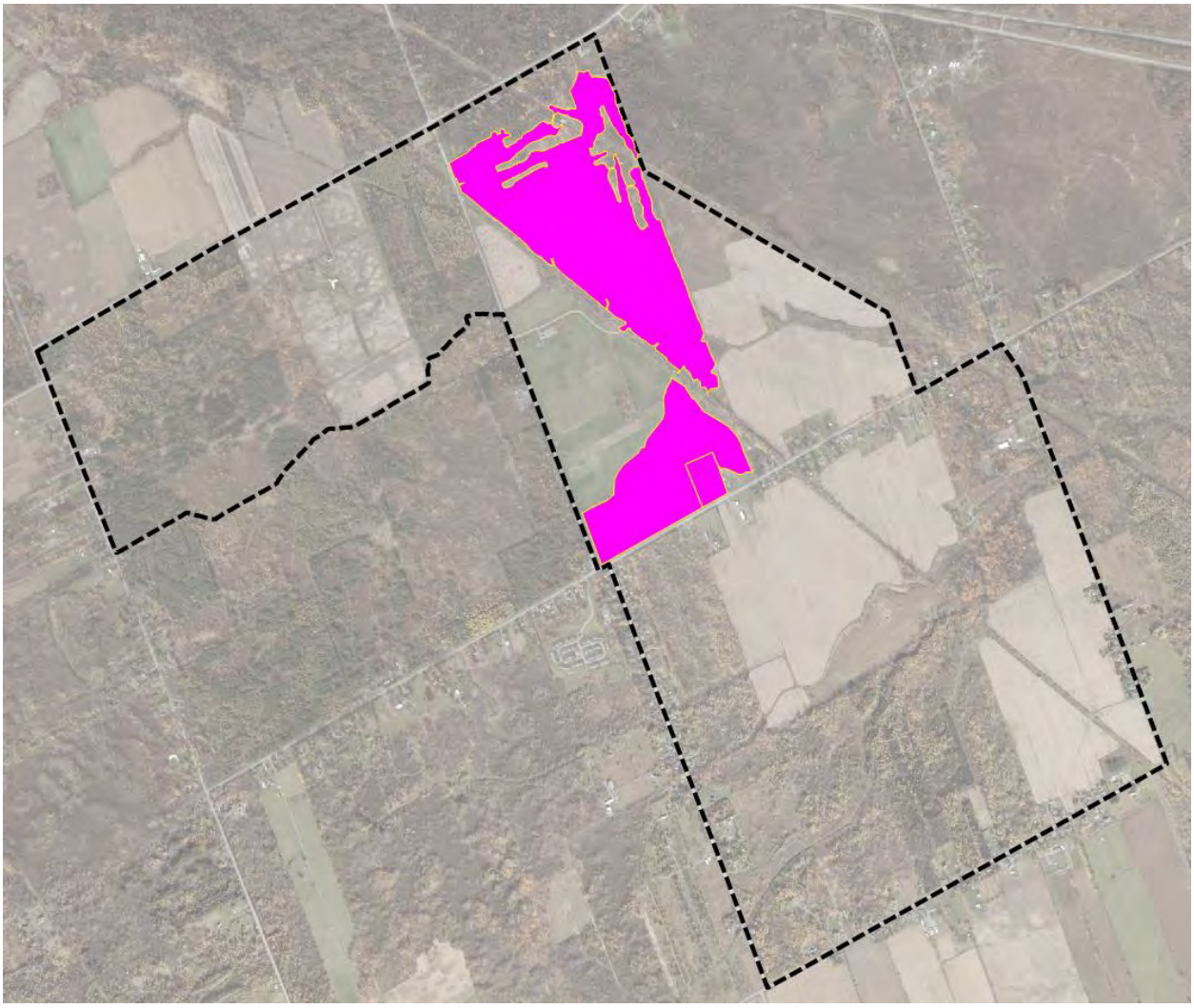


Figure 28 Location of Anthropogenic Land Use Cover (CGL)

Mineral Cultural Meadow Ecosite (CUM1)

A Mineral Cultural Meadow Ecosite (CUM1) characterized a portion of the Tewin Lands to which access was not permitted (Figure 29). This unit was used to describe a hydro corridor, situated in the northeast corner of the Tewin Lands, as well as patches of varying size along the west edge of the study area. Aerial imagery indicated these areas were grass dominated and relatively open, with scattered shrub cover.

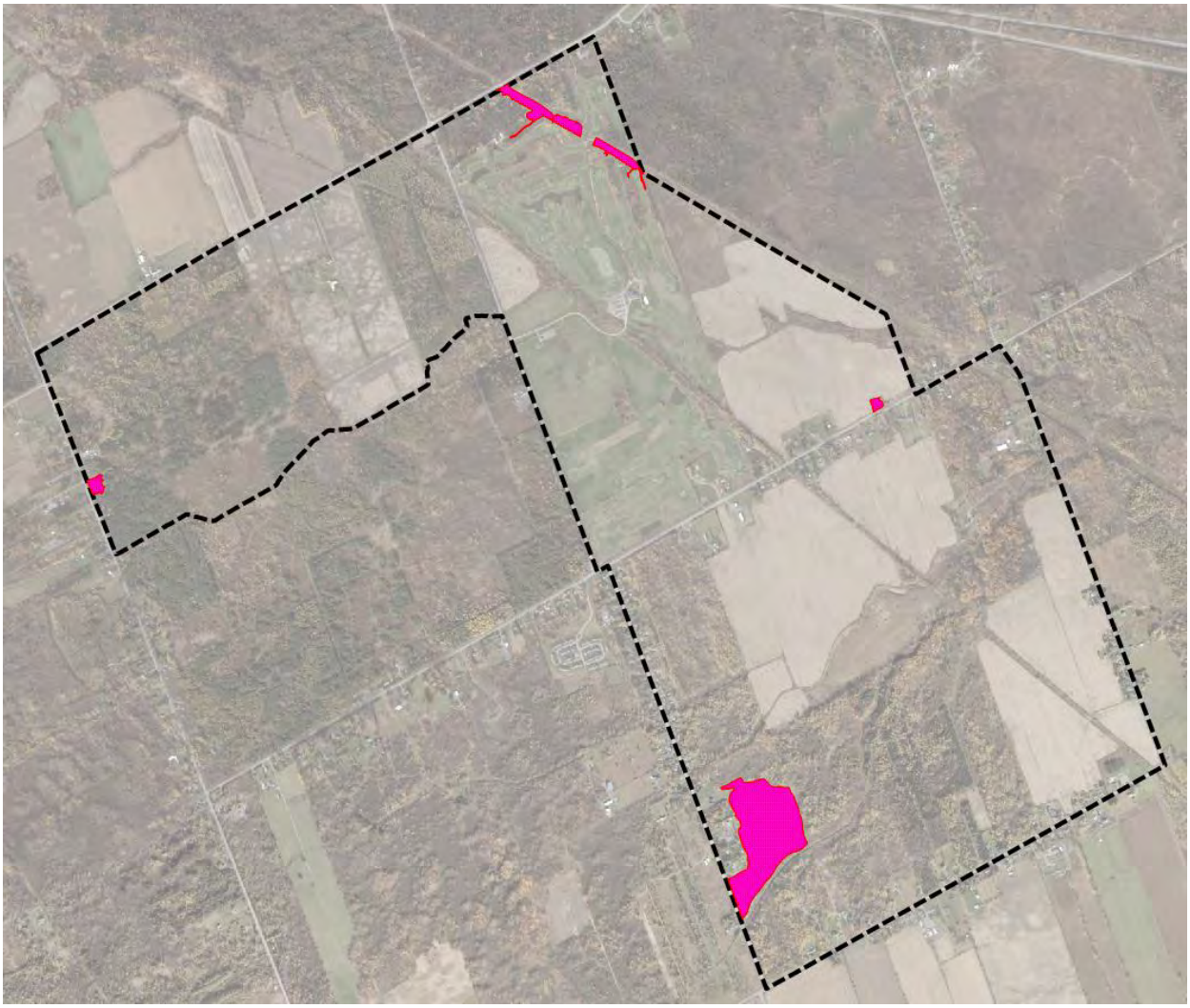


Figure 29 Location of Mineral Cultural Meadow (CUM1)

Business Sector (CVC_1)

Business Sector properties (CVC_1) were situated along Ramsayville Road within the Tewin Lands (Figure 30). Access was not granted for these properties; aerial imagery indicated these areas comprised residences with associated structures and vehicles used to support a business.

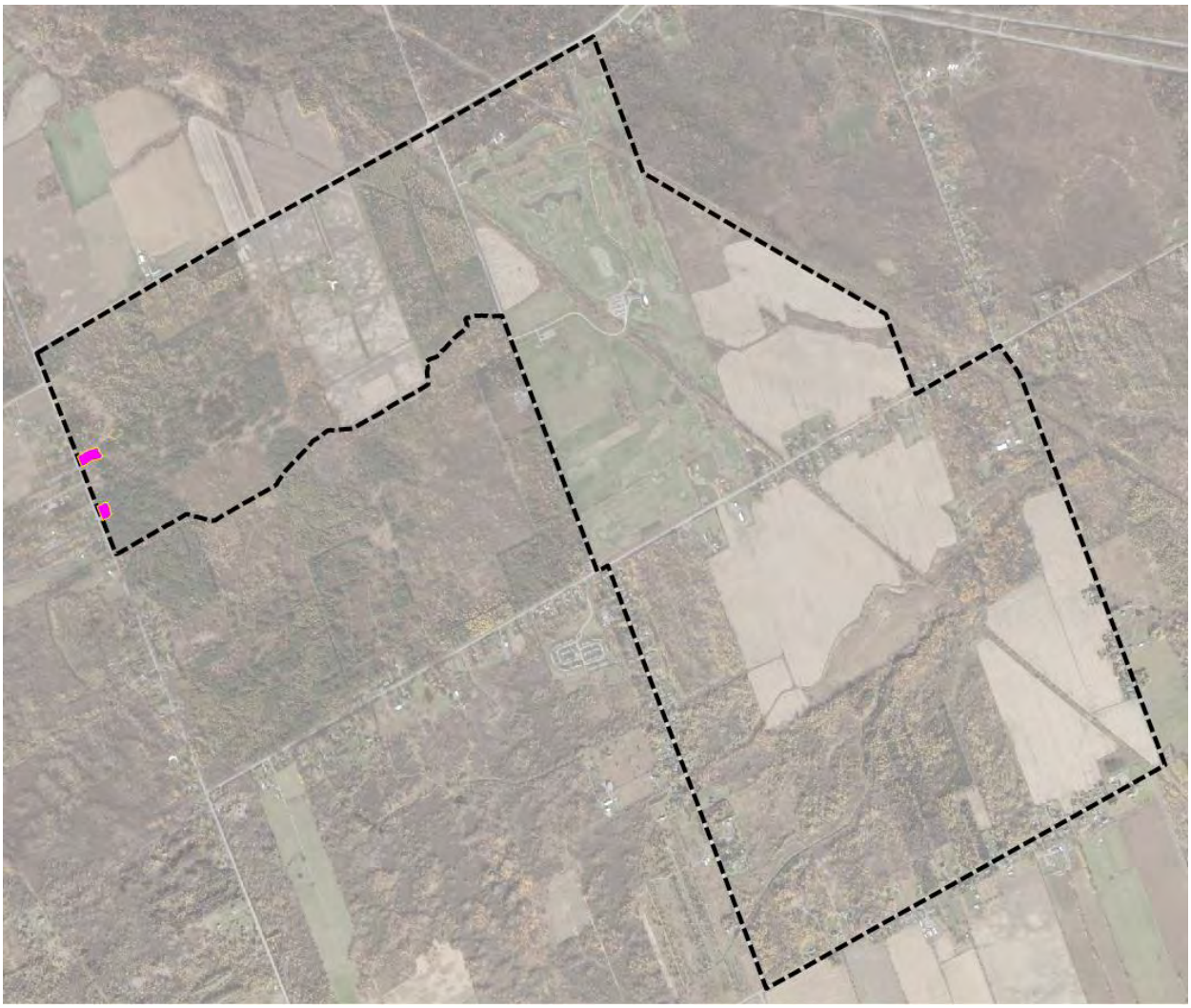


Figure 30 Location of Business Sector (CVC_1)

Single-family Residential Property (CVR_3)

Single-family Residential Properties (CVR_3) were concentrated along the roadways within the Tewin Lands, particularly portions of Ramsayville Road, Thunder Road, and Farmers Way (Figure 31). Access was not granted for these properties; aerial imagery indicated these areas comprised relatively small lots supporting a house and associated structures (e.g., detached garage) within a maintained yard area. These properties differed from Rural Properties (described below), largely based on the relative size of the lots and local density of residences.

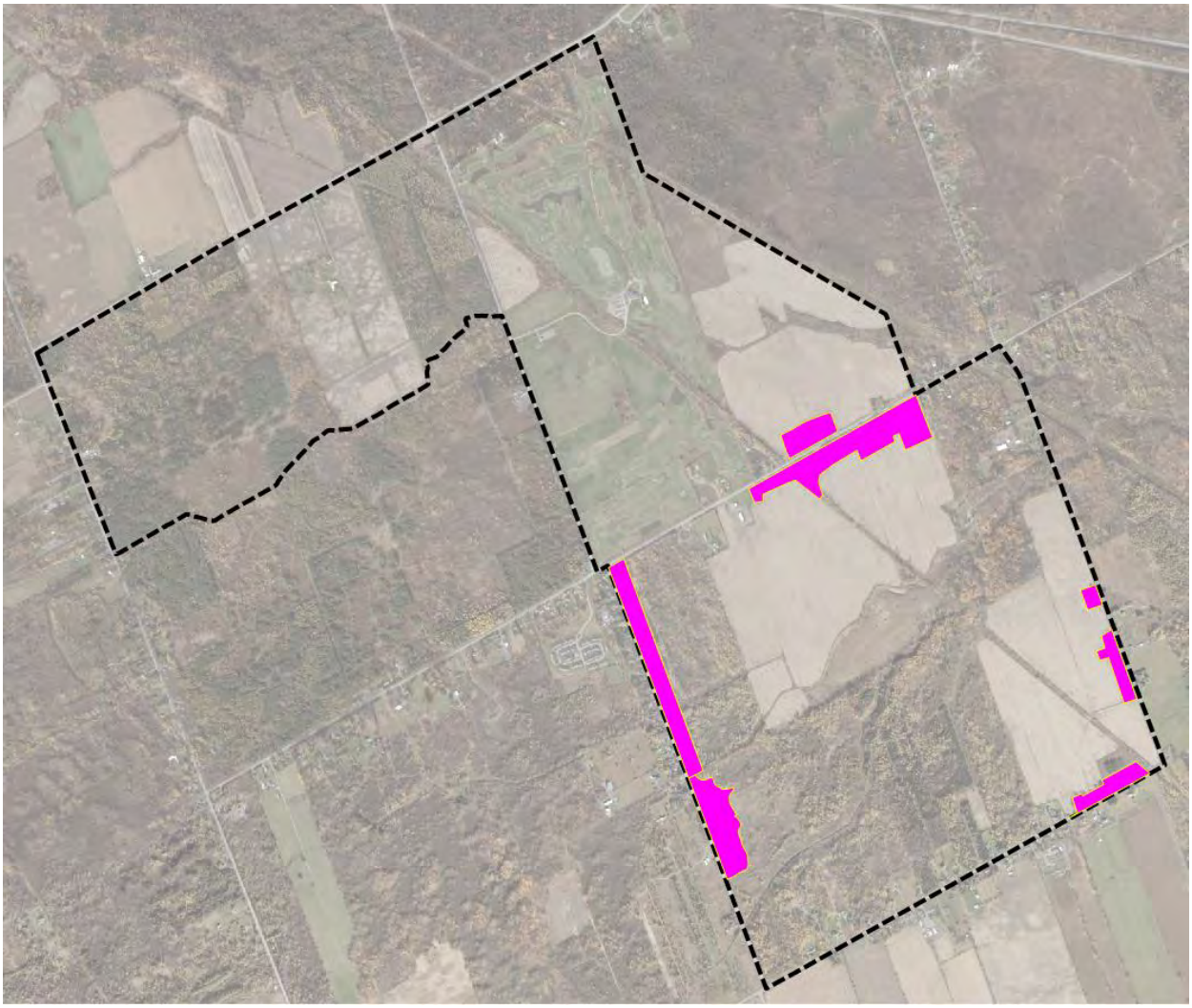


Figure 31 Location of Single-family Residential Property (CVR_3)

Rural Property (CVR_4)

Rural Properties (CVR_4) were concentrated along the roadways within the Tewin Lands, particularly portions of Ramsayville Road, Thunder Road, Anderson Road, Piperville Road, and Farmers Way (Figure 32). Access was not granted for these properties; aerial imagery indicated these areas comprised large lots supporting a house and associated structures (e.g., detached garage and other outbuildings) with areas of maintained yard as well as natural vegetation cover.

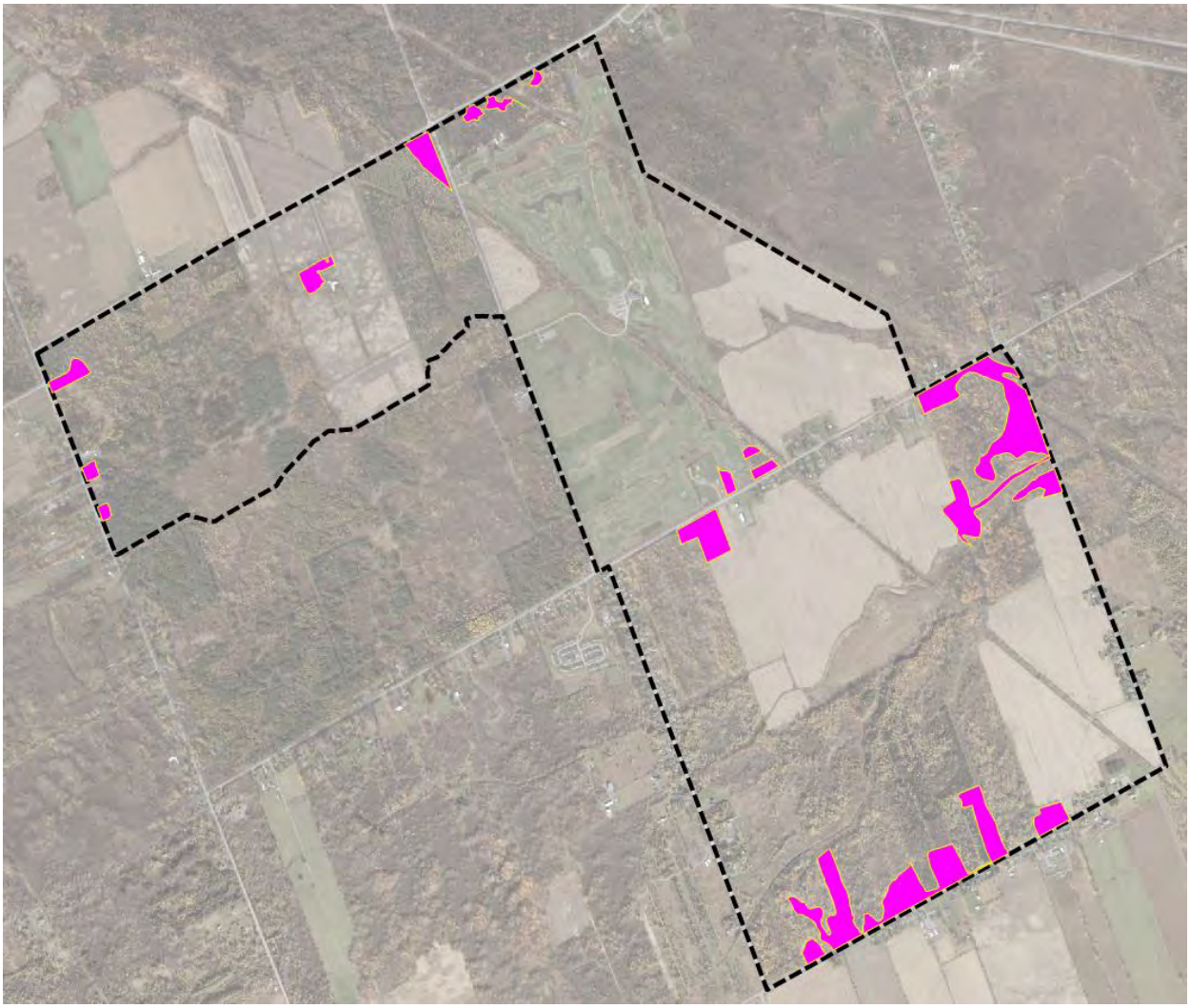


Figure 32 Location of Rural Property (CVR_4)

Open Agriculture (OAG)

Areas of Open Agriculture (OAG) represented a considerable portion of the Tewin Lands, particularly between Anderson Road and Farmers Way, and typically encompassed areas to which access was not permitted (Figure 33). These areas supported a variety of annual row crops. Canopy layers were predominantly absent, although agricultural fields were occasionally interspersed by naturalized hedgerows, utility lines, and drainage features supporting naturalized vegetation cover.

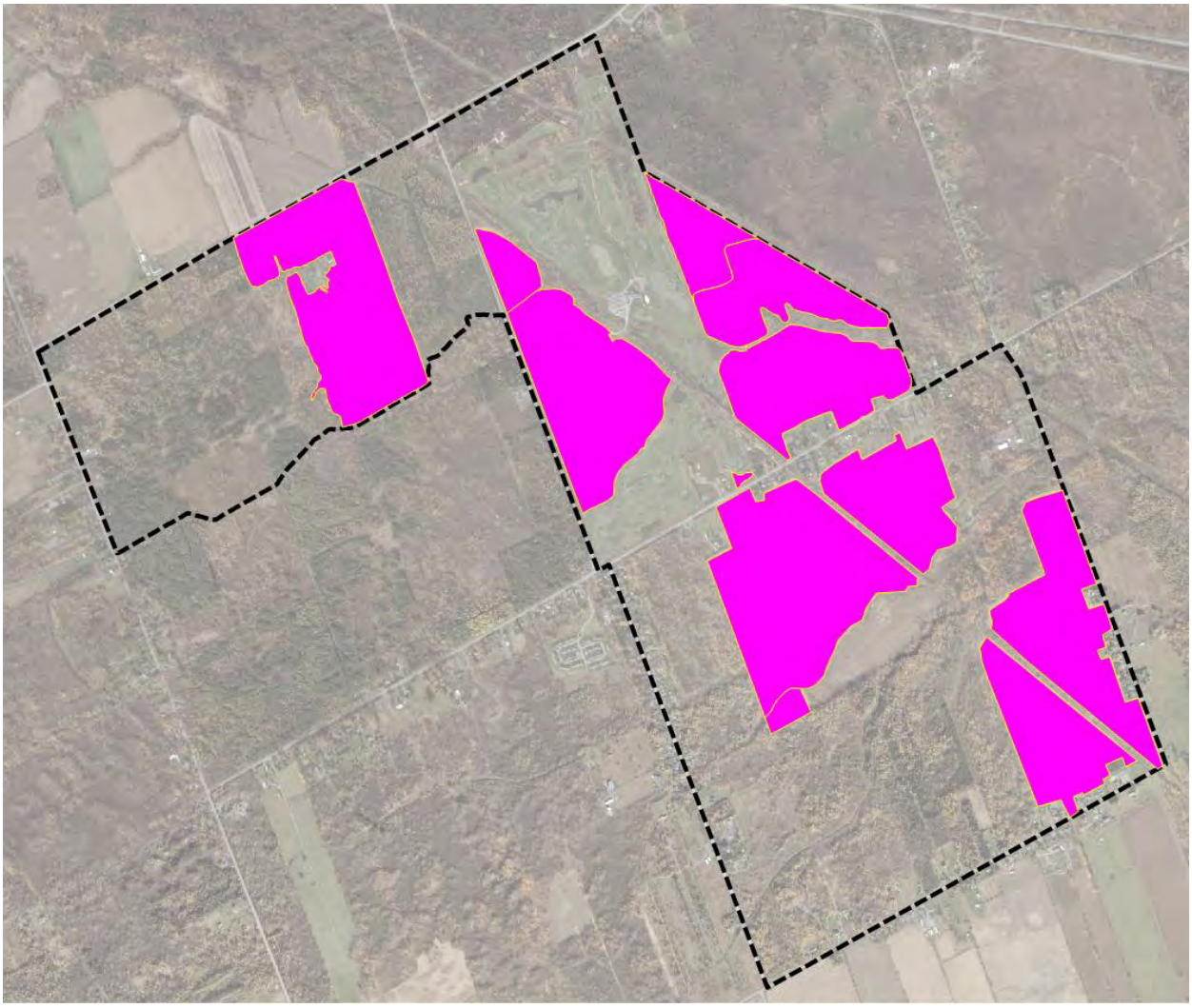


Figure 33 Location of Open Agriculture (OAG)

2.4.1.2 Wetland ELC Units

Deciduous Swamp Ecosite (SWD)

A Deciduous Swamp Ecosite (SWD) was located along a drainage feature on the east side of the Tewin Lands, a portion of the study area to which access was not permitted (Figure 34). Aerial imagery indicated a treed canopy comprising deciduous species, while imagery in combination with available information on hydrology, topography, and adjacent community characteristics indicated a wetland (treed swamp) community at this location.

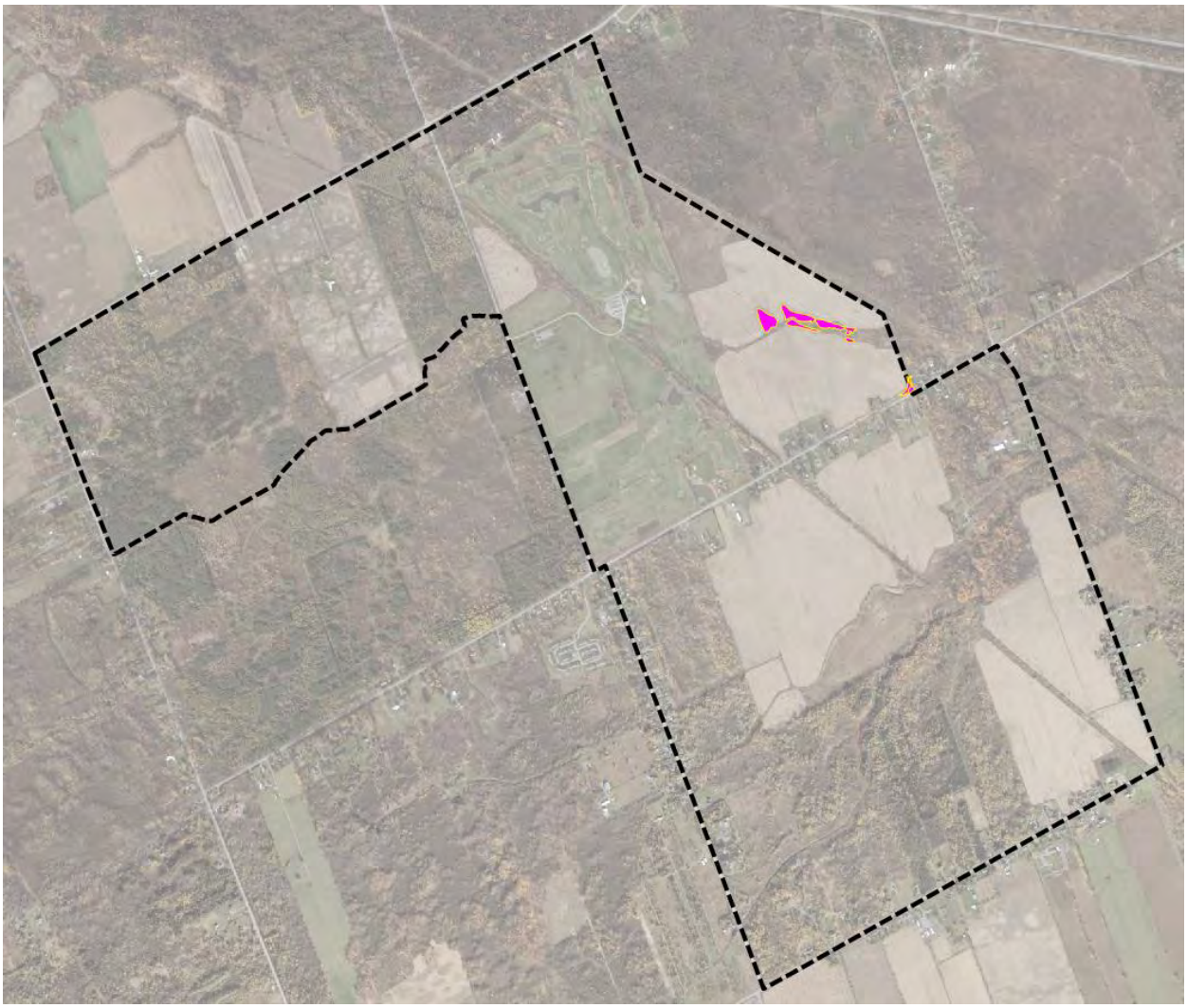


Figure 34 Location of Deciduous Ecosite (SWD)

Willow Mineral Deciduous Swamp Type (SWDM4-1)

A Willow Mineral Deciduous Swamp Type (SWDM4-1) was located along the north edge of the Study Area (Figure 35). The canopy was characterized by White Willow and Red Maple. The subcanopy was dominated by Alder Buckthorn and Glossy Buckthorn, while groundcover comprised predominantly Sensitive Fern, with Lady Fern, Woodland Horsetail, and species of grasses and sedges.

Figure 35 Willow Mineral Deciduous Swamp Type (SWDM4-1) (photo taken June 9, 2022)

White Birch – Poplar Mineral Deciduous Swamp Type (SWDM4-3)

A White Birch – Poplar Mineral Deciduous Swamp Type (SWDM4-3) was a widespread ELC type within the Tewin Lands (Figure 36). The canopy was characterized by White Birch and Trembling Aspen, with occasional White Willow and Red Maple. The subcanopy was dominated by Glossy Buckthorn and species of alder (*Alnus* spp.). Groundcover was dominated by Sensitive Fern, Woodland Horsetail, and species of grasses, with occasional Ostrich Fern (*Matteuccia struthiopteris*) and species of aster.

Figure 36 White Birch – Poplar Mineral Deciduous Swamp Type (SWDM4-3) (photo taken June 9, 2022)

Mixed Swamp Ecosite (SWM)

A Mixed Swamp Ecosite (SWM) was located along the north edge of the Tewin Lands, in areas to which access was not permitted (Figure 37). Aerial imagery indicated a treed canopy comprising a mixture of coniferous and deciduous species, while imagery in combination with available information on hydrology, topography, and adjacent community characteristics indicated a wetland (treed swamp) community at this location.

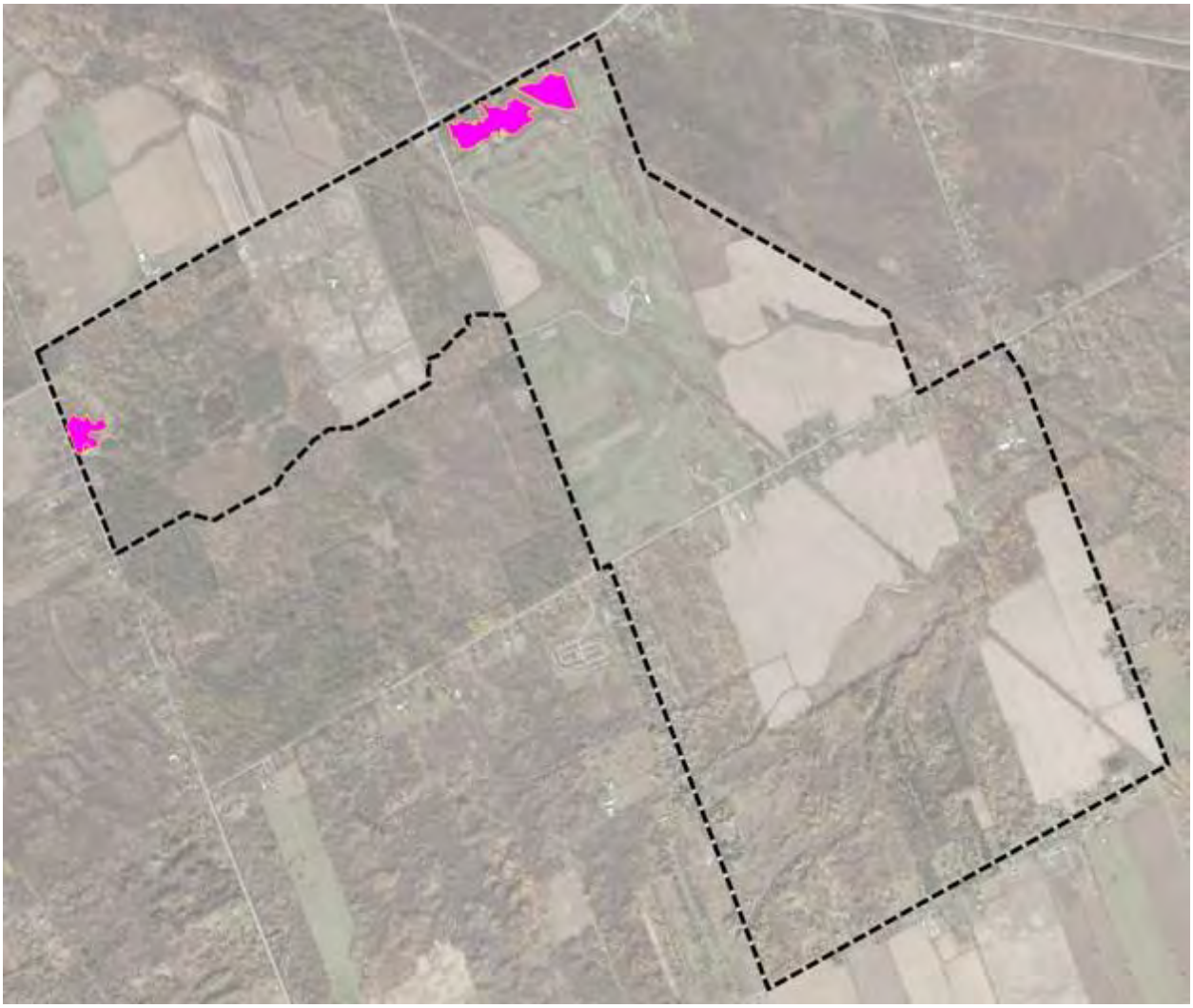


Figure 37 Location of Mixed Swamp Ecosite (SWM)

Red Maple – Conifer Mineral Mixed Swamp Type (SWMM2-1)

A Red Maple – Conifer Mineral Mixed Swamp Type (SWMM2-1) was located along the north edge of the Tewin Lands, representing units within a mosaic of treed and thicket swamp areas (Figure 38). The canopy was characterized by Red Maple, Green Ash, and Eastern White Pine, with occasional White Birch. The subcanopy was characterized by abundant Glossy Buckthorn and Wild Red Raspberry. Groundcover was dominated by Sensitive Fern, with White Wintergreen (*Pyrola elliptica*) and species of sedge (*Carex* spp.).

Figure 38 Red Maple – Conifer Mineral Mixed Swamp Type (SWMM2-1) (photo taken June 8, 2022)

Poplar – Conifer Mineral Mixed Swamp Type (SWMM3-2)

A Poplar – Conifer Mineral Mixed Swamp Type (SWMM3-2) was located near the north edge of the Tewin Lands, presenting units within a wetland comprising deciduous and mixed treed swamp components, and meadow marsh areas (Figure 39). The canopy was dominated by Trembling Aspen and White Spruce, with White Birch, Red Maple, and White Willow. The subcanopy was dominated by Glossy Buckthorn. Groundcover comprised Sensitive Fern, with Lady Fern, Woodland Horsetail, and species of grasses and sedges.

Figure 39 Poplar – Conifer Mineral Mixed Swamp Type (SWMM 3-2) (photo taken June 9, 2022)

Thicket Swamp Ecosite (SWT)

A Thicket Swamp Ecosite (SWT) was located along a drainage feature on the east edge of the Tewin Lands, a portion of the study areas to which access was not permitted (Figure 40). Aerial imagery indicated an open or absent upper canopy, with a dense subcanopy, comprising deciduous shrubs. Available imagery, in combination with information on hydrology, topography, and adjacent community characteristics indicated a wetland (thicket swamp) community at this location.

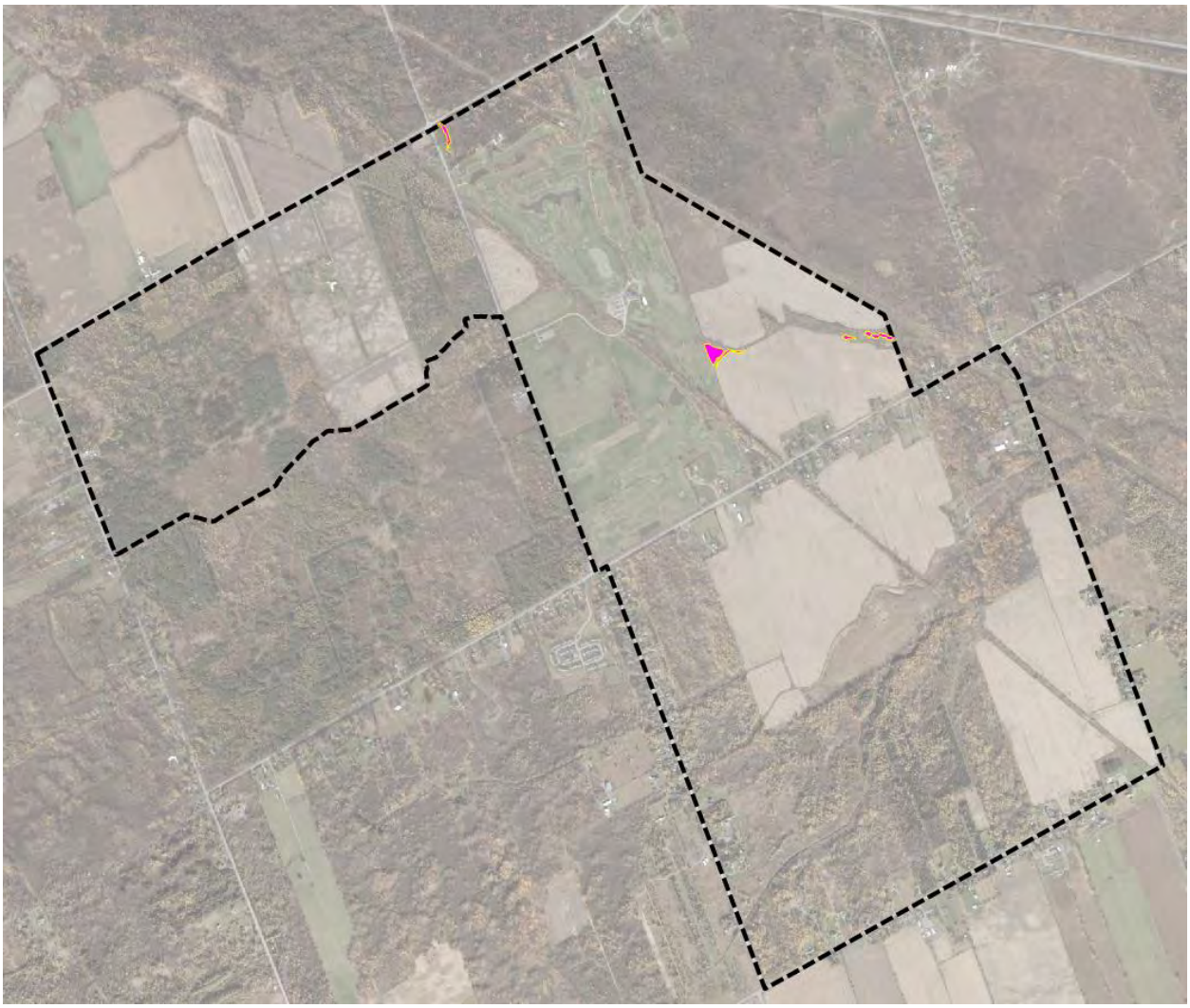


Figure 40 Location of Thicket Swamp Ecosite (SWT)

Willow Mineral Deciduous Thicket Swamp Ecosite (SWTM3)

A Willow Mineral Deciduous Thicket Swamp Ecosite (SWTM3) was located in the northwest corner of the Tewin Lands, representing units within a wetland mosaic comprising deciduous and mixed treed swamps, regenerating moist coniferous plantations, and meadow marsh areas (Figure 41). The canopy was dominated by species of willow, with occasional White Birch and Trembling Aspen. The subcanopy comprised species of willow (*Salix* spp.) with White Birch. Groundcover was characterized by Canada Goldenrod, Fringed Sedge (*Carex crinita*), and species of grasses, with occasional Common Cattail (T*ypha latifolia*) and a species of vetch (*Vicia* sp.). The area was characterized by braided channels holding standing water, interspersed with relatively drier hummocks.

Figure 41 Willow Mineral Deciduous Thicket Swamp Ecosite (SWTM3) (photo taken June 8, 2022)

Non-native Mineral Deciduous Thicket Swamp Type (SWTM5-8)

A Non-native Mineral Deciduous Thicket Swamp Type (SWTM5-8) was a widespread ELC type throughout the Tewin Lands (Figure 42). The upper canopy was sparse and characterized by occasional White Ash (*Fraxinus americana*). The subcanopy was dominated by dense Glossy Buckthorn, a non-native species, with occasional White Meadowsweet. Groundcover comprised Sensitive Fern, Reed-canary Grass (*Phalaris arundinacea*), and species of aster.

Figure 42 Non-native Mineral Deciduous Thicket Swamp Type (SWTM5-8) (photo taken June 7, 2022)

Meadow Marsh Ecosite (MAMM)

Meadow Marsh Ecosites (MAMM) were located along a drainage feature on the east edge of the Tewin Lands, an area to which access was not permitted (Figure 43). Aerial imagery indicated an open area, with sparse or non-existent tree and shrub cover. Imagery, in combination with available information on hydrology, topography, and adjacent community characteristics indicated a wetland (meadow marsh) community at this location.

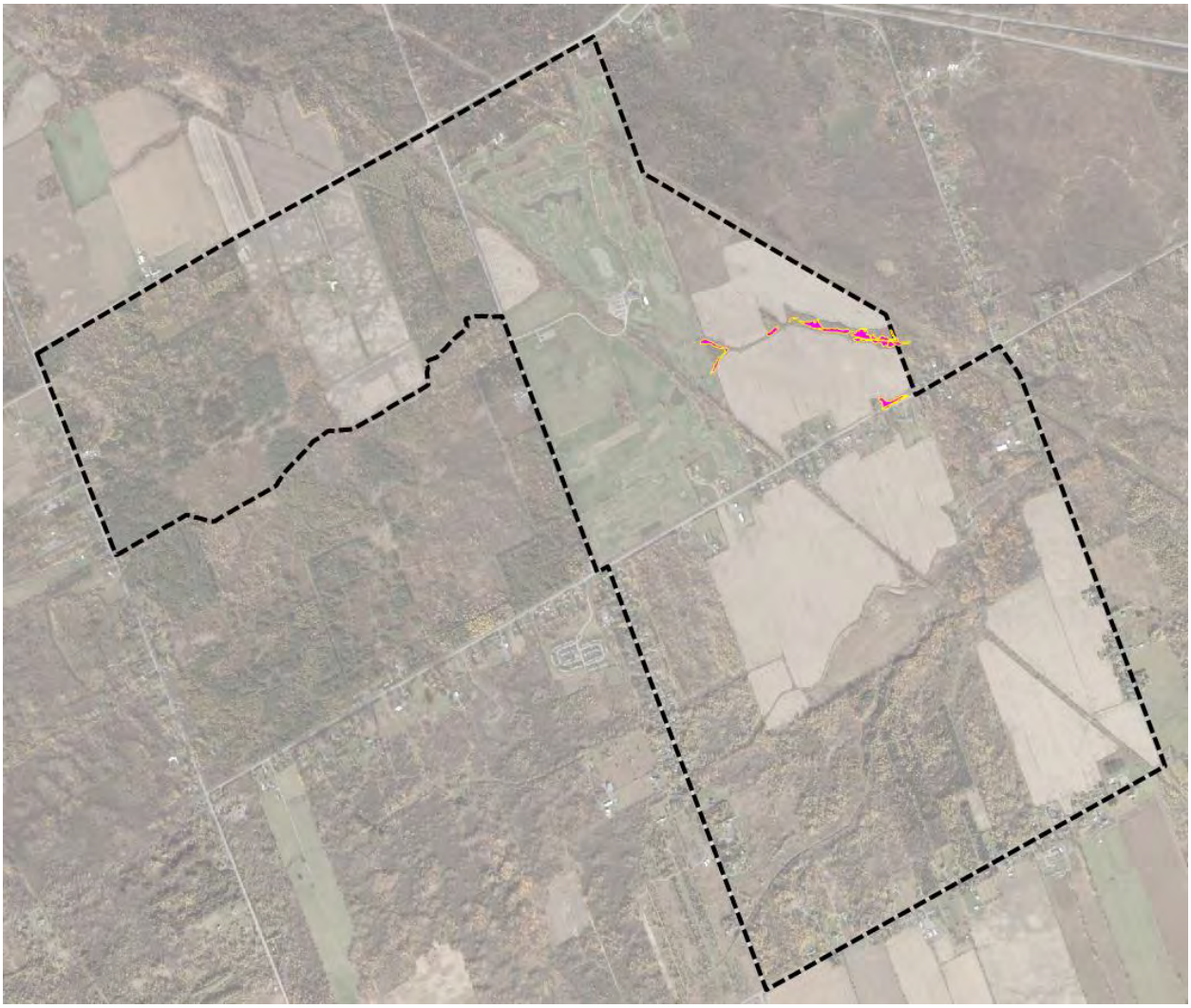


Figure 43 Location of Meadow Marsh Ecosite (MAMM)

Reed-canary Grass Graminoid Mineral Meadow Marsh (MAMM1-3)

Reed-canary Grass Graminoid Mineral Meadow Marsh (MAMM1-3) was present but infrequently encountered and occurred in small patches throughout the Tewin Lands. These patches often represented relatively open areas within wetland mosaics comprising marshes, as well as treed and occasionally thicket swamp units (Figure 44). The area was relatively open, dominated by Reed-canary Grass, Canada Goldenrod, Sensitive Fern, and Woodland Horsetail. Trembling Aspen, White Meadowsweet, ash saplings, and species of willow characterized the margins of the community.

Figure 44 Reed-canary Grass Graminoid Mineral Meadow Marsh (MAMM1-3) (photo taken June 8, 2022)

Mixed Mineral Meadow Marsh Type (MAMM3-1)

Mixed Mineral Meadow Marsh Type (MAMM3-1) was present but infrequently encountered and occurred in small patches throughout the Tewin Lands, often representing relatively open areas within wetland mosaics comprising marshes, as well as treed and occasional thicket swamp units (Figure 45). The area was characterized by dense cover of Reed-canary Grass with Canada Goldenrod. Scattered shrub cover included species of willow, Highbush Cranberry, and White Meadowsweet. The area was characterized by areas of standing water interspersed with relatively drier areas.

Figure 45 Mixed Mineral Meadow Marsh Type (MAMM3-1) (photo taken June 8, 2022)

Graminoid Mineral Shallow Marsh Ecosite (MASM1)

Graminoid Mineral Shallow Marsh Ecosites (MASM1) occurred in two discrete units near the east edge of the Tewin Lands, immediately surrounded by meadow marsh areas and deciduous forest (Figure 46). Access had not been granted for these areas; aerial imagery indicated an open water area, surrounded by open, graminoid or forb dominated margins. Imagery, in combination with information on hydrology, topography, and adjacent community characteristics indicated a wetland (shallow marsh) community at this location.

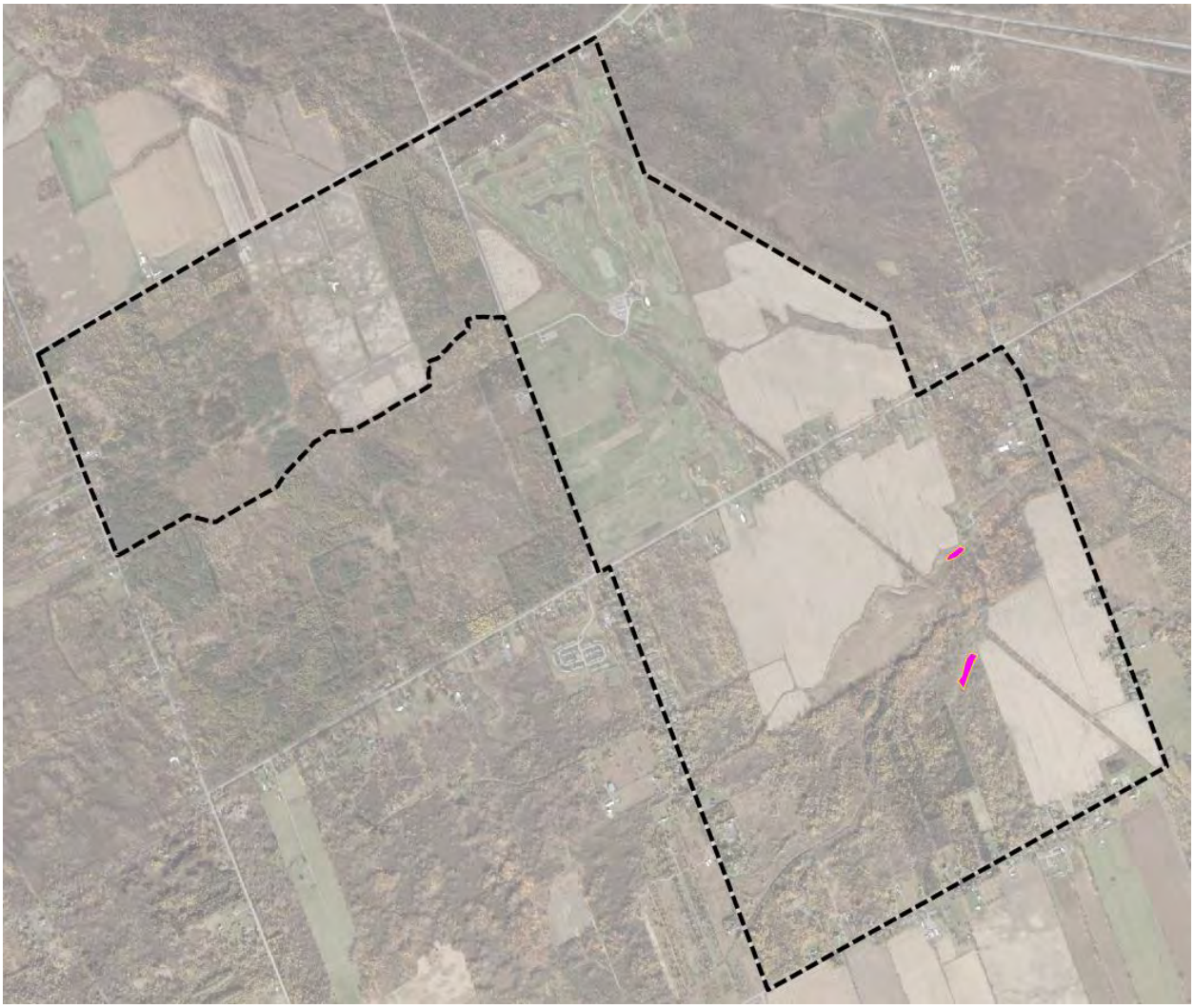


Figure 46 Location of Graminoid Mineral Shallow Marsh Ecosite (MASM1)

2.4.2 Terrestrial Species

2.4.2.1 Breeding Birds

A summary of the weather conditions during the 2022 breeding bird surveys is provided in Table 1.

Table 1 Dates and weather conditions during breeding bird surveys

Date	Wind (Beaufort Scale)	Air Temperature (°C)	Cloud Cover (%)	Precipitation
2022-05-31	0 to 3	18 to 22	50 to 0	None
2022-06-08	1 to 2	17 to 18	25 to 30	None
2022-06-13	1 to 3	14 to 19	0 to 20	None
2022-06-14	1	16 to 17	25 to 0	None
2022-06-30	0 to 2	14 to 19	100 to 95	Damp/Haze/Fog

A total of 67 bird species were detected in the Tewin Lands via morning breeding bird surveys and incidental observations. A complete list of all species observed throughout the 2022 field season is available in Appendix D. The following species were observed at 80% or more of the survey stations: American Crow (*Corvus brachyrhynchos*), American Goldfinch (*Spinus tristis*), American Robin (*Turdus migratorius*), Black-capped Chickadee (*Poecile atricapillus*), Cedar Waxwing (*Bombycilla cedrorum*), Common Yellowthroat (*Geothlypis trichas*), Ovenbird (*Seiurus aurocapilla*), Song Sparrow (*Melospiza melodia*), Veery (*Catharus fuscescens*), White-throated Sparrow (*Zonotrichia albicollis*), and Yellow Warbler (*Setophaga petechia*).

Six listed SAR were detected during the morning breeding bird surveys and through incidental observations. Eastern Wood-pewee (*Contopus virens*; listed as Special Concern under the ESA) was relatively widespread across the study area and was detected on all three survey dates with observations recorded at six survey stations (BBS-S3, BBS-S5, BBS-S6, BBS-S8, BBS-S9 and BBS-S11). Bobolink (*Dolichonyx oryzivorus*) and Eastern Meadowlark (*Sturnella magna*; both listed as Threatened under the ESA) were detected at the same two survey stations (BBS-S1 and BBS-S2). Barn Swallow (*Hirundo rustica*; listed as Special Concern under the ESA) was consistently observed during all three surveys at a single survey station (BBS-S1). Wood Thrush (*Hylocichla mustelina*; listed as Special Concern under the ESA) was detected at two survey stations (BBS-S9 and BBS-S10) during a single survey. Grasshopper Sparrow (*Ammodramus savannarum*; listed as Special Concern under the ESA) was relatively rare within the Tewin Lands, with observations from a single survey station on one of the survey dates (BBS-S2 on May 31, 2022).

Additional information on the SAR birds detected in the Study Areas is provided in Section 2.4.4.4 below.

2.4.2.2 Nightjars

A summary of the conditions during the 2022 nightjar surveys is provided in Table 2. No Eastern Whip-poor-will or Common Nighthawk individuals were heard during any of the 2022 surveys, despite the suitability of survey conditions.

Table 2 Dates and weather conditions during nightjar surveys

Date	Wind (Beaufort Scale)	Air Temperature (°C)	Cloud Cover (%)	Precipitation	Moon Visible? (Y/N)
2022-05-19	2 to 1	8 to 7	20 to 15	None	Y, 93.5%
2022-06-13	0	18	15	None	Y, 90%
2022-06-14	0	22	0	None	Y, 30-100%

2.4.2.3 Anurans

A summary of the weather conditions during the 2022 anuran surveys is provided in Table 3. A total of four anuran species were observed during evening aural surveys (Table 4). Spring Peeper (*Pseudacris crucifer*) and Wood Frog (*Lithobates sylvaticus*) were the only species observed at Call Code Level 3 (i.e., full chorus) during aural surveys, both during the first survey (April 12, 2022).

Table 3 Dates and weather conditions during anuran surveys

Date	Wind (Beaufort Scale)	Air Temperature (°C)	Cloud Cover (%)	Precipitation
2022-04-12	1 to 4	16 to 14	100 to 70	None
2022-05-24	2 to 1	13 to 11	0 to 15	None
2022-06-28	3 to 4	20 to 19	0	None
2022-07-04	0	23	75 to 100	None

Table 4 Summary of anurans detected during anuran surveys

Common Name	Scientific Name	Station(s) Observed	Survey Date(s) Observed	Highest Calling Code[1]
American Bullfrog	*Lithobates catesbeianus*	MMP-S6	2022-06-28	1
Green Frog	*Lithobates clamitans*	MMP-S5, MMP-S6, MMP-S7, MMP-S9	2022-05-24, 2022-06-28, 2022-07-04	1
Spring Peeper	*Pseudacris crucifer*	MMP-S1*, MMP-S2*, MMP-S3*, MMP-S4, MMP-S5*, MMP-S8, MMP-S9*, MMP-S10*, MMP-S11	2022-04-12, 2022-05-24, 2022-06-28	3
Wood Frog	*Lithobates sylvaticus*	MMP-S4, MMP-S5, MMP-S6, MMP-S7, MMP-S8, MMP-S9*, MMP-S11	2022-04-12	3

1 Calling codes are defined as follows (Birds Canada et al., 2008): **1** – Calls not simultaneous, individuals can be accurately counted; **2** – Some calling simultaneous, individuals reliably estimated; **3** – Full chorus, continuous and overlapping, individuals not reliably estimated.

* Location where species was observed at full chorus (i.e., Calling Code 3). Only MPP-S9 had more than one species calling at this level

2.4.3 Aquatic Habitat

2.4.3.1 Headwater Drainage Features

The HDFA here provides a high-level review of the general functionality of portions of the site as headwater areas. Three major blocks are considered with Block 1 in the northwest, Block 2 in the northeast, and Block 3 in the southeast (Figure 47).

On the Tewin Site, wetlands and terrestrial features, and open and treed features, tend to extend over broad areas, thus generating wide swaths of land that can be anticipated to generally function in a consistent manner in terms of headwater services provided. Blocks are thus further categorized into areas based on land cover. Category A areas consist primarily of wetland areas with extensive woody vegetation (i.e., treed swamps or thicket swamps). Category B areas are generally both open and terrestrial (e.g., agricultural fields or golf course). Category C areas are wooded and terrestrial (i.e., forested) (Figure 47).

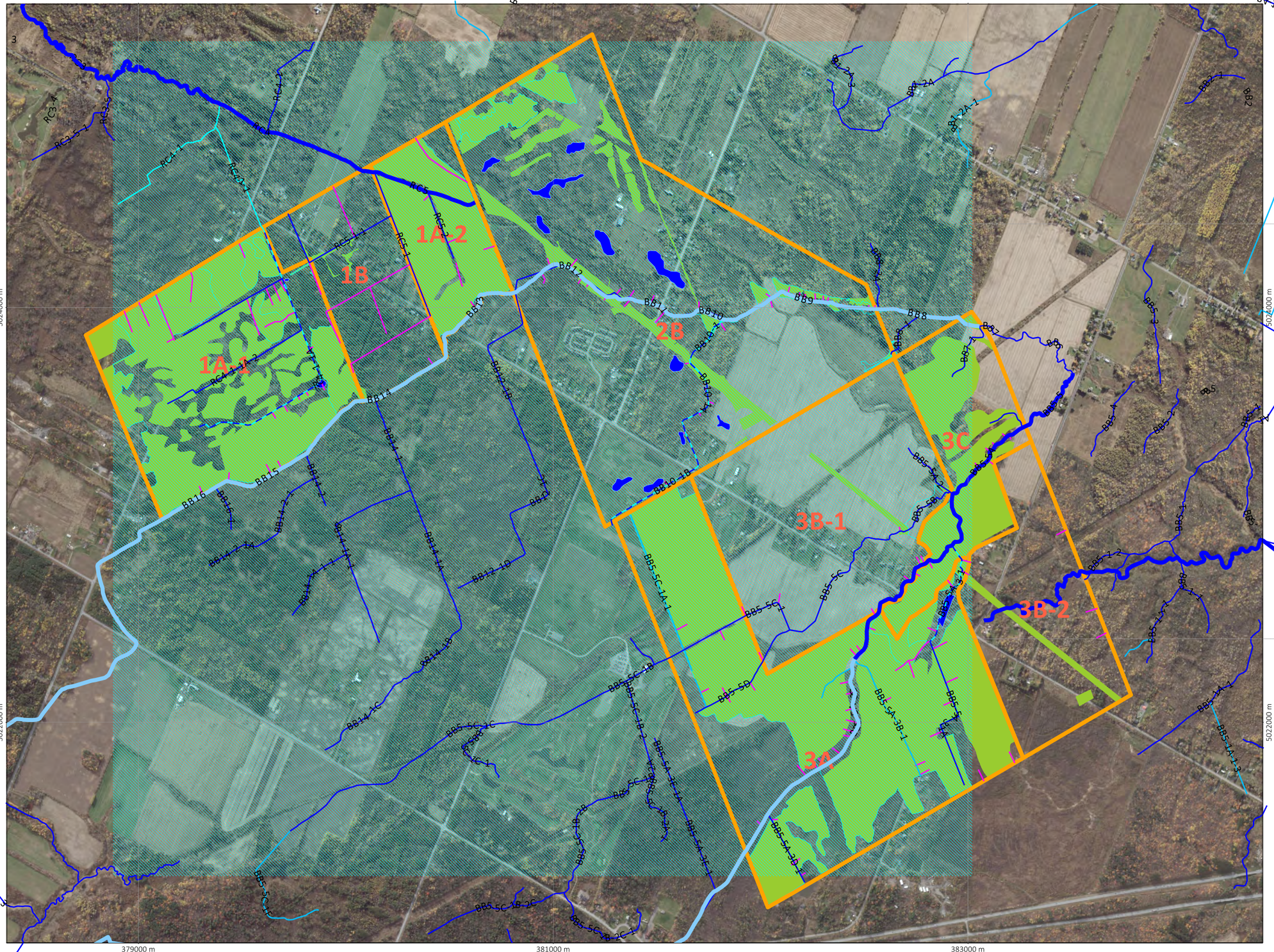
Block 1 in the northwest of the site includes extensive swamp areas on its west (Area 1A-1) and east (Area 1A-2) sides. A total of 23 small side channels were observed connecting to the major channels through Area 1A-1. These small headwater channels generally had wetted widths of 1 m or less at the peak of spring freshet but were dry by the end of May. These features are situated, however, within the broader surrounding wetland, effectively providing a contiguous, forested headwater area for the major channels located there. The small side channels correspond with more concentrated areas of spring runoff but do not provide additional fish habitat or water contributions outside of the freshet beyond those of the surrounding wetland fabric. Depths during the freshet were generally < 30 cm and were mostly due to backwater from the major channels, as flows were mostly negligible. Fish habitat through the area was limited to the Reach RC4-1-1A (Figure 47), which included several beaver dams that retained higher water levels within the channel than would otherwise likely be expected. Fish species occurring here are reviewed in Table 13.

Major channels within Area 1A-2 similarly have a broad, contiguous headwater area with their surrounding wetland. This area, however, generally lacks small side channels. The few small headwater features that do occur here were only wet during the spring freshet.

Area 1B in the center of Block 1 consists of active agricultural fields with almost no tree cover. Headwater channels here are long, linear drainage ditches, 2-3 m in width that convey spring runoff to major channels. Their maximum wetted depth in spring, however, was generally <15 cm. These features were all found to be dry by late May and are thus not considered to provide fish habitat and are considered ephemeral.

Area 2B comprises all of Block 2. Other than small residential properties located around the periphery, Area 2B consisted of the Anderson Links Golf course and adjacent agricultural fields. Banks along the major channels within Area 2B generally included narrow bands of trees and/or deciduous shrubs, but small headwater features along these corridors generally consisted of shallow swales from the adjacent fields, conveying spring meltwater runoff. These features were all fully dry by late May and, as such, none provided areas of additional fish habitat or more than ephemeral flows. Fish-bearing aquatic features within the area were limited to the Smith Gooding Municipal Drain and to Reach BB10-1 (Figure 47, and per Section 2.4.3.4).

Figure 47



Legend

HDFA "Areas"
Wooded (Trees and/or Shrubs)
Wetland

Municipal Drain
Natural Creek

Major Channels
- Intermitent
- Permanent
- Permanent (Fish Habitat)

Headwater Drainage Feature

N

0 — 1000 m

Project: 1199
Map File: TEWIN199- 2211d
MTM Zone 9
(NAD 83)
Printed on: 2022-12-08

Block 3 in the southeast of the site includes swamp areas along its south and west sides (Area 3A), with two large open agricultural fields (Areas 3B-1 and3B-2) on either side of a swath of terrestrial forest (Area 3C) in the northeast between the agricultural fields. A total of 43 small side channels were observed connecting to the major channels through Area 3A. These small headwater channels generally had wetted widths of 2 m or less at the peak of the spring freshet. Depths during the freshet were generally ≤15 cm but occasionally reached depths of 50 cm immediately beside the main channel where standing back water (i.e., from the major channels) could collect. Headwater channels were damp to dry by late May. These features are situated, however, within the broader surrounding wetland, effectively providing a contiguous, forested headwater area for the major channels located there. The small side channels correspond with more concentrated areas of spring runoff but do not provide additional fish habitat or water contributions outside of the freshet beyond those of the surrounding wetland fabric. Fish habitat through the area was limited to the Reach BB5-5A-3-1 and the Johnston Municipal Drain (Figure 47). Fish species occurring here are reviewed in Section 2.4.3.4.

Areas 3B-1 and 3B-2 consist of active agricultural fields with almost no tree cover. Headwater features here were limited to shallow channels/swales (i.e., having some, albeit limited bank structure) from the adjacent fields, conveying spring meltwater runoff. The channels had ephemeral hydrology with limited to negligible natural surrounding natural vegetation and provided no potential as fish habitat.

Headwater features within Area 3C were limited to two small side channels at the upstream-most end, and two more at the downstream end. The major watercourse through the area (i.e., the downstream reach of the Johnston Municipal Drain) was otherwise contained within its banks through the adjacent forest with no adjacent wetland or contributing lower-order channels. The adjacent forest cover would be anticipated to provide allochthonous inputs and general shading but does not appear to otherwise be a headwater source for the feature or to provide expanded areas of potential fish habitat.

2.4.3.2 Water Quality

Surface water chemistry and water quality data for the water samples collected on three occasions (spring, mid-summer, and fall) during the 2022 field study can be found in Appendix B. Water quality data collected by SNC from 1998 to 2021 is also provided in Appendix B. Surface water chemistry and quality data for Bear Brook and its tributaries are discussed in this section while water chemistry and quality data for Ramsay Creek are discussed in Section 3.4.1. Water sampling stations are shown on Figure 5.

Water collected from tributaries in the Tewin lands is hard (120 to 180 mg/L $CaCO_3$) to very hard (> 180 mg/L; Appendix B). The hardest surface waters were collected from the Johnston Municipal Drain at S13 and a tributary to Bear Brook in the southern lands at S14: both had average hardness levels of ~ 400 to 450 mg/L.

The average pH values for all sites fell within the PWQO range (between 6.5 and 8.5). Some water samples adjacent to Boundary Road collected by SNC in 2007 had low pH values (4.1 ± 0.03, ±SD, n=8) below the PWQO range. These values were likely errors.

Dissolved oxygen concentrations for all sites (except Bear Brook tributary at Hall Road) were on average above the PWQO value (4 mg/L). Dissolved oxygen levels generally were highly variable, ranging from near the guideline to about 12 mg/L. Levels in the Bear Brook tributary at Hall Road were consistently below the guideline, while samples from S1, S2, S4, S8, S9, S13, and S14 were sometimes below the guideline.

Most of the water samples that were below the PWQO value for dissolved oxygen were collected in the summer months (July and August).

The following chemical elements had concentrations above their respective PWQO:

- Total phosphorus (99% of the water samples collected);
- Total iron (85% of the water samples collected);
- Total chromium (58% of the water samples collected);
- Total cadmium (57% of the water samples collected);
- Total silver (32% of the water samples collected);
- Total cobalt (24% of the water samples collected);
- Total thallium (21% of the water samples collected); and,
- Total copper (18% of the water samples collected) (Appendix B).

Total phosphorus concentrations detected in the water samples from Bear Brook and its tributaries in or nearby the Tewin Lands were elevated and historically exceeded the interim PWQO value for streams (0.03 mg/L; Appendix B). This is most likely caused by the influence of agricultural fields in the surrounding area which are known to be major source of phosphorus to waterbodies (Riemersma et al. 2006). In addition to high hardness, the S13 (0.72 ± 0.93 mg/L; ±SD, n=3) and S14 (0.56 ± 0.94 mg/L; ±SD, n=3) sites had the highest total phosphorus concentrations among the tributaries sampled (Appendix B). Both sites are located just downstream of an agricultural field (Figure 5, Figure 48). Total phosphorus concentrations detected in the other water samples collected from the Bear Brook watershed were not as elevated as in S13 and S14, but still exceeded the PWQO, with S9 being the next most enriched site (0.24 ± 0.33 mg/L; ±SD, n=3; 12 times higher than the PWQO value) and S4 being the least phosphorus enriched site (0.06 ± 0.01 mg/L; ±SD, n=3; 3 times higher than the PWQO value).

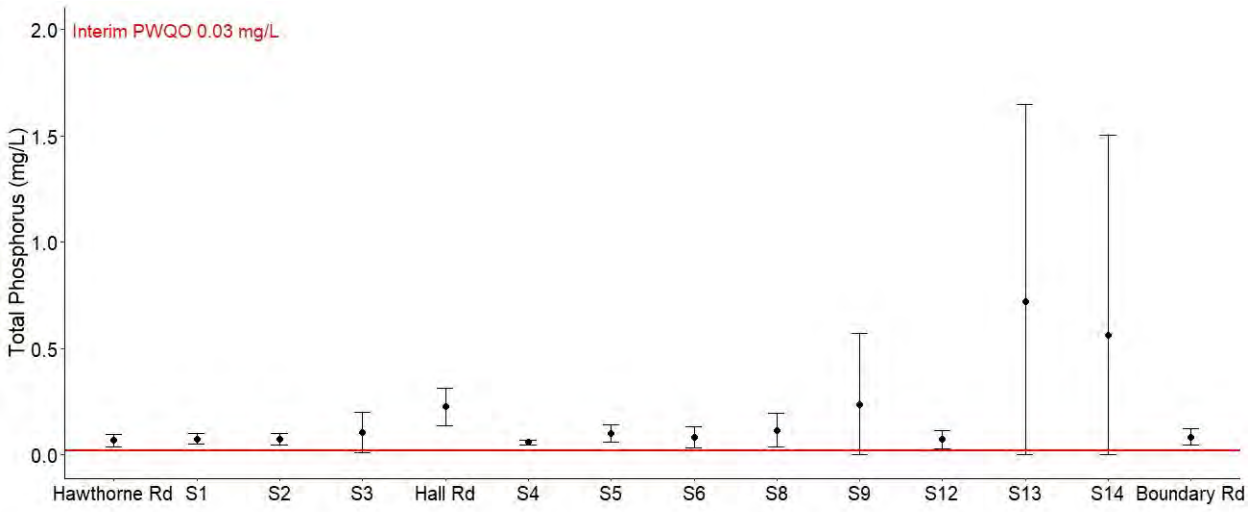


Figure 48 Total phosphorus concentrations in the water samples collected within and downstream of the Tewin Lands. Red horizontal line depicts the interim PWQO value (0.03 mg/L) for Total Phosphorus. The whiskers depict the standard deviation

Total iron concentrations measured in or nearby the Tewin Lands generally exceeded the PWQO value (0.3 mg/L; Appendix B). Total Iron concentrations were highest in the samples from Hall Road collected by SNC (3.04 ± 1.41 mg/L; ±SD, n=5), followed by S14 (2.57 ± 4.29 mg/L; ±SD, n=3), S9 (1.53 ± 2.20 mg/L; ±SD, n=3), and S13 (1.12 ± 0.67 mg/L; ±SD, n=3).

Total chromium concentrations detected for most of the sites in or nearby the Tewin Lands were just above the PWQO value for Chromium (VI) (0.001 mg/L; Appendix B). The hexavalent speciation of Chromium (i.e., Chromium [VI]) is much more toxic than Chromium (III) (Katz and Salem, 1993), and since the Tewin Lands water samples were analyzed for total chromium, chromium concentrations were compared to the chromium (VI) PWQO value to be conservative. Seven of the sites associated with Bear Brook (Boundary Road collected by SNC, S5, S14, S6, S12, S13, and Hawthorne Road collected by SNC) on average exceeded the PWQO value for chromium (VI) while three sites associated with Bear Brook (S1, S3, and S4) on average had Total Chromium concentrations equal to the PWQO value.

Total cadmium concentrations detected in the water samples were for the most part below the interim PWQO value (0.00050 mg/L when hardness is above 100 mg/L as $CaCO_3$, which was the case for the water collected from the Tewin Lands; Appendix B). Only water samples collected adjacent to Hawthorne Road by SNC (0.00073 ± 0.00026 mg/L; ±SD, n=11) surpassed the PWQO value. Similarly, total silver and thallium concentrations were low across all sites except in the water collected adjacent to Boundary Road (0.0063 ± 0.0332 mg/L and 0.0015 ± 0.0024 mg/L; ±SD, n=83 and n=100, respectively) and Hawthorne Road (0.00077 ± 0.00026 mg/L and 0.00077 ± 0.00026 mg/L, respectively; ±SD, n=11) by SNC, where the PWQO values (0.0001 and 0.0003 mg/L, respectively) were surpassed.

Total cobalt concentrations in the water in or around the Tewin lands were relatively low (Appendix B). Only water collected adjacent from Hawthorn Road by SNC (0.0039 ± 0.0013 mg/L; ±SD, n=11), S13

(0.0032 ± 0.0042 mg/L; ±SD, n=3), adjacent to Hall Road by SNC (0.0012 ± 0.0000 mg/L; ±SD, n=5), and S14 (0.0009 ± 0.0014 mg/L; ±SD, n=3) on average exceeded the interim PWQO value (0.0009 mg/L).

Only a few individual water samples collected adjacent to Hawthorne Road and Boundary Road surpassed the interim PWQO value for copper (0.005 mg/L when hardness is above 20 mg/L as $CaCO_3$; which was the case for the water collected from the Tewin Lands). However, total copper concentrations in the water adjacent to Hawthorne Road and Boundary Road (0.0042 ± 0.0029 mg/L and 0.0039 ± 0.0013 mg/L; ±SD, n=11 and n=182, respectively) were on average below the PWQO value (Appendix B).

Given that the water quality of the watercourses surveyed within the Bear Brook Watershed do not meet the PWQO, MOEE (1994a) Policy 2 would apply.

2.4.3.3 Thermal Characterization of Watercourses

Figure 49 is an example nomogram, or plot of maximum water temperature in relation to maximum air temperature during a heat wave. The nomogram enables the classification of thermal status per Chu et al. (1999). Nomograms for water temperatures for all the Bear Brook sites can be found in Appendix B, while Table 5 summarizes the temperature of the sampled watercourses in or around the Tewin Lands.

From the water temperature data, it appears that the S9 site (located in the Bear Brook Municipal Drain adjacent to Hall Road; Figure 5) had gone dry or almost dry through July and August of 2022 as the temperature loggers were never completely submerged in the water. No conclusions can therefore be made on the thermal regime in S9. Additionally, temperature loggers were only fully submerged for a few days in July and August in S3 (a tributary of Bear Brook; five days) as well as S8 and S13 (Johnston Municipal Drain; two days for both sites), suggesting that these sites are intermittent watercourses and do not provide suitable habitat for fish throughout the summer months. However, when the loggers were fully submerged, all three watercourses are characterized as cool-warm water systems. The nomograms created for S1, S12, and S14 reveal that these watercourses are cool-warm water systems, while the nomograms created for S2, S4, S5, and S6 suggest that these watercourses are warmwater systems (Appendix B).

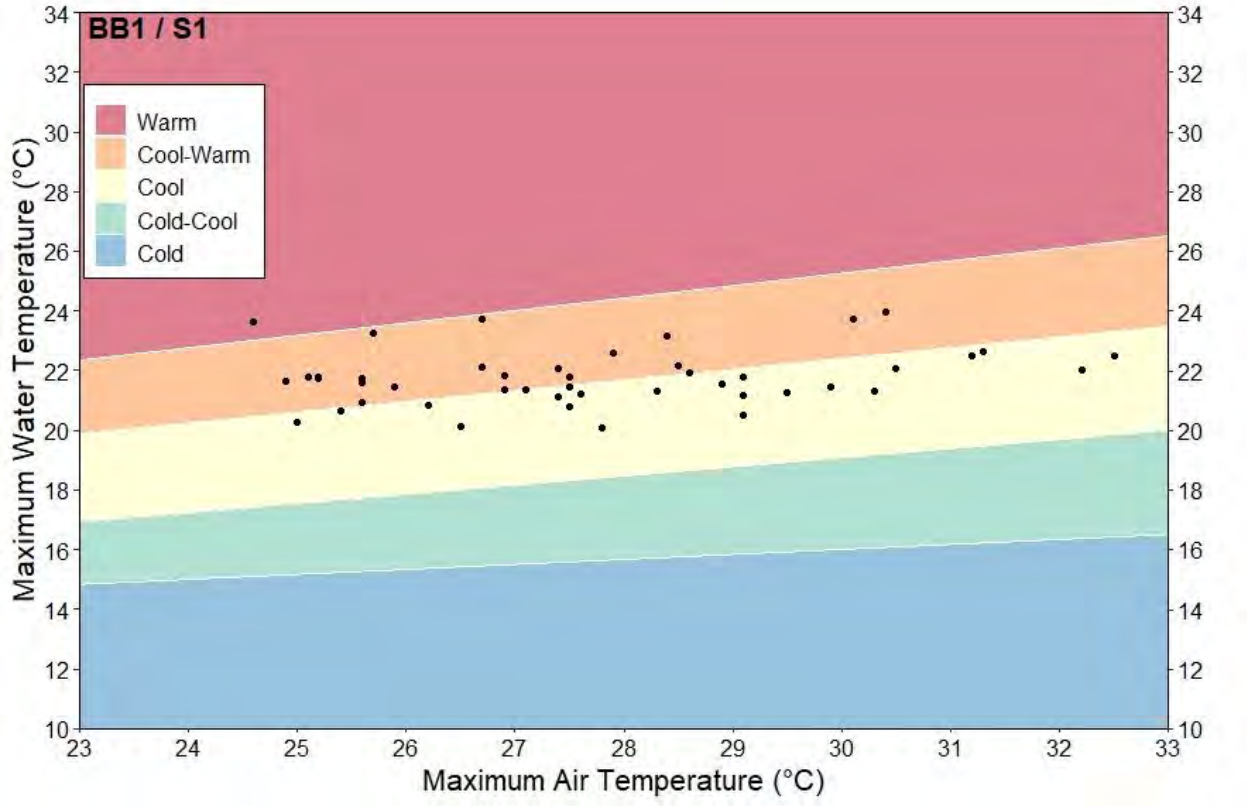


Figure 49 Nomogram for the S1 section of Bear Brook

Table 5 Inferred thermal regimes for the watercourses sampled in the Bear Brook watershed based on nomograms

Site	Sample Size (Days)	Min Water Temperature from July to August (°C)	Max Water Temperature from July to August (°C)	Temperature Regime
S1	47	20.09	23.95	Cool-Warm
S2	43	19.34	28.07	Warm
S3	5	20.99	23.52	Cool-Warm
S4	48	21.02	26.16	Warm
S5	33	20.98	28.39	Warm
S6	45	20.91	28.23	Warm
S8	2	21.24	21.41	Cool-Warm
S9	—	—	—	—
S12	48	19.66	24.35	Cool-Warm
S13	2	20.14	21.95	Cool-Warm
S14	47	15.76	25.51	Cool-Warm

2.4.3.4 Benthic Community Assessment

Benthic community assessments were conducted to provide insight into the overall condition of aquatic habitat within the study area directly in relation to watershed more broadly.

Physio-chemical Conditions of the Surveyed Watercourses

Water temperatures recorded during the benthic community assessments conducted in 2022 within the Tewin Lands ranged from 7.1 to 9.1 °C (Table 6). The pH values of the surveyed watercourses were on average 6.9 ± 0.11 (±SD, n=5) while the dissolved oxygen and specific conductivity ranged from 1.9 mg/L to 9.1 mg/L and 822 to 971 µS/cm, respectively. Physio-chemical conditions recorded during the benthic community assessments conducted by SNC were not provided.

Table 6 Water quality recorded at the benthic community sample stations within the Tewin Lands, November 2022

Sample Station	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)
S2-B	7.06	6.83	8.20	893
S8-B	8.32	6.85	2.12	822
S9-B	8.87	6.99	3.13	851
S13-B	9.07	7.08	1.88	971
S14-B	8.42	6.82	9.13	937

Benthic Community Composition

Benthic community sampling was carried out by SNC from 2019 to 2021 and by KAL on November 1, 2022, at four stations within the Tewin Lands (Figure 6), one of which was surveyed twice in two different years. Additionally, SNC and KAL collected benthic community samples at seven stations upstream (two of which were surveyed in two different years) and seven stations downstream (one of which was surveyed in three difference years) of the Tewin Lands (Figure 6). A total of 27,380 organisms were identified to the lowest practicable level, belonging to 49 taxonomic families. Some individuals could only be identified to either the taxonomic phylum (one), class (two), subclass (two), order (eleven), or suborder (one). 30 taxonomic families were identified within, upstream, and downstream of the Tewin Lands. Additionally, 9 taxonomic orders (not identified to the taxonomic family) were also identified. From the four samples collected within the Tewin Lands (Table 7), 42 taxonomic families were identified as well as organisms belonging to one taxonomic order and one taxonomic class. Total numbers of benthic invertebrates collected in the assessed watercourses within the Tewin Lands varied between 356 (S6-B - UB102147) and 2,325 (S4-B - UB11715) per station, with an average of 1512 ± 833 (±SD, n=4) organisms (see Appendix H).

A total of 61 taxonomic families were identified in the surveyed watercourses upstream and downstream of the Tewin Lands, three of which not occurring within the Tewin Lands. There were 44 taxonomic families in the surveyed watercourses upstream of the Tewin Lands while 52 taxonomic families downstream of the Tewing Lands. Of the 61 taxonomic families identified, 38 of these were identified in both the watercourses upstream and downstream of the Tewin Lands. Total numbers of benthic invertebrates collected in the assessed watercourses upstream of the Tewin Lands varied between 343 (SBB_Davidson) and 1,648 (UB092158) organisms per station, with an average of 882 ± 621 (±SD, n=9) organisms (Appendix I). Total numbers of benthic in invertebrates collected in the assessed watercourses downstream of the Tewin Lands were much more abundant and varied between 65 (S2-B) and 3,180

(UB08644) organisms per station, with an average of 1,477 ± 1,291 (±SD, n=9) organisms (Appendix I). The relative abundance of taxa representing the benthic communities of the surveyed watercourses are provided in Table 7, Table 8, and Table 9.

Within the Tewin Lands, the benthic communities were dominated by isopod crustaceans (Asellidae family), ranging from 1.3% (S4-B - UB11715) to 29.5% (S6-B - UB102147) of the total abundance across samples. Midges (Chironomidae family) were the second most abundant taxa identified within the Tewin Lands, ranging from 8.9% (S5-B - UB02731) to 18.5% (S6-B - UB102147). Midges are known to be tolerant to pollution and high abundance of these organisms can be indicative of a system with degraded conditions. The third most abundant taxa were riffle beetles (Elmidae family), ranging from 3.7% (S4 - SBB_FW/Piperville) to 16.6% (S4-B - UB11715) of the total abundance. The proportion of permanent aquatic organisms for the watercourses ranged from 52.7% (S4-B - UB11715) to 79.2% (S6-B - UB102147) indicating that all surveyed watercourses within the Tewin Lands are permanent watercourses. The benthic community assessments produced benthic communities typical for freshwater ecosystems and the Tewin Lands were numerically dominated by insects (Insecta order) and crustaceans (Malacostraca order). The identified benthic macroinvertebrates are tolerant to warm water systems.

Upstream of the Tewin Lands, the benthic communities were dominated by midges (Chironomidae family), ranging from 2.6% (S12-B - UB042156) to 42.6% (SBB_Davidon) of the total abundance across samples, indicating potential environmental degradation. The second most dominant taxa were riffle beetles (Elmidae family) ranging from 0% (not present in S8-B and S13-B) to 31.3% (S12-B - UB042156 in 2021) of the total abundance, while the third most dominant taxa were clams (Sphaeriidae family) ranging from 0% (not present in S8-B and S13-B) to 42.6% (UB122145) of the total abundance across samples. The surveyed watercourses upstream of the Tewin Lands were dominated by insects (Insecta order) followed by crustaceans (Malacostraca order), and mussels (Bivalvia class). The proportion of permanent aquatic organisms ranged from 41.5% (UB092158) to 92.6% (UB122145) indicating that all surveyed watercourses upstream of the Tewin Lands are permanent watercourses. The benthic community assessments produced benthic communities typical for freshwater ecosystems.

Downstream of the Tewin Lands, the benthic communities were dominated by midges (Chironomidae family), ranging from 1.1% (UB13643 in 2021) to 40.0% (S2-B) of the total abundance across samples. The relatively high proportion of midges in the benthic community is indicative that these systems might be subjected to degraded environmental conditions. The second most dominant taxa were squaregill mayflies (Caenidae family) ranging from 0% (not present in S2-B, S9-B, and S14-B) to 21.6% (UB13643 in 2020) of the total abundance across samples, while the third most abundant taxa were riffle beetles (Elmidae family) ranging from 0% (not present in S2-B, S3-B, S9-B, and S14-B) to 30.1% (UB13643 in 2021) of the total abundance. The surveyed watercourses downstream of the Tewin lands were mainly dominated by insects (Insecta order) followed by snails (Gastropoda order) and crustaceans (Malacostraca order); benthic communities typical for freshwater ecosystems. The proportion of permanent aquatic organisms ranged from 33.8 (S2-B) to 93.2% (S9-B) indicating that all surveyed watercourses upstream of the Tewin Lands are permanent watercourses. The identified benthic macroinvertebrates are tolerant to warm water systems but Stoneflies (Plecoptera family) identified at S2-B (a section of Bear Brook adjacent to Piperville Road) are an indication of cold-water implications to the watercourse. Stoneflies were not identified in any other surveyed watercourses within, upstream, nor downstream of the Tewin Lands.

Table 7 Relative (percent) abundance of benthic families collected from the surveyed watercourses in the Tewin Lands

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	S4 (UB11715)	S4-B (SBB_FW/Piperville)	S5-B (UB02731)	S6-B (UB102147)
						2020	2021	2020	2020
Annelida	Clitellata	Hirudinea	—	—	—	0	0.1	0.1	0.3
Annelida	Clitellata	Oligochaeta	—	—	—	1.2	1.1	2.7	18
Arthropoda	Arachnida	—	Trombidiformes	—	Hydrachnidae	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	—	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Crangonyctidae	0.3	0.1	0.1	1.7
Arthropoda	Malacostraca	—	Amphipoda	—	Gammaridae	4.6	22.5	14.1	0
Arthropoda	Malacostraca	—	Amphipoda	—	Hyalillidae	1.2	0	0	2.5
Arthropoda	Malacostraca	—	Decapoda	—	—	0	0.1	0.1	0.6
Arthropoda	Malacostraca	—	Isopoda	—	—	0	0	0	0
Arthropoda	Malacostraca	—	Isopoda	Asellota	Asellidae	1.3	16.4	19.6	29.5
Arthropoda	Insecta	—	Coleoptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	—	Chrysomelidae	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Dytiscidae	0	0.8	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Elmidae	16.6	3.7	14.1	13.2
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Dryopidae	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Gyrinidae	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Haliplidae	0.1	0.1	0	1.1
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Hydrophilidae	0	0	0.1	0
Arthropoda	Insecta	—	Ephemeroptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pannota	Caenidae	7.7	17.1	4.3	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Baetidae	1.8	0	0	0.3
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Heptageniidae	0.4	0	0	0
Arthropoda	Insecta	—	Ephemeroptera	Schistonota	Ephemeridae	0	0	0.1	0
Arthropoda	Insecta	—	Diptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Empididae	0	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Stratiomyidae	0	0	0.1	0
Arthropoda	Insecta	—	Diptera	Nematocera	Ceratopogonidae	4	3.3	2.1	0
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	10.2	17.1	8.9	18.5
Arthropoda	Insecta	—	Diptera	Nematocera	Psychodidae	0	0	0.9	0.6
Arthropoda	Insecta	—	Diptera	—	Culicidae	0	0	0	0.3
Arthropoda	Insecta	—	Diptera	—	Ephydridae	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Simuliidae	3.9	0	0.9	0
Arthropoda	Insecta	—	Diptera	—	Tabanidae	0	0.1	0.3	0
Arthropoda	Insecta	—	Diptera	—	Tipulidae	0.3	0.5	1.4	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Belostomatidae	0.1	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Corixidae	12.8	0.7	4.1	4.2
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Mesoveliidae	0.1	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Notonectidae	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Hydrometridae	0	0	0	0

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	S4 (UB11715)	S4-B (SBB_FW/Piperville)	S5-B (UB02731)	S6-B (UB102147)
						2020	2021	2020	2020
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Naucoridae	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Veliidae	0	0	0.1	0
Arthropoda	Insecta	—	Hemiptera	—	Pleidae	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Lepidoptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Megaloptera	—	Sialidae	0.3	0.1	0.1	0
Arthropoda	Insecta	—	Odonata	Zygoptera	—	0	0	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	Coenagrionidae	1.9	0	0	0.3
Arthropoda	Insecta	—	Odonata	Zygoptera	Lestidae	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Aeshnidae	0.3	0.1	0	0
Arthropoda	Insecta	—	Odonata	—	Calopterygidae	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Corduliidae	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Libellulidae	0.1	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Capniidae	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Taeniopterygidae	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	—	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Hydropsychidae	16.1	0.3	14.3	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Polycentropodidae	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Integripalpia	Lepidostomatidae	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Spicipalpia	Hydroptilidae	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Leptoceridae	0	0	0.4	0
Arthropoda	Insecta	—	Trichoptera	—	Limnephilidae	0	0	0.1	0
Arthropoda	Insecta	—	Trichoptera	—	Phryganeidae	0.3	0.4	0.8	0.3
Mollusca	Gastropoda	—	—	—	—	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Architaenioglossa	—	Viviparidae	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Amnicolidae	2.4	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Hydrobiidae	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Neotaenioglossa	—	Bithyniidae	0	0	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Lymnaeidae	1	0	0.7	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Physidae	2	5.5	3.2	1.4
Mollusca	Gastropoda	—	Heterostropha	—	Valvatidae	0.7	0	0	0
Mollusca	Gastropoda	—	Basommatophora	—	Planorbidae	1	3.8	0.6	0.3
Mollusca	Bivalvia	—	—	—	—	0	0	0	0
Mollusca	Bivalvia	—	Unionida	—	Unionidae	0	0.1	0.1	0
Mollusca	Bivalvia	—	Sphaeriida	—	Sphaeriidae	7.2	6.1	5.7	7
Nematoda	—	—	—	—	—	0	0	0	0
Proportion of Aquatic Organism						**52.7**	**60.8**	**65.2**	**79.2**
Number of Taxa (Order & Family)						**33**	**23**	**29**	**18**

Table Notes: The sample IDs in parentheses represents the benthic community samples collected by SNC.
* Permanent aquatic organisms include: Amphipoda (side-swimmers), Bivalvia (molluscs), Coleoptera (beetles), Gastropoda (snails), Hemiptera (true bugs), Hirudinea (leeches), Hydracarina (water mites), Isopoda (sow bugs), and Oligochaeta (aquatic earthworms).

Table 8 Relative (percent) abundance of benthic families collected from the surveyed watercourses upstream of the Tewin Lands

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	UB122145 – Smith Gooding MD	SBB_Davidson – Smith Gooding MD	UB092158 – Smith Gooding MD	UB092158 – Smith Gooding MD	S5-B (SBB_FW/Thunder)	S8-B	S12-B (UB042156)	S12-B (UB042156)	S13-B
						2022	2023	2020	2021	2021	2022	2020	2021	2022
Annelida	Clitellata	Hirudinea	—	—	—	0.1	0	0	0.2	0.1	0	0.1	0.2	0
Annelida	Clitellata	Oligochaeta	—	—	—	0.5	0	2.5	2	0.3	11.9	2.9	4.2	7.5
Arthropoda	Arachnida	—	Trombidiformes	—	Hydrachnidae	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Crangonyctidae	0.3	0	0.1	0.1	0	0	0.7	1	0
Arthropoda	Malacostraca	—	Amphipoda	—	Gammaridae	0	0.3	30	0.2	7.5	0	2.7	5.3	0
Arthropoda	Malacostraca	—	Amphipoda	—	Hyalillidae	0	0	8.7	2	0.5	0	0.1	0	0
Arthropoda	Malacostraca	—	Decapoda	—	—	0	0	0	0.2	0.1	0	0.3	0.1	0
Arthropoda	Malacostraca	—	Isopoda	—	—	0	0	0	0	0	17.8	0	0	0
Arthropoda	Malacostraca	—	Isopoda	Asellota	Asellidae	16.7	7.6	6.6	4.7	9.8	0	15.3	16.9	0
Arthropoda	Insecta	—	Coleoptera	—	—	0	0	0	0	0	9.9	0	0	7.5
Arthropoda	Insecta	—	Coleoptera	—	Chrysomelidae	0	0	0	0	0	0	0	0.1	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Dytiscidae	3.6	0	0.1	0.2	0	0	0.7	0.1	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Elmidae	0.2	1.7	6.6	29.2	9.6	0	14	31.3	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Dryopidae	0	0	0	0	0	0	0.1	0.4	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Gyrinidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Haliplidae	0.5	0.3	1.5	0	0	0	0.4	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Hydrophilidae	0.1	0	0.1	0	0	0	0.1	0	0
Arthropoda	Insecta	—	Ephemeroptera	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pannota	Caenidae	0	0	24.9	35.6	6.9	0	1.5	0.2	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Baetidae	1.4	0	1.6	0.1	0	0	0.1	0.1	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Heptageniidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Ephemeroptera	Schistonota	Ephemeridae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Empididae	0	0	0	0	0	0	0	0.4	0
Arthropoda	Insecta	—	Diptera	Brachycera	Stratiomyidae	0.2	0	0.1	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	Nematocera	Ceratopogonidae	0	0	3	2.3	3.8	0	0	0.9	0
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	3.1	42.6	11.8	19.8	44.6	56.4	37.3	2.6	12.5
Arthropoda	Insecta	—	Diptera	Nematocera	Psychodidae	0	0	0	0	0.1	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Culicidae	0	0	0.1	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Ephydridae	0	0	0	0.1	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Simuliidae	0	0	0	0	0	0	3.8	2.2	0
Arthropoda	Insecta	—	Diptera	—	Tabanidae	0	0.3	0	0	0	0	0.1	0.1	0
Arthropoda	Insecta	—	Diptera	—	Tipulidae	0	0.3	0	0	0.1	0	0.2	5.8	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Belostomatidae	0	0	0.3	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Corixidae	0	0	0.1	0.5	0.1	0	1.3	0.3	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Mesoveliidae	0	0	0	0.1	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Notonectidae	0	0	0	0.1	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Hydrometridae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Naucoridae	0	0	0	0	0	0	0	0	0

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	UB122145 – Smith Gooding MD	SBB_Davidson – Smith Gooding MD	UB092158 – Smith Gooding MD	UB092158 – Smith Gooding MD	S5-B (SBB_FW/Thunder)	S8-B	S12-B (UB042156)	S12-B (UB042156)	S13-B
						2022	2023	2020	2021	2021	2022	2020	2021	2022
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Veliidae	0	0	0	0	0	0	0.1	0	0
Arthropoda	Insecta	—	Hemiptera	—	Pleidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Lepidoptera	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Megaloptera	—	Sialidae	0	0	0	0.2	0.1	0	0	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	—	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	Coenagrionidae	0	0	0.7	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	Lestidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Aeshnidae	0	0.6	0.1	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Calopterygidae	0	0	0	0	0	0	0.3	0.1	0
Arthropoda	Insecta	—	Odonata	—	Corduliidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Libellulidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Capniidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Taeniopterygidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	—	0	0	0	0	0	1	0	0	7.5
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Hydropsychidae	0.5	0.6	0.1	0.1	0	0	3	14.3	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Polycentropodidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Integripalpia	Lepidostomatidae	0	0	0	0	0	0	2.5	0	0
Arthropoda	Insecta	—	Trichoptera	Spicipalpia	Hydroptilidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Leptoceridae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Limnephilidae	1.3	0	0	0	0	0	0	0.6	0
Arthropoda	Insecta	—	Trichoptera	—	Phryganeidae	0.9	0.6	0.2	0.1	0	0	1.9	0.8	0
Mollusca	Gastropoda	—	—	—	—	0	0	0	0	0	1	0	0	17.5
Mollusca	Gastropoda	Caenogastropoda	Architaenioglossa	—	Viviparidae	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Amnicolidae	0.1	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Hydrobiidae	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Neotaenioglossa	—	Bithyniidae	6	6.4	0.3	0.7	0	0	0	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Lymnaeidae	19.6	0.9	0.2	1.2	0.1	0	1.4	0.6	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Physidae	1.6	0.6	0	0	1.6	0	5.2	7.9	0
Mollusca	Gastropoda	—	Heterostropha	—	Valvatidae	0	0	0.1	0.2	0	0	0	0	0
Mollusca	Gastropoda	—	Basommatophora	—	Planorbidae	0.7	3.2	0	0	5.7	0	1.5	0	0
Mollusca	Bivalvia	—	—	—	—	0	0	0	0	0	1	0	0	47.5
Mollusca	Bivalvia	—	Unionida	—	Unionidae	0	0	0	0	0.3	0	0.1	0	0
Mollusca	Bivalvia	—	Sphaeriida	—	Sphaeriidae	42.6	34.1	0.6	0.4	8.5	0	2.3	3.8	0
Nematoda	—	—	—	—	—	0	0	0	0	0	1	0	0	0
Proportion of Aquatic Organism						**92.6**	**55.1**	**57.6**	**41.5**	**44.2**	**41.6**	**49.0**	**72.0**	**80.0**
Number of Taxa (Order & Family)						**20**	**15**	**25**	**24**	**19**	**8**	**29**	**26**	**6**

Table Notes: The sample IDs in parentheses represents the benthic community samples collected by SNC.
* Permanent aquatic organisms include: Amphipoda (side-swimmers), Bivalvia (molluscs), Coleoptera (beetles), Gastropoda (snails), Hemiptera (true bugs), Hirudinea (leeches), Hydracarina (water mites), Isopoda (sow bugs), and Oligochaeta (aquatic earthworms).

Table 9 Relative (percent) abundance of benthic families collected from the surveyed watercourses downstream of the Tewin Lands

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	UB13643 – South Bear Brook	UB13643 – South Bear Brook	UB13643 – South Bear Brook	UB08644 – South Bear Brook	UB063142 – South Bear Brook	S2-B	S3-B (UB143004)	S9-B	S14-B
						2019	2020	2021	2020	2021	2022	2020	2022	2022
Annelida	Clitellata	Hirudinea	—	—	—	0	0.1	0	0	0.1	0	0.2	1.9	0
Annelida	Clitellata	Oligochaeta	—	—	—	2.9	0.3	0.1	0.6	0.4	13.8	3.2	15.5	8.4
Arthropoda	Arachnida	—	Trombidiformes	—	Hydrachnidae	0	0	0	0	0	1.5	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	—	0	0	0	0	0	1.5	0	4.9	1.9
Arthropoda	Malacostraca	—	Amphipoda	—	Crangonyctidae	0.5	0.1	0	0	0	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Gammaridae	5.6	9.6	20.7	5.8	1.2	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Hyalillidae	0.2	0	1.8	2.6	0.6	0	1	0	0
Arthropoda	Malacostraca	—	Decapoda	—	—	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	—	Isopoda	—	—	0	0	0	0	0	1.5	0	0	0
Arthropoda	Malacostraca	—	Isopoda	Asellota	Asellidae	4.1	19.4	5.5	2.4	0	0	2.3	0	0
Arthropoda	Insecta	—	Coleoptera	—	—	0	0	0	0	0	7.7	0	1	2.8
Arthropoda	Insecta	—	Coleoptera	—	Chrysomelidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Dytiscidae	0	0.5	0	0	0.1	0	0.8	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Elmidae	10	6.1	30.1	16.8	13.4	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Dryopidae	0	0.1	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Gyrinidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Haliplidae	0	0	1.7	0.4	2.7	0	10	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Hydrophilidae	0	0	0	0	0	0	1.8	0	0
Arthropoda	Insecta	—	Ephemeroptera	—	—	0	0	0	0	0	9.2	0	0	16.8
Arthropoda	Insecta	—	Ephemeroptera	Pannota	Caenidae	19.7	21.6	17.4	14.6	10.6	0	0.5	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Baetidae	0	0.4	0.7	1.8	1.9	0	15.8	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Heptageniidae	0	0.04	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Ephemeroptera	Schistonota	Ephemeridae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	—	0	0	0	0	0	3.1	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Empididae	0.4	0	0.5	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Stratiomyidae	0.1	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	Nematocera	Ceratopogonidae	7.7	4.9	3.3	5.2	9	0	9.8	0	12.1
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	15.2	13.9	1.1	25.8	11.4	40	23.8	5.8	15
Arthropoda	Insecta	—	Diptera	Nematocera	Psychodidae	2.7	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Culicidae	0	0	0	0	0	0	3	0	0
Arthropoda	Insecta	—	Diptera	—	Ephydridae	0	0	0	0	0.1	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Simuliidae	0	0.1	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Tabanidae	0.5	0.2	0	0.1	0.3	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Tipulidae	2	0.2	0	1.1	0.1	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Belostomatidae	0	0	0.2	0	0	0	1.7	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Corixidae	0	0	0	0.1	0	0	1.7	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Mesoveliidae	0	0	0.1	0.5	0	0	1.8	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Notonectidae	0	0	0	0	0	0	1.3	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Hydrometridae	0	0	0	0	0	0	0.2	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Naucoridae	0	0	0	0	0	0	0.3	0	0

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	UB13643 – South Bear Brook	UB13643 – South Bear Brook	UB13643 – South Bear Brook	UB08644 – South Bear Brook	UB063142 – South Bear Brook	S2-B	S3-B (UB143004)	S9-B	S14-B
						2019	2020	2021	2020	2021	2022	2020	2022	2022
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Veliidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	—	Pleidae	0	0	0	0	0.1	0	6.5	0	0
Arthropoda	Insecta	—	Hemiptera	—	—	0	0	0	0	0	6.2	0	0	0
Arthropoda	Insecta	—	Lepidoptera	—	—	0	0	0	0	0	1.5	0	0	0
Arthropoda	Insecta	—	Megaloptera	—	Sialidae	0	0	0.2	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	—	0	0	0	0	0	1.5	0	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	Coenagrionidae	0	0.7	1.9	3.5	8.1	0	3	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	Lestidae	0	0	0	0	0.1	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Aeshnidae	0.1	0.3	0.1	0.1	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Calopterygidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Corduliidae	0	0	0.1	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Libellulidae	0	0	0	0.2	0.4	0	1.8	0	0
Arthropoda	Insecta	—	Plecoptera	—	—	0	0	0	0	0	1.5	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Capniidae	0.1	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Taeniopterygidae	0.2	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	—	0	0	0	0	0	7.7	0	0	1.9
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Hydropsychidae	8.9	1.1	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Polycentropodidae	0	0	0.7	0.2	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Integripalpia	Lepidostomatidae	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Spicipalpia	Hydroptilidae	0	0	0	0.7	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Leptoceridae	0	0.3	6.1	2.6	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Limnephilidae	2.6	0.2	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Phryganeidae	0.5	2.1	0.1	0.6	0	0	0.2	0	0
Mollusca	Gastropoda	—	—	—	—	0	0	0	0	0	3.1	0	68	38.3
Mollusca	Gastropoda	Caenogastropoda	Architaenioglossa	—	Viviparidae	0	0	0	0	0.1	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Amnicolidae	2.4	1.8	0.9	7.1	6.4	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Hydrobiidae	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Neotaenioglossa	—	Bithyniidae	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Lymnaeidae	0.4	2.6	0.2	0.1	2	0	2.3	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Physidae	0	0.4	0.8	0.3	1	0	0.2	0	0
Mollusca	Gastropoda	—	Heterostropha	—	Valvatidae	0	0	0.8	1.9	27.9	0	0	0	0
Mollusca	Gastropoda	—	Basommatophora	—	Planorbidae	6.6	4.8	0.6	0.8	0.2	0	6.8	0	0
Mollusca	Bivalvia	—	—	—	—	0	0	0	0	0	0	0	1.9	0
Mollusca	Bivalvia	—	Unionida	—	Unionidae	0	0	0.1	0	0	0	0	0	0
Mollusca	Bivalvia	—	Sphaeriida	—	Sphaeriidae	6.7	7.8	4.3	4	2.1	0	0	0	0
Nematoda	—	—	—	—	—	0	0	0	0	0	0	0	1	2.8
Proportion of Aquatic Organism						**39.3**	**53.9**	**67.8**	**43.5**	**58.2**	**33.8**	**42.1**	**93.2**	**51.4**
Number of Taxa (Order & Family)						**27**	**31**	**30**	**33**	**25**	**14**	**25**	**8**	**9**

Table Notes: The sample IDs in parentheses represents the benthic community samples collected by SNC.
* Permanent aquatic organisms include: Amphipoda (side-swimmers), Bivalvia (molluscs), Coleoptera (beetles), Gastropoda (snails), Hemiptera (true bugs), Hirudinea (leeches), Hydracarina (water mites), Isopoda (sow bugs), and Oligochaeta (aquatic earthworms).

2.4.3.5 Fish Community

The Bear Brook Watershed is home to at least 26 different species (refer to Table 10 through Table 13 for a summary of the fish species caught). From the fish community assessments conducted by SNC (2020 and 2021) and the 2022 field survey, there have been no invasive fish species nor fish species that are currently listed under the *Endangered Species Act* or the *Species at Risk Act* that were caught. Rock Bass (*Ambloplites rupestris*) and White Suckers (*Catostomus commersonii*) were the only "sport fish" caught (eight survey stations each; Table 10 through Table 13). Overall, the most commonly caught species in the Bear Brook Watershed were the Creek Chub (*Semotilus atromaculatus*; 15 different sites), Central Mudminnow (*Umbra limi*; 15 different sites), and Pumpkinseed (*Lepomis gibbosus*; 9 different sites). All fish captured other than the Rock Bass were common baitfish to Central Ontario and are all tolerant to warm waters.

Table 10 Fish species captured in the watercourses within the Tewin Lands during the fish community assessments conducted by SNC in 2020 and 2021

MNRF Code	Common Name	Scientific Name	S5 (UB02731)	Within the Tewin Site (UB05741)	S9 (UB16780)	S9 (UB16780)	S2 (UB173003)	S3 (UB143004)	S3 (UB143004)	S6 (UB102147)	S6 (UB102147)	S8 (UB202143)
			Tributary of Bear Brook		Bear Brook Municipal Drain		Bear Brook				Smith-Gooding Municipal Drain	Johnston Municipal Drain
			Minnow Trap				Minnow Trap	Electrofishing	Minnow Trap	Electrofishing	Minnow Trap	Electrofishing
			2020-08-21	2020-08-21	2020-09-03	2021-06-10	2020-09-03	2021-06-10	2020-09-03	2021-06-14	2020-08-21	2021-06-10
141	Central Mudminnow	*Umbra limi*	0	14	0	24	0	9	0	0	0	20
163	White Sucker	*Catostomus commersonii*	8	0	0	0	0	1	0	0	1	1
182	Northern Redbelly Dace	*Chrosomus eos*	0	0	0	1	0	6	0	0	0	8
189	Brassy Minnow	*Hybognathus hankinsoni*	0	0	0	0	0	33	0	0	0	12
198	Common Shiner	*Luxilus cornutus*	0	0	0	0	0	3	0	3	0	9
208	Bluntnose Minnow	*Pimephales notatus*	4	0	0	0	0	8	4	2	0	28
209	Fathead Minnow	*Pimephales promelas*	0	0	0	5	0	0	0	0	0	5
211	Longnose Dace	*Rhinichthys cataractae*	2	0	0	0	0	0	0	0	0	0
212	Creek Chub	*Semotilus atromaculatus*	17	0	0	0	0	7	13	7	45	31
214	Pearl Dace	*Margariscus margarita*	14	0	0	0	0	0	0	0	0	0
233	Brown Bullhead	*Ameiurus nebulosus*	0	0	1	1	0	0	0	0	0	0

MNRF Code	Common Name	Scientific Name	S5 (UB02731)	Within the Tewin Site (UB05741)	S9 (UB16780)	S9 (UB16780)	S2 (UB173003)	S3 (UB143004)	S3 (UB143004)	S6 (UB102147)	S6 (UB102147)	S8 (UB202143)
			Tributary of Bear Brook		Bear Brook Municipal Drain		Bear Brook				Smith-Gooding Municipal Drain	Johnston Municipal Drain
			Minnow Trap				Minnow Trap	Electrofishing	Minnow Trap	Electrofishing	Minnow Trap	Electrofishing
			2020-08-21	2020-08-21	2020-09-03	2021-06-10	2020-09-03	2021-06-10	2020-09-03	2021-06-14	2020-08-21	2021-06-10
261	Banded Killifish	*Fundulus diaphanus*	0	0	0	0	0	0	0	0	0	2
281	Brook Stickleback	*Culaea inconstans*	2	46	0	0	0	1	0	0	0	18
311	Rock Bass	*Ambloplites rupestris*	2	0	0	0	1	0	0	0	0	0
313	Pumpkinseed	*Lepomis gibbosus*	2	6	0	0	0	0	1	4	11	0
342	Logperch	*Percina caprodes*	9	0	0	0	0	0	0	0	0	0
348	Darters	*Etheostoma* Spp.	3	0	0	0	0	1	0	2	0	5
Total Number of Species			10	3	1	4	1	9	3	5	3	11
Total Fish Catch			63	66	1	31	1	69	18	18	57	139
Total Effort (seconds)			—	—	—	—	—	249	—	631	—	198
Catch Per Unit Effort (CPUE; fish/minute)			—	—	—	—	—	16.6	—	1.7	—	42.1

Table 11 Fish species captured in the watercourses downstream (D/S) and upstream (U/S) of the Tewin Lands during the fish community assessments conducted by SNC in 2020 and 2021

MNRF Code	Common Name	Scientific Name	D/S of Site (UB1900)	S1 - D/S of Site (UB03643)	D/S of Site (UB063142)	D/S of Site (UB08644)	D/S of Site (UB08644)	U/S of Site (UB152155)	U/S of Site (UB18000)
			Bear Brook Municipal Drain	Bear Brook	Bear Brook	Bear Brook	Bear Brook	Smith-Gooding Municipal Drain	Smith-Gooding Municipal Drain
			Minnow Trap	Electrofishing	Fyke Net	Minnow Trap	Fyke Net	Minnow Trap	Minnow Trap
			2020-09-03	2021-03-11	2021-06-10	2020-09-03	2021-06-15	2020-08-21	2020-08-21
141	Central Mudminnow	*Umbra limi*	0	0	0	0	0	6	1
163	White Sucker	*Catostomus commersonii*	0	1	1	0	8	1	0
168	Silver Redhorse	*Moxostoma anisurum*	0	0	1	0	0	0	0
172	Greater Redhorse	*Moxostoma valenciennesi*	0	0	1	0	0	0	0
189	Brassy Minnow	*Hybognathus hankinsoni*	0	2	5	0	0	0	0
194	Golden Shiner	*Notemigonus crysoleucas*	0	6	27	0	66	0	0
196	Emerald Shiner	*Notropis atherinoides*	0	0	0	0	14	0	0
198	Common Shiner	*Luxilus cornutus*	0	0	2	0	0	0	1
206	Mimic Shiner	*Notropis volucellus*	0	4	18	0	47	0	0
208	Bluntnose Minnow	*Pimephales notatus*	0	0	12	0	20	0	0
209	Fathead Minnow	*Pimephales promelas*	0	1	0	0	12	0	0
212	Creek Chub	*Semotilus atromaculatus*	1	0	0	0	45	0	0
213	Fallfish	*Semotilus corporalis*	0	0	0	0	1	0	0

MNRF Code	Common Name	Scientific Name	D/S of Site (UB1900)	S1 - D/S of Site (UB03643)	D/S of Site (UB063142)	D/S of Site (UB08644)	D/S of Site (UB08644)	U/S of Site (UB152155)	U/S of Site (UB18000)
			Bear Brook Municipal Drain	Bear Brook	Bear Brook	Bear Brook	Bear Brook	Smith-Gooding Municipal Drain	Smith-Gooding Municipal Drain
			Minnow Trap	Electrofishing	Fyke Net	Minnow Trap	Fyke Net	Minnow Trap	Minnow Trap
			2020-09-03	2021-03-11	2021-06-10	2020-09-03	2021-06-15	2020-08-21	2020-08-21
214	Pearl Dace	*Margariscus nachtriebi*	0	0	0	0	0	1	0
233	Brown Bullhead	*Ameiurus nebulosus*	0	2	2	1	8	0	0
236	Tadpole Madtom	*Noturus gyrinus*	0	0	1	0	11	0	0
261	Banded Killifish	*Fundulus diaphanus*	0	3	8	0	46	0	0
281	Brook Stickleback	*Culaea inconstans*	0	0	0	0	0	13	0
310	Sunfishes	Centrarchidae Spp.	0	0	90	0	157	0	0
311	Rock Bass	*Ambloplites rupestris*	0	1	14	10	69	0	0
313	Pumpkinseed	*Lepomis gibbosus*	0	0	0	2	0	0	7
Total Number of Species			1	8	13	3	13	4	3
Total Fish Catch			1	20	182	13	504	21	9
Total Effort (seconds)			—	670	—	—	—	—	—
Catch Per Unit Effort (CPUE; fish/minute)			—	1.8	—	—	—	—	—
Table Notes: The sample IDs in parentheses represents the benthic community samples collected by SNC									

Table 12 Fish species captured in the Bear Brook, downstream of the Tewin Lands, during the fish community sampling November 8, 2022

MNRF Code	Common Name	Scientific Name	Bear Brook Electrofishing Reaches	
			Reach 1	Reach 2
141	Central Mudminnow	*Umbra limi*	18	14
198	Common Shiner	*Luxilus cornutus*	1	0
212	Creek Chub	*Semotilus atromaculatus*	7	6
261	Banded killifish	*Fundulus diaphanus*	1	0
311	Rock Bass	*Ambloplites rupestris*	2	3
313	Pumpkinseed	*Lepomis gibbosus*	5	7
651	Brown Bullhead	*Ameiurus nebulosus*	3	0
Total Number of Species			7	4
Total Fish Catch			37	30
Total Effort (seconds)			1160	1073
Catch Per Unit Effort (CPUE; fish/minute)			1.9	1.7

Table 13 Fish species captured in the headwater features (HDFs) within the Tewin Lands during the fish community assessments conducted by Kilgour & Associates in May of 2022

MNRF Code	Common Name	Scientific Name	HDFA Electrofishing Reaches										
		KAL Labels	HDF1	HDF2	HDF3	HDF4	HDF5	HDF6	HDF7	HDF8	HDF9	HDF10	HDF11
		GEO Morphix Labels	RC4-1-1A	RC4-1-1A	RC4-1-1A-2	RC4-1-1A-1	RC4-1-1A	RC5-1	BB10-1	BB10-1B	BB5-5A	BB5-5A	BB5-5A-3-1
141	Central Mudminnow	*Umbra limi*	6	3	0	22	7	1	6	0	0	0	5
182	Northern Redbelly Dace	*Chrosomus eos*	0	4	0	1	0	0	0	0	0	0	1
183	Finescale Dace	*Chrosomus neogaeus*	0	0	0	0	3	0	0	0	0	0	0
189	Brassy Minnow	*Hybognathus hankinsoni*	0	1	0	0	0	0	0	0	0	0	0
198	Common Shiner	*Luxilus cornutus*	0	0	0	0	0	0	2	0	0	0	0
208	Bluntnose Minnow	*Pimephales notatus*	0	0	0	0	0	0	0	0	0	0	10
209	Fathead Minnow	*Pimephales promelas*	0	0	0	1	0	0	6	0	0	0	4
212	Creek Chub	*Semotilus atromaculatus*	0	6	0	2	5	0	1	0	0	0	3
281	Brook Stickleback	*Culaea inconstans*	0	1	0	0	0	5	1	0	0	0	0
314	Bluegill	*Lepomis macrochirus*	0	0	0	0	0	0	9	0	0	0	0
Total Number of Species			1	5	0	4	3	2	6	0	0	0	5
Total Fish Catch			6	15	0	26	15	6	25	0	0	0	23
Total Effort (seconds)			33	103	30	232	67	99	130	261	56	53	245
Catch Per Unit Effort (CPUE; fish/minute)			10.91	8.74	0	6.72	13.43	3.64	11.54	0	0	0	5.63

S1 is located in the Bear Brook and found downstream of the Tewin Lands, adjacent to Russell Road (Figure 7). On November 8, 2022, a fish community assessment was conducted by backpack electrofishing where the site was divided into two reaches. A total of six species were captured in Reach 1 while four species (all of which also occurred in Reach 1) were captured in Reach 2 (Table 12). The seven species captured included three species of minnow (Central Mudminnow, Common Shiner, Creek Chub), two species of sunfish (Rock Bass, Pumpkinseed), one species of topminnow (Banded Killifish), and one species of catfish (Brown Bullhead). CPUE was similar between both reaches (1.79 ± 0.17 fish/minute; ±SD, n=2). Central Mudminnow were the dominant species in both reaches, making up 48% of the total catch. All fish captured at this site are warm water tolerable but only the Brown Bullhead (*Ameiurus nebulosus*) and Pumpkinseed prefer warm waters, both belonging to the warm thermal class (Table 14).

S2 is a section of Bear Brook located downstream of the Tewin Lands, adjacent to Piperville Road (Figure 7). SNC conducted a fish community assessment in S2 on September 3, 2020, using minnow traps (Table 10). Only one Rock Bass was captured, which can tolerate warm water tolerant but prefer cool waters (Table 14).

S3 is a section of a tributary of Bear Brook located just upstream of S2 (downstream of Tewin Lands) and adjacent to Hall Road (Figure 7). SNC conducted two fish community collections (Table 10). Using minnow traps in fall of 2020, three species of fish were captured including two minnow species (Bluntnose Minnow; Creek Chub) and one species of sunfish (Pumpkinseed). Catch rates were highest for Creek Chub, consisting of 72% of the total catch. In June of 2021, the reach was sampled via back electrofishing yielding a higher number of captured species (nine), including two of the same three species captured the year prior (Bluntnose Minnow and Creek Chub). Additional species of captured fish in 2021 included five species of minnow (Central Mudminnow, Common Shiner, Northern Redbelly Dace, Brassy Minnow), one species of stickleback (Brook Stickleback), one species of sucker (White Sucker), and darters (identified as *Etheostoma* spp.). In 2021, catch rates were highest for Brassy Minnow, which made up 48% of the total catch. The CPUE for the fish community assessment conducted via electrofishing was 16.6 fish/minute. All captured fish species are warm water tolerable but only Bluntnose Minnows and Pumpkinseed prefer warm waters (Table 14).

S5 is in a tributary of Bear Brook within the Tewin Lands, found adjacent to Farmers Way (Figure 7) UB063142. It confluences with Bear Brook just downstream of the S4 Water Quality site (Figure 6). The fish community was sampled by SNC in August 2020, using minnow traps (Table 10). Ten species of fish were captured, Bluntnose Minnow, Creek Chub, Longnose Dace, Pearl Dace, Pumpkinseed, Rock Bass, Brook Stickleback, Logperch, White Sucker and some individuals only identified as Darters (*Etheostoma*). Catch rates were highest for Creek Chub, consisting of 27% of the total catch. Most of the captured fish species prefer cool water except for Bluntnose Minnow and Pumpkinseed which prefer warmer waters. However, all fish species captured are tolerant of warm waters (Table 14).

S6 is found within Bear Brook and the Tewin Lands, adjacent to Anderson Road (Figure 7), and flows downstream towards S4 (Figure 6). SNC conducted a fish community assessment at S6 on two occasions, one in late August 2020 and another in mid-June of 2021 (Table 10). Minnow traps were used in 2020 and caught Creek Chub, Pumpkinseed and White Sucker. Creek Chub was caught most frequently making up 79% of the total catch. The survey conducted in 2021 used backpack electrofishing and yielded a larger variety of fish species, resulting in a CPUE of 1.71 fish/minute. The catch was again made up primarily of Creek Chub (39% of total catch) with Bluntnose Minnow, Central Mudminnow, Common Shiner, Darters

(not identified to species), and Pumpkinseed also captured. All fish captured are warm water tolerant but generally prefer cool water systems with the exception of Pumpkinseed which prefer warmer waters (Table 14).

S8 is a section of the Johnston Municipal Drain, a tributary of Bear Brook, which is adjacent to Anderson Road (Figure 7). The Johnston Municipal Drain confluences with Bear Brook just downstream of S4 (Figure 6). SNC conducted fish community assessment at S8 in early June 2021 using backpack electrofishing (Table 10). Eleven species of fish were captured during the effort. Creek Chub were the dominant species captured making up 22% of total numbers. In addition to Creek Chub, Bluntnose minnow, Central Mudminnow, Common Shiner, Fathead Minnow, Northern Redbelly Dace, Banded Killifish, Brook Stickleback, White Sucker, Brassy Minnow, and some Darters were captured at S8. The CPUE for the fish community assessment conducted by SNC was 42 fish/minute. All species of fish captured are warm water tolerant but only Bluntnose Minnow and Fathead Minnow prefer warm waters (Table 14).

S9 is a section of the Bear Brook Municipal Drain found adjacent to Hall Road (Figure 7). SNC conducted two fish community assessments using minnow traps in September of 2020 and again in June of 2021 (Table 10). In 2020, only one Brown Bullhead was captured and identified. In June of 2021, four species of fish were captured, Central Mudminnow, Fathead Minnow, Northern Redbelly Dace, and Brown Bullhead. Central Mudminnow was the most frequently caught fish species in 2021 representing 77% of total fish caught. All captured fish are warm water tolerant but two of the fish species prefer warm waters (Brown Bullhead and Fathead Minnow) while the other two species (Central Mudminnow and Northern Redbelly Dace) prefer cool-warm water systems (Table 14).

On August 21, 2020, SNC conducted a fish community survey using minnow traps in a tributary of Bear Brook located adjacent to Thunder Road (Figure 7 and Table 10). They captured three species of fish (Brook Stickleback, Central Mudminnow, and Pumpkinseed) where Central Mudminnow was the most commonly caught fish, representing 70% of the total fish caught. All three fish species are warm water tolerant, but the Brook Stickleback prefer cool waters while the Central Mudminnow prefer cool-warm waters (Table 14).

During the month of May, 2022, a fish community survey was conducted via backpack electrofishing in headwater areas of the Tewin Lands (Figure 7 and Table 13). During the three days of surveys, ten different species of fish were captured with Central Mudminnow being the most frequently caught fish (representing 43% of the fish caught), followed by the Creek Chub, Fathead Minnow, Bluntnose Minnow, Bluegill, Brook Stickleback, Northern Redbelly Dace, Finescale Dace, Common Shiner, and Brassy Minnow. Most of the captured fish species prefer cool waters except for Bluntnose Minnows, Fathead Minnows, and Bluegills; however, all fish captured during the surveys are warm water tolerant (Table 14).

Table 14 Thermal preference and thermals tolerance of fish species captured in the Bear Brook Watershed

Fish Species (*Taxonomic name*)	Thermal Class	Thermal Tolerance	
		Final Temperature Preferendum (FTP)	Upper Incipient Lethal Temperature (UILT)
Banded Killifish (*Fundulus diaphanus*)	Cool	23.0	31.7
Bluegill (*Lepomis macrochirus*)	Warm	30.2	32.2
Bluntnose Minnow (*Pimephales notatus*)	Warm	24.1	31.5
Brassy Minnow (*Hybognathus hankinsoni*)	Cool	—	—
Brook Stickleback (*Culaea inconstans*)	Cool	21.3	30.6
Brown Bullhead (Ameiurus nebulosus)	Warm	26.2	33.4
Central Mudminnow (*Umbra limi*)	Cool-Warm	—	33.5
Common Shiner (*Luxilus cornutus*)	Warm	21.9	30.4
Creek Chub (*Semotilus atromaculatus*)	Cool	24.9	29.1
Emerald Shiner (*Notropis atherinoides*)	Cool	19.3	27.4
Fathead Minnow (*Pimephales promelas*)	Warm	26.6	31.3
Fallfish (*Semotilus corporalis*)	Cool	22.0	—
Finescale Dace (*Phoxinus neogaeus*)	Cool	24.1	30.3
Golden Shiner (*Notemigonus crysoleucas*)	Cool	21.8	32.0
Greater Redhorse (*Moxostoma valenciennesi*)	Cool-Warm	—	—
Logperch (*Percina caprodes*)	Cool-Warm	—	—
Longnose Dace (*Rhinichthys cataractae*)	Cool	15.3	—
Mimic Shiner (*Notropis volucellus*)	Warm	—	—
Northern Redbelly Dace (*Phoxinus eos*)	Cool-Warm	25.3	29.2
Pearl Dace (*Margariscus nachtriebi*)	Cold-Cool	—	—
Pumpkinseed (*Lepomis gibbosus*)	Warm	27.7	31.7
Rock Bass (*Ambloplites rupestris*)	Cool	24.9	33.9
Silver Redhorse (*Moxostoma anisurum*)	Cool	—	—
Tadpole Madtom (*Noturus gyrinus*)	Warm	—	—
White Sucker (*Catostomus commersonii*)	Cool	23.4	27.8

Table notes: temperature preferenda are from Hasnain et al. 2010

2.4.3.6 Fish Habitat Characterization

Downstream of Tewin

Station S1 (identified as BB1 by GEO Morphix, 2022 and as UB13643 by SNC) is a representative reach of Bear Brook downstream of the Tewin Lands and adjacent to Russell Road (Figure 7). It is, and will be, influenced the condition of and activity around upstream section located with in the Tewin Lands. The unconfined perennial watercourse with a clearly defined bed and banks (60-90° angle) was previously assessed by GEO Morphix on June 29, 2022. The average bank width and depth were 10.63 and 1.97 m, respectively, where the bank substrate was composed of clay/silt and sand and the bed substrate was composed of a mixture of clay/silt, sand, and gravel. There was evidence of erosion where the undercut banks (60-100% erosion) were slumped and bank failure was observed in some sections. Based on the RGA and RSAT scores, this section of Bear Brook is in adjustment (RGA score of 0.41) and is maintaining a fair degree of stream health (RSAT score of 21).

On November 8, 2022, a fish habitat and community survey was conducted at station S1. The site was divided into two reaches (Reach 1: ~ 100 m; and Reach 2: ~ 70 m), and fish were collected via electrofishing in each reach (discussed further below). Reaches 1 and 2 had similar habitat characteristics (Table 15). Both reaches are composed of run type habitat, and flow through meadow and forested areas. In-water vegetation in both reaches was comprised solely of sparse submergent vegetation (5% coverage). The dominant riparian vegetation for both reaches included mainly herbaceous species, such as species of goldenrod and Purple Loosestrife (*Lythrum salicaria*). Based on the water quality data (not meeting the PWQO for several parameters), the fish habitat and community characterization (not considered critical habitat for listed species), and benthic community assessment (relatively high proportion of Chironomidae), this section of Bear Brook shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species and could function as a migration corridor.

Table 15 Summary of *in-situ* water quality data collected at each electrofishing reach within the Bear Brook (downstream of the Tewin Lands) during the fish community assessment, November 8, 2022

Reach Characteristics	Bear Brook at S1	
	Reach 1	Reach 2
Length (m)	~ 100	~ 70
Temperature (°C)	8.59	8.75
Dissolved Oxygen (mg/L)	11.0	11.0
Specific Conductivity (µS/cm)	901	912
Stream Type	Run	Run

Figure 50 Photograph illustrating the downriver view of Reach 1 of the S1 section of Bear Brook (photo taken November 8, 2022)

Figure 51 Photograph illustrating the view across Reach 2 of the S1 section of Bear Brook (photo taken November 8, 2022)

Downstream of Tewin

Station S2 (identified as BB3 by GEO Morphix (2022)) is a section of Bear Brook located downstream of the Tewin Lands, adjacent to Piperville Road (Figure 7). The unconfined perennial watercourse with a clearly defined bed and banks (60-90° angle) was previously assessed by GEO Morphix on November 2, 2021. At the time of the survey, the average bank width and depth were 8.73 and 1.68 m, respectively, where the banks and bed substrate were composed of clay and sand. The banks of this section of Bear Brook are slumped but are relatively stable, as they have experienced minimal erosion (5-30%). Based on the RGA and RSAT scores, this section of Bear Brook is in transition (RGA score of 0.38) but is maintaining a good degree of stream health (RSAT score of 27). This section of Bear Brook likely supports the full life cycle of resident fish species, but the beaver dam (Figure 52) located in the stream prevents fish from using the watercourse as a migration corridor. Based on the water quality data (not meeting the PWQO for several parameters), the fish habitat and community characterization (not considered critical habitat for listed species), and benthic community assessment (relatively high proportion of Chironomidae), this section of Bear Brook shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species and could function as a migration corridor.

Figure 52 Photograph of the beaver dam located at the S2 sample station (photo taken on September 27, 2022)

Downstream of Tewin

S3 (identified as BB4 by GEO Morphix (2022)) is a section of a tributary of Bear Brook located just upstream of S2 and adjacent to Hall Road (Figure 53). The unconfined perennial watercourse with a clearly defined bed and banks (60-90° angle) was previously assessed by GEO Morphix on November 2, 2021. At the time of the survey, the average bank width and depth were 7.73 and 1.54 m, respectively, where the banks and bed substrate were composed of clay and sand. The banks of this tributary are slumped but are

relatively stable as they have experienced minimal erosion (5-30%). Based on the RGA and RSAT scores, this section of Bear Brook is in transition/stressed (RGA score of 0.40) but is maintaining a good degree of stream health (RSAT score of 30). Based on the water quality data (not meeting the PWQO for several parameters), the fish habitat and community characterization (not considered critical habitat for listed species), and benthic community assessment (relatively high proportion of Chironomidae), this tributary of Bear Brook shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species and could function as a migration corridor.

Figure 53 Photograph of the culvert inlet at S3 (photo taken on September 27, 2022)

Within and Downstream of Tewin

S5 (identified as BB5-5 by GEO Morphix (2022)) is a tributary of Bear Brook partly within the Tewin Lands, found adjacent to Farmers Way where it confluences with Bear Brook just downstream of Tewin Lands (Figure 54). The confined perennial watercourse with a clearly defined bed and banks (60-90° angle) was previously assessed by GEO Morphix on November 1, 2021. At the time of the survey, the average bank width and depth were 4.08 and 1.28 m, respectively, where the bank and bed substrate were composed of clay and sand. The undercut banks of this Bear Brook tributary are evidence that erosion is occurring (30-60 %) and is further supported by the RGA score (0.33) which suggests the channel is in transition. The RSAT score (28) suggests the watercourse is in good health. Based on the water quality data (not meeting the PWQO for several parameters) as well as the fish habitat and community characterization (not considered critical habitat for listed species), this tributary of Bear Brook shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species.

Figure 54 Upstream view of the culvert inlet at S5 (photo taken on September 27, 2022)

Within Tewin

S6 (identified as BB13 by GEO Morphix (2022)) is found within Bear Brook, adjacent to Anderson Road, and flows downstream towards S4 (Figure 55). The unconfined perennial watercourse with a well-defined bed and banks (30-60° angle) was previously assessed by GEO Morphix on October 20, 2021. At the time of the survey, the average bank width and depth were 1.60 and 0.35 m, respectively, where the banks and bed substrate were composed of clay/silt. The slumped banks are evidence that this section of Bear Brook creek has experienced some erosion (30-60%). Based on the RGA and RSAT scores, this section of the watercourse is in transition (RGA score of 0.21) but is maintaining a good degree of stream health (RSAT score of 25). Based on the water quality data (not meeting the PWQO for several parameters), the fish habitat and community characterization (not considered critical habitat for listed species), and benthic community assessment (relatively high proportion of Chironomidae), this section of Bear Brook likely supports the full life cycle of resident fish species and could function as a migration corridor.

Figure 55 Upstream view of the culvert inlet at S6 (photo taken on September 27, 2022)

Within Tewin

S8 (identified as BB5-5A-3D by GEO Morphix (2022)) is a section of the Johnston Municipal Drain, a tributary of Bear Brook, which is adjacent to Anderson Road and within the Tewin Lands (Figure 56). The Johnston Municipal Drain eventually confluences with Bear Brook just downstream of S4. The confined perennial watercourse with a clearly defined bed and banks (60-90° angle) was previously assessed by GEO Morphix on October 28, 2021. At the time of the survey, the average bank width and depth were 6.25 and 2.50 m, respectively, where the bank substrate was composed of clay/silt. The banks of this section of Bear Brook are slumped and were not stable in the past as they have experienced significant erosion (60-100%). However, based on the RGA and RSAT scores, this section of the watercourse is in regime/stable (RGA score of 0.20) and is maintaining a good degree of stream health (RSAT score of 25). Based on the water quality data (not meeting the PWQO for several parameters), the fish habitat and community characterization (not considered critical habitat for listed species), and benthic community assessment (relatively low taxonomic richness and high proportion of Chironomidae), this section of the Johnston Municipal Drain likely supports the full life cycle of resident fish species but likely does not function as a migration corridor due to the beaver dam found in the drain restricts flows.

Figure 56 Upstream view of the culvert inlet at S8 (photo taken on September 27, 2022)

Table 16 Channel morphology and physical attributes of the watercourses surveyed by GEO Morphix (2022) during their rapid geomorphological field assessments

KAL Sample Identification	GEO Morphix Sample Identification	Valley Type	Bank Angle	Mean Bankfull Width (m)	Mean Bankfull Depth (m)	Banks Substrate	Bed Substrate	Evidence of Erosion and Percent	RGA Classification and Score	RSAT Classification and Score
S1	BB1	Unconfined	60-90°	10.63	1.97	Clay/Silt, Sand	Clay/Silt, Sand, Gravel	Undercutting, banks slumping (60-100%)	In Adjustment (0.41)	Fair (20)
S2	BB3	Unconfined	60-90°	8.73	1.68	Clay, Sand	Clay, Sand	Banks slumping (5-30%)	In Transition (0.38)	Good (27)
S3	BB4	Unconfined	60-90°	7.73	1.54	Clay, Sand	Clay, Sand	Banks slumping (5-30%)	In Adjustment (0.40)	Good (30)
S5	BB5-5	Confined	60-90°	4.08	1.28	Clay, Sand	Clay, Sand	Undercutting (30-60%)	In Transition (0.33)	Good (28)
S6	BB13	Unconfined	30-60°	1.60	0.35	Clay/Silt	Clay/Silt	Banks slumping (< 5%)	In Transition (0.21)	Good (25)
S8	BB5-5A-3D	Confined	60-90°	6.25	2.50	Clay/Silt	N/A	Banks slumping (60-100%)	In Regime (0.20)	Good (25)

2.4.4 Natural Heritage System Elements

This section discusses how the distributions of species directly observed or considered as potentially occurring within the Tewin Lands, and/or of physical elements therein, may provide ecological values or Natural Heritage System Elements that could interact with future development of the Tewin Lands.

Protected ecological values may be associated with the natural features within the Tewin Lands, such as forested areas that meet the definition of Significant Woodlands and/or contribute to canopy cover generally, or other natural areas defined or delineated according to other natural heritage conservation programs or systems. Protected ecological values also relate to two different considerations of species occurring or potentially occurring within the Tewin Lands. Firstly, species listed as at-risk under the ESA and/or SARA and their habitats are directly protected by those acts. Secondly, certain groupings of species (not necessarily SAR), or habitat areas that may support such groupings, may be identified, and protected as Significant Wildlife Habitat (SWH). Areas of candidate SWH are typically identified based on ELC habitat descriptions provided in the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E* (MNRF, 2015). Whether a candidate SWH is considered a confirmed SWH is typically based on observations of certain species within the candidate habitat (MNRF, 2015). Note that even though SWH is defined on a provincial level by the MNRF, the protection of confirmed SWH is a municipal matter. Natural heritage elements that meet the definition of Confirmed SWHs found within the Tewin Lands are further described below.

2.4.4.1 Forested Areas and Trees

Woodlands

Significant Woodlands are forested areas that are ecologically, functionally, or economically important (MNR, 2010). For any treed area meeting the definition of "woodlands" under the Forestry Act, or delineated as a "forest" ecosite under an ELC, City of Ottawa Official Plan applies one of two different sets of criteria to identify those areas as Significant Woodland.

1. **In the rural area** - meeting any one of the criteria in the Natural Heritage Reference Manual (MNR, 2010) – such as woodland size, species composition, tree age, and/or site history – as assessed in a subwatershed planning context and applied in accordance with Council-approved guidelines, where such guidelines exist; or

2. **In the urban area** - any area 0.8 ha in size or larger, supporting woodland 60 years of age and older at the time of evaluation.

The Tewin Lands falls within the urban boundary of the City of Ottawa and are thus identified as an urban area. For this study, forested features apparent within the 1976 aerial imagery from geoOttawa were delineated to provide a base of for identifying candidate Significant Woodlands. The forested features delineated the 1976 air photo were confirmed to visually correspond with those evident with October 8, 1964, aerial photos of the area from the National Air Photo Library (photos 0019 and 0021 from Roll #A18649) as trees large enough to be visible within a 1964 air photo are assumed to have been present at least 60 years prior to the study (i.e., since 1963). The delineated areas were then trimmed wherever tree loss was apparent in geoOttawa imagery from any year between 1976 and 2021 (the most current imagery on the geoOttawa system) or during field studies in 2022 (per Section 2.4.1). Per the

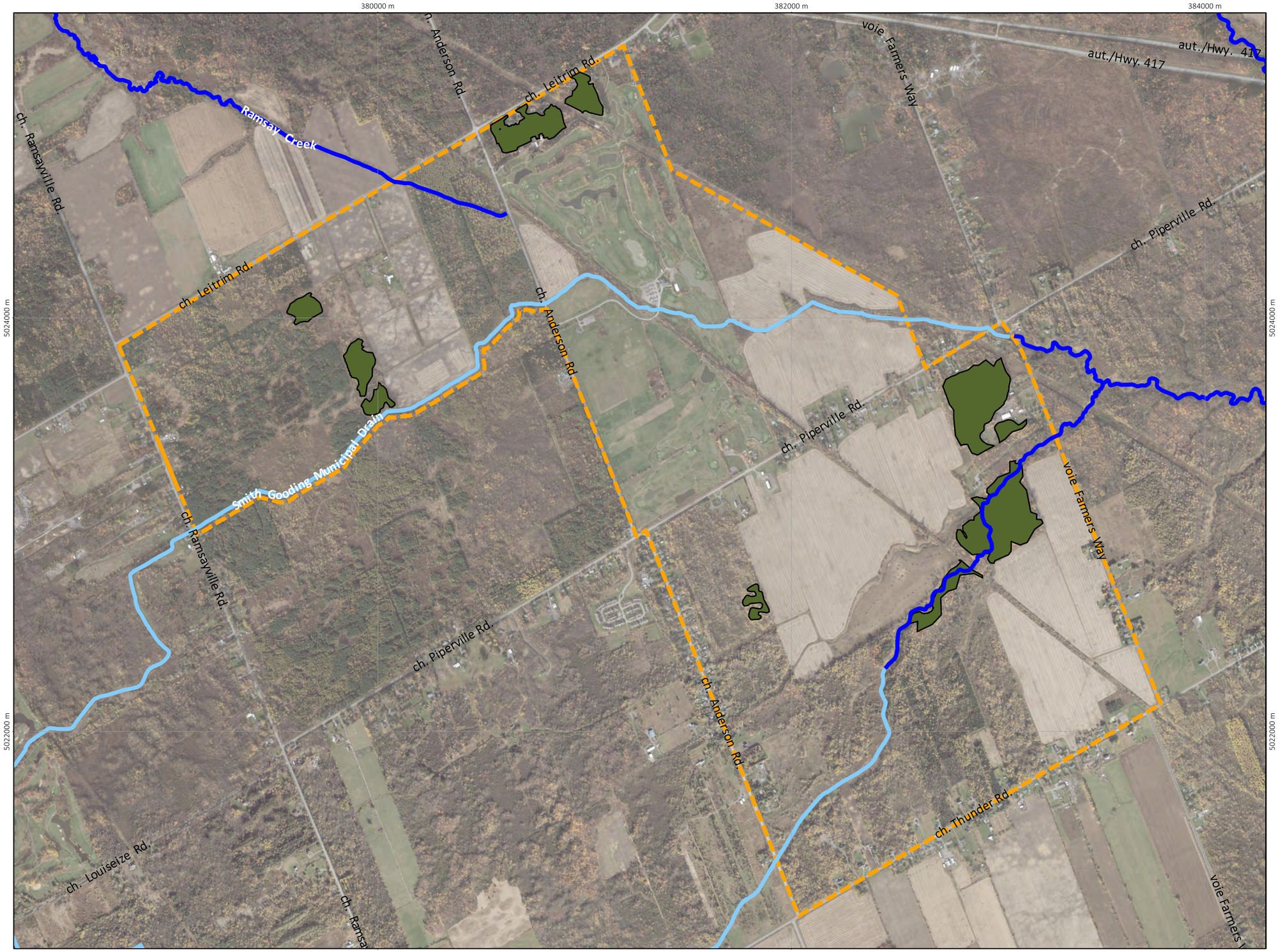


Figure 57 Areas meeting the definition for Significant Woodland within the Tewin Lands

Legend

- Study Area
- Mature Woodland (>0.8 ha)

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-24

KILGOUR & Associates

City's Significant Woodland Policy, remaining areas larger than 0.8 ha would qualify as Significant Woodlands. Ten forest patches within the Tewin Lands met the definition of Significant Woodland per the City of Ottawa Official Plan (Figure 57).

Eight of these areas are relatively small, ranging in size from 0.83 ha to 4.45 ha (Figure 57). They comprise a variety of ELC units, including mixed forest (FOMM6-1, FOMM9-2), naturalizing conifer plantation (FOCM6-1), mixed swamps (SWM, SWMM2-1), deciduous swamp (SWDM4-3), and thicket swamp (SWTM5-8). Two areas located near the corner of Farmer's Way and Piperville Road, however, comprise relatively larger areas (8.8 and 10.4 ha respectively) of mature, Fresh-Moist Sugar Maple – Yellow Birch Deciduous Forest (FOD6-3; Figure 57).

Canopy Cover

In the City of Ottawa (2021), "urban forest" includes all the trees within the urban area, and their growing environments, whether they grow singly, in groups or in woodlands, on both public and private property. Per the City of Ottawa Official Plan, the City has a canopy cover target of 40 per cent for the urban forest. This target applies to the urban area has whole, recognizing that variability in canopy cover will exist throughout the area (i.e., not every sub-portion of the urban area will or can match this target). Determining the current existing canopy cover allows comparisons of how different development options may be supportive of the City's overall canopy target.

The current existing cover within the study area is estimated to be 31.9% based on the ELC for the area (Figure 58). Percent canopy cover was estimated within ecosites during the ELC investigation (Section 2.4.1) with general averages noted for broad landcover types. The ELC delineation of "forested" ecosites — including forests, plantations, and swamps — captured heavily treed extensions on residential/commercial lots as well as dense hedgerow features, while excluding noticeable gaps within more broadly treed areas. As such, these ecosites generally comprised 90% canopy cover. Canopy cover over the golf course and commercial areas was deemed negligible (0%), having treed clusters excluded from their ecosite delineation. Roadway corridors were delineated to the edges of natural vegetation and so were also listed as having 0% canopy cover. Other open areas include occasional individual trees and were estimated to have 5% canopy cover on average. Tree canopy cover within thicket ecosites was generally around 25%, while woodland ecosites had 50%.

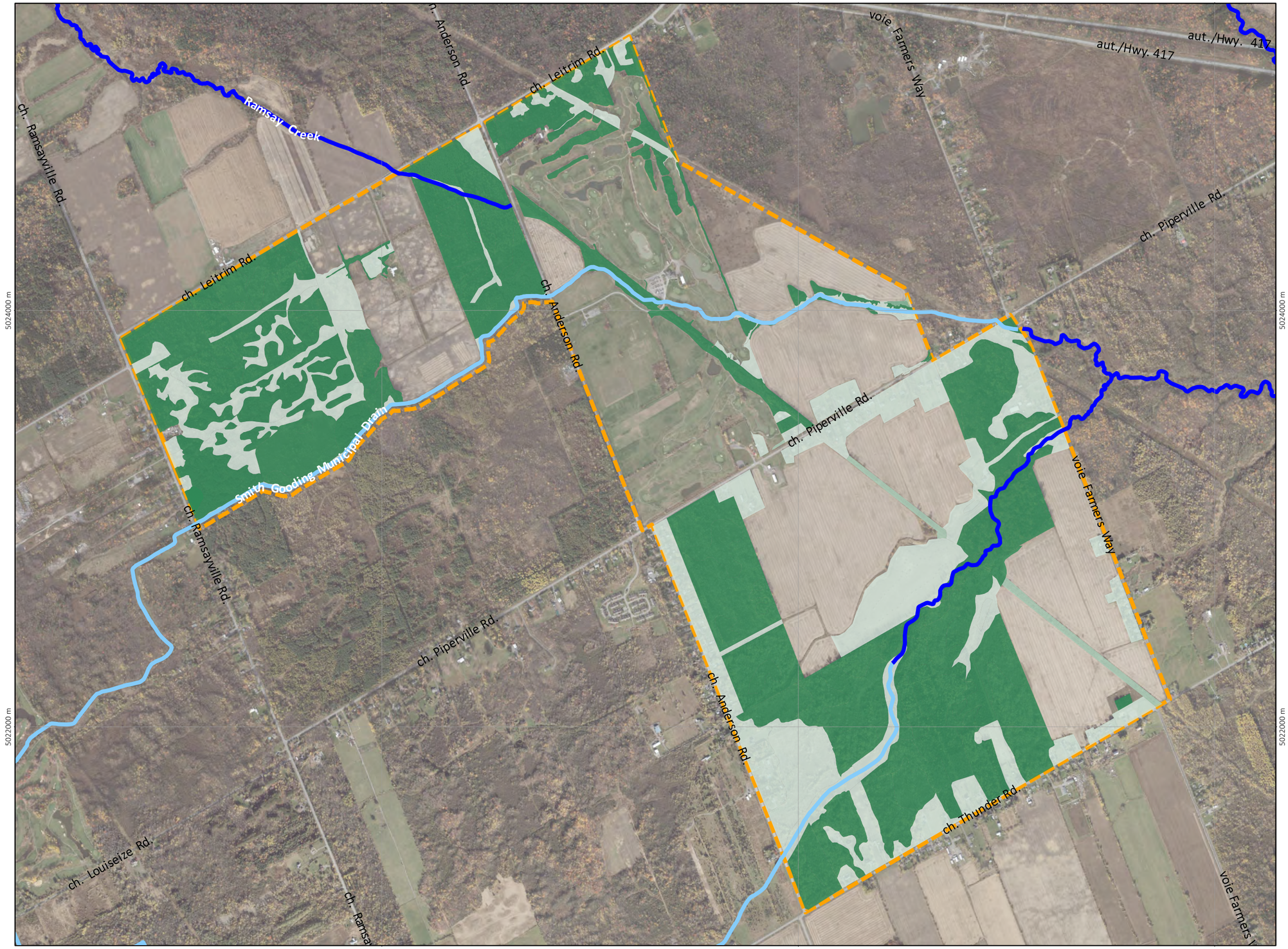


Figure 58 Percent tree canopy cover across the Tewin Lands

Legend

Study Area

% Canopy Cover

0
5
25
50
90

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-24

KILGOUR & Associates

2.4.4.2 Wetland

There are no Provincially Significant Wetlands (PSWs) currently identified within the Tewin Lands. The South Bear Brook Wetland (east of the Tewin lands) was recently evaluated by the City of Ottawa and found to constitute PSW. The western boundary of the South Bear Brook PSW, however, is located ~500m east (and downstream) of the Tewin lands (Figure 59).

The Tewin Lands do include areas of wetland features, including treed swamps, thicket swamps, and marshes. In total, 243.6 ha of wetlands are situated within the Tewin Lands. The City of Ottawa Official Plan (2021a) recognizes that wetlands that are not deemed Provincially Significant may contribute to maintaining the natural functions of an area and make up portions of the Natural Heritage System that extends throughout the urban and rural area and into adjacent municipalities. Wetland areas associated with the Tewin Lands, however, were almost entirely under active agriculture up to at least 1976 based on geoOttawa imagery, within only small, scattered patches left treed (corresponding with mature forest areas located within current wetland features - Figure 8). These areas still have extensive networks of agricultural ditching connecting to the Smith-Gooding and the Johnston Drains (Figure 47) and are considered more difficult to conserve (City of Ottawa, 2021b).

2.4.4.3 Natural Environment Areas

Per the City of Ottawa Official Plan, Natural Environment Areas are included as features within the Natural Heritage System (i.e., within OP Schedule C11). The Natural Environment Systems Strategy (NESS) initiative was developed for the City of Ottawa (formerly the Regional Municipality of Ottawa-Carleton) in the 1990s. This system compiled data for to identify Natural Environment Areas at a regional scale and assessed their contributions of such areas to natural processes, such as maintaining biodiversity, supporting hydrological cycles, and providing areas for primary productivity (Brownell and Larson, 1995). Features previously identified as Natural Environment Areas (where they still exist) would generally be expected warrant inclusion as Natural Heritage Features under OP Schedule C11 regardless of their NESS status. NESS reports, however, may provide context or history on the identified ecological values for those areas.

The natural area designated as NESS 83 in the NESS are located east and southeast of the Tewin Lands but two discrete patches do edge slightly into the study area. These include a relatively small patch immediately south of Leitrim Road, and a relatively larger area bounded by Piperville and Thunder Roads to the north and south, and Farmers Way and Anderson Road to the east and west. These areas corresponds to mixed and deciduous swamp areas (SWM, SWDM4-3 units) and mixed, deciduous, and coniferous forests (FOMM9-2, FOM7, FOMM6-1, FOMM6-3, FOCM6-1 units) identified during the ELC exercise (Section 2.4.1 above). NESS 83 was described as comprising terrestrial deciduous forests and treed swamps and containing streams and seeps that contribute to the headwater area for Bear Brook (Brownell and Blaney, 1997). Generally, NESS 83 exhibited a moderate significance for species diversity and as a major headwater area (Brownell and Blaney, 1997). Forested areas were characterized throughout the natural area as being primarily young and in poor to fair condition; however, some sections of good-condition, mature (50-99 years old) forest were noted within the area (Brownell and Blaney, 1997).

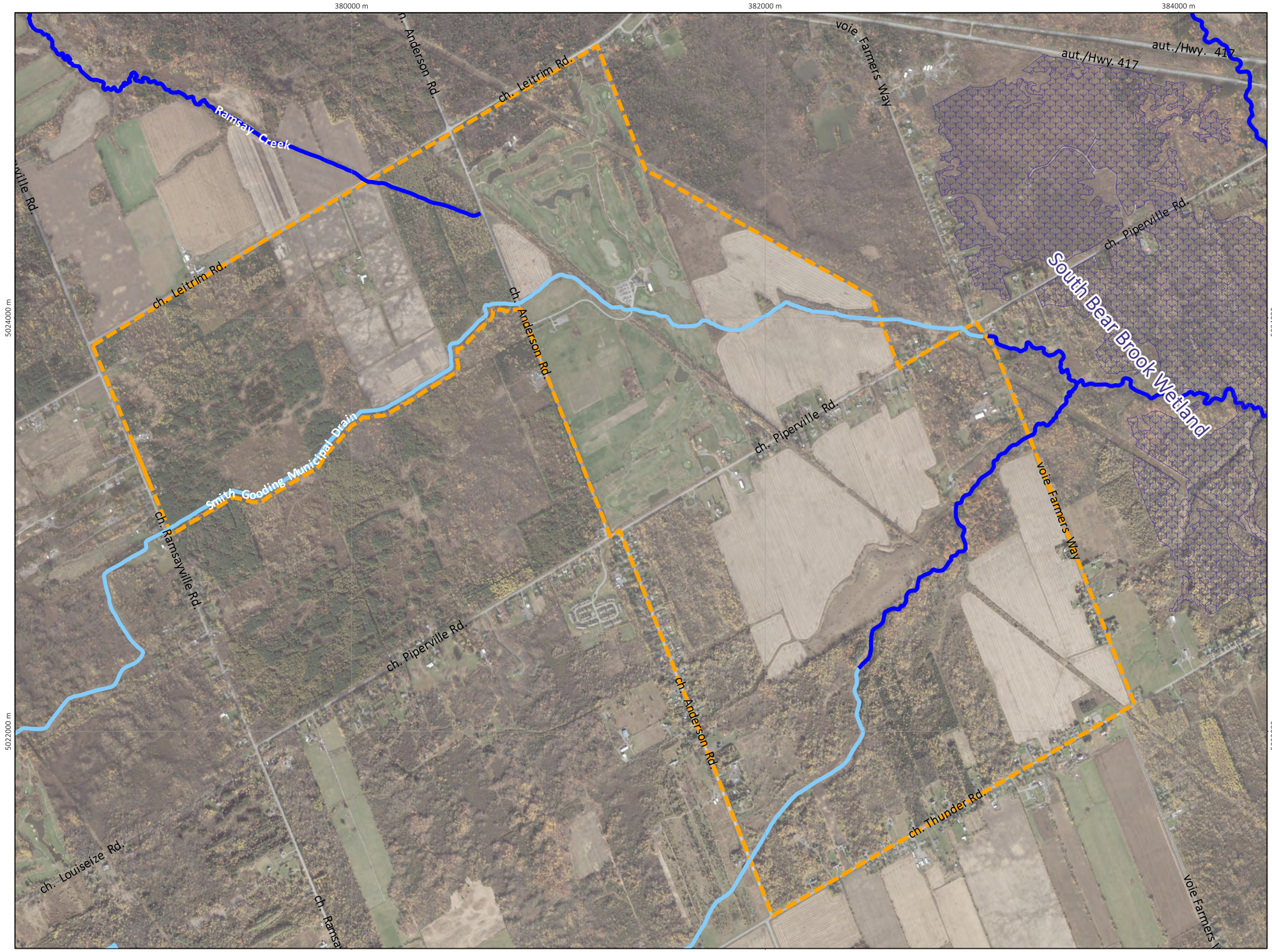


Figure 59 Provincially Significant Wetland near the Tewin Lands

Legend

- Study Area
- Provincially Significant Wetland

N

0 1000 m

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-24

KILGOUR & Associates

2.4.4.4 Species at Risk

SAR listed as Threatened or Endangered under the ESA have direct legal protections for both individuals and their habitats. SAR found to occur, or to have potential to occur, on/near the Tewin Lands were identified based on the findings of direct field programs and/or records reviews. Their potential to interact with the proposed development was assessed based on our review of existing information (SAR habitat requirements and occurrence records), ELC units, (habitat availability), and targeted field studies (Appendix E). The full assessment considered the potential for overall negative interactions of the proposed development with protected elements (i.e., SAR and/or their habitat). A moderate potential to interact with the proposed development was considered for SAR having a medium occurrence potential (i.e., either the individual or its habitat occurring within the Tewin Lands), or a high occurrence potential but the project design avoids interactions with individuals and/or habitat, based on agency guidelines and directives, or by default. A high potential to interact with the proposed project was considered for SAR for which the proposed project is anticipated to directly alter identified habitat and/or interact with individuals. All other SAR with potential to occur in the vicinity of the Tewin Lands based on their documented ranges were assessed as having low, negligible, or no potential to interact with the proposed development in the Tewin Lands due to a lack of occurrence records and/or suitable habitat (Appendix E). SAR assessed as having a moderate to high potential for overall negative interactions with the proposed development are summarized in Table 17.

Table 17 Species at risk with a moderate to high potential to interact with the proposed development in the Tewin Lands

Species Name (*Taxonomic Name*)	Status under the *Endangered Species Act*	Status under Schedule 1 of the *Species at Risk Act*	Potential to Interact with the Proposed Development
Birds			
Barn Swallow (*Hirundo rustica*)	Special Concern	Threatened	High
Bobolink (*Dolychonix oryzivorus*)	Threatened	Threatened	High
Canada Warbler (*Cardellina canadensis*)	Special Concern	Threatened	Moderate
Chimney Swift (*Chaetura pelagica*)	Threatened	Threatened	Moderate
Common Nighthawk (*Chordeiles minor*)	Special Concern	Special Concern	Moderate
Eastern Meadowlark (*Sturnella magna*)	Threatened	Threatened	High
Eastern Wood-pewee (*Contopus virens*)	Special Concern	Special Concern	High
Evening Grosbeak (*Coccothraustes vespertinus*)	Special Concern	Special Concern	Moderate
Grasshopper Sparrow (*Ammodramus savannarum*)	Special Concern	Special Concern	High
Olive-sided Flycatcher (*Contopus cooperi*)	Special Concern	Special Concern	Moderate

Species Name (*Taxonomic Name*)	Status under the *Endangered Species Act*	Status under Schedule 1 of the *Species at Risk Act*	Potential to Interact with the Proposed Development
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	Endangered	Endangered	Moderate
Rusty Blackbird (*Euphagus carolinus*)	Special Concern	Special Concern	Moderate
Short-eared Owl (*Asio flammeus*)	Threatened	Special Concern (In consultation for uplisting to Threatened)	Moderate
Wood Thrush (*Hylocichla mustelina*)	Special Concern	Threatened	High
Mammals			
Eastern Small-footed Myotis (*Myotis leibii*)	Endangered	Not Listed	Moderate
Little Brown Myotis (*Myotis lucifugus*)	Endangered	Endangered	Moderate
Northern Myotis (*Myotis septentrionalis*)	Endangered	Endangered	Moderate
Tri-colored Bat (*Perimyotis subflavus*)	Endangered	Endangered	Moderate
Amphibians			
Western Chorus Frog (*Pseudacris triseriata*)	Not Listed	Threatened (Great Lakes/St. Lawrence population)	Moderate
Reptiles			
Blanding's Turtle (*Emydoidea blandingii*)	Threatened	Endangered	Moderate
Eastern Milksnake (*Lampropeltis triangulum*)	Not Listed	Special Concern	Moderate
Eastern Ribbonsnake (*Thamnophis sauritus*)	Special Concern	Special Concern	Moderate
Midland Painted Turtle (*Chrysemys picta marginata*)	Not Listed	Special Concern	High
Snapping Turtle (*Chelydra serpentina*)	Special Concern	Special Concern	Moderate
Arthropods			
American Bumble Bee (*Bombus pensylvanicus*)	Special Concern	Special Concern	Moderate
Monarch (*Danaus plexippus*)	Special Concern	Special Concern	High
Suckley's Cuckoo Bumble Bee (*Bombus suckleyi*)	Endangered	Threatened	Moderate
Yellow-banded Bumble Bee (*Bombus terricola*)	Special Concern	Special Concern	Moderate
Vascular Plants			
Black Ash (*Fraxinus nigra*)	Endangered	No Status (In consultation for uplisting to Threatened)	Moderate
Butternut (*Juglans cinerea*)	Endangered	Endangered	Moderate

Midland Painted Turtle (*Chrysemys picta marginata*), Western Chorus Frog (*Pseudacris triseriata*), and their habitats are only protected under SARA, not the ESA, and so these species would not normally be protected on privately owned land. However, the Federal Minister of ECCC can[4] and has imposed SARA protections on private projects where habitat is deemed "*…necessary for the survival or recovery of the species…*[5]" in the area of concern. For example, ECCC provided protection to a significant and isolated population of Western Chorus Frog in Longeuille, Quebec[6] in 2021. In that case the Longeuille population had been identified as locally and regionally significant (Environment Canada, 2015). Western Chorus Frogs and Midland Painted turtles are well distributed in the Ottawa area (Seburn and Gunson, 2011). The Tewin Lands are not captured by Environment Canada (2015) as providing critical habitat for Western Chorus Frog. Surveys of the Tewin lands in 2022 detect both species, but densities and distribution were not exceptional. As such, it considered unlikely that ECCC would provide protection for these species in the Tewin lands, but the possibility of such cannot be completely ignored.

Species that are listed as Special Concern under the ESA are not afforded individual or habitat protection under the Act. However, these species and their habitats may be protected by the municipality if habitat areas meet the criteria for Significant Wildlife Habitat for Special Concern species (MNRF, 2015). As such, discussion regarding species listed as Special Concern under the ESA is from a perspective of Significant Wildlife Habitat through the remainder of this report.

Two bird species listed as Threatened were observed within the Tewin Lands during breeding bird surveys in 2022: Bobolink and Eastern Meadowlark. Additionally, at the time of field studies, Barn Swallow was listed as Threatened under the ESA. On January 25, 2023, however, Barn Swallow was downlisted to Special Concern under Ontario Regulation 230/08. Now that the species is listed as special concern, it no longer receives protections under the ESA; however, its habitat may receive protection as Significant Wildlife Habitat for Special Concern Species (see Section 2.4.4.6), and Barn Swallow individuals, eggs, and nests will still receive protection under the Migratory Bird Convention Act.

Potential impacts to individual Bobolink and Eastern Meadowlark can largely be mitigated by minimizing the amount of vegetation clearing to what is immediately required and completing vegetation clearing outside of the breeding bird window (April 15 to August 30), thereby minimizing impacts to vegetation while birds are present and nesting. The removal of habitat, however, can only be completed under a "net benefit permit" administered by the MECP. The "net benefit" would likely involve the development and/or maintenance of compensatory habitat.

Bobolink and Eastern Meadowlark

Bobolink was detected during the breeding bird surveys on May 31 and June 13, 2022. It was documented at Breeding Bird Station BBS-S2, representing a regenerating hydro line at the edge of the golf course. Eastern Meadowlark was detected during the breeding bird surveys on May 31, June 13, and June 30, 2022, also at Breeding Bird Station BBS-S2. It was also detected as an incidental observation on April 4, 2022, in the northwest corner of the Tewin Lands. The General Habitat Descriptions for Bobolink and

[4] SARA 80(4)(c)(ii)
[5] SARA 80(4)(c)(ii)(A)
[6] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/orders/western-chorus-frog-longueuil-emergency-protection-order-summary.html

Eastern Meadowlark (MECP, 2021b; MECP, 2021c) outline the various categories of habitat and their protection.

Bobolink and Eastern Meadowlark are obligate grassland species that nest on the ground. They breed and forage in tall grasslands and open areas, including hayfields, pastures, agricultural fields, abandoned fields, and cultural meadows that are greater than 5 ha in size. Ideal nesting habitat contains tall grass with abundant litter and grass cover, low shrub and woody vegetation cover, and very little bare ground (McCracken et al., 2013; MECP, 2021b; MECP, 2021c).

Potential impacts to individual birds can largely be mitigated by minimizing the amount of vegetation clearing to what is immediately required and completing vegetation clearing outside of the breeding bird window (April 15 to August 30), thereby minimizing impacts to vegetation while birds are present and nesting. The removal of habitat, however, can only be completed under a "net benefit permit" administered by the MECP. The "net benefit" would likely involve the development and/or maintenance of compensatory habitat.

2.4.4.5 Wildlife Habitat

Guidelines and criteria for the identification of Significant Wildlife Habitat (SWH) in ecoregion 6E (in which Tewin resides) are provided by MNRF (2015a). Under the *Significant Wildlife Habitat Criteria Schedules* (MNRF, 2015a), potential SWHs are identified based on the presence both of certain habitat types (generally based on the presence of specific ELC ecosite) and of the presence of certain numbers and/or groupings of species. Areas including the appropriate habitat (i.e., supporting ecosite or land cover element/feature above a defined size threshold) and with defining species occurring in the broader vicinity area described as "candidate" (e.g., a pond >500 m^2 may be deemed a candidate Amphibian Breeding Wetlands Habitat if anurans had potential access to it during the breeding season). Such areas that have been directly observed as supporting the relevant species are defined as "confirmed" (e.g., if the pond in the previous example was found to support large numbers of two more breeding anuran species). Note, however, that even though a feature or area may be deemed "confirmed" as SWH per the *Significant Wildlife Habitat Criteria Schedules*, the designation (and subsequent protection) of the wildlife habitat as "significant" is a municipal matter. As such, the City of Ottawa is ultimately responsible for designating an area as SWH and determining the appropriate protections and/or mitigation measures. The determination of "significance" will be supported by an EIS to determine the relative importance of the feature(s) in terms of ecologically functions, representation or amount, and contributing to the quality and diversity the geographic region. Smaller or degraded areas qualifying as "confirmed" SWHs under the provincial guidelines may be deemed as "not significant", for example, where more expansive or higher quality such features exist nearby.

The Tewin Lands is associated with 15 types of habitats that meet the MNRF's criteria for candidate SWH (Table 18). Of those 15, only three potentially meet the MNRF's criteria for confirmed SWH, based on the results of the 2022 field studies. For these areas, relevant species were identified as using some portion of the available potential habitat. The species surveys employed for this preliminary report, however, were intended to observe general presence only, and were not designed to delineate detailed boundaries of habitat usage.

Table 18 Summary of the types of Significant Wildlife Habitat associated with the Tewin Lands

Type of Significant Wildlife Habitat (candidate/confirmed[1])	MNRF Criteria for Candidate/Confirmed Significant Wildlife Habitat (MNRF, 2015) Satisfied within the Tewin Lands[2]	Rationale
Raptor Wintering Area (candidate)	Criteria for Candidate SWH for Hawks/Owls: Presence of at least one ELC unit from the following land classes: Forest (FOD, FOM, FOC) and Upland (CUM, CUT, CUS, CUW). Sites must be >20 ha with a combination of forest and upland.	The Tewin Lands are characterized as a mosaic of forested areas and open meadows and fields. FOD, FOM, FOC, and CUM units were detected within the Tewin Lands.
Bat Maternity Colonies (candidate)	Criteria for Candidate SWH: All ELC Ecosites in the following ELC Community Series: FOD, FOM, SWD, SWM.	The Tewin Lands include numerous mature forest ecosites within FOD, FOM, SWD and SWD ecosites, many of which support >10 large diameter (>25 cm DBH) wildlife trees per hectare.
Turtle Wintering Areas (candidate)	Criteria for Candidate SWH for Snapping and Midland Painted Turtles: ELC Community Classes: SW, MA, OA and SA; ELC Community Series FEO and BOO. Water must be deep enough not to freeze to the bottom and have soft mud substrates.	The Tewin Lands include SW and MA ELC Community Classes. Water depth in most of the wetlands and drains is too shallow to allow for overwintering; however, portions of Bear Brook and other drains may provide sufficient depth for overwintering. Additional depth measurements and turtle surveys would be required to confirm this SWH.
Deer Yarding Areas (candidate)	Criteria for Candidate SWH: ELC Community Series including FOM, FOC, SWM, and SWC	The Tewin Lands include FOM, FOC, SWM, and SWC ELC Community series. Note that MNRF determines this type of SWH.
Deer Winter Congregation Areas (candidate)	Criteria for Candidate SWH: All forested Ecosites associated with the following ELC Community Series: FOC, FOM, FOD, SWC, SWM, SWD. Conifer plantations much smaller than 50 ha may also be used.	The Tewin Lands include units within FOC, FOM, FOD, SWC, SWM and SWD ELC Community Series. Note that woodlots providing SWH as Deer Winter Congregation Areas are generally >100 ha in size; the largest contiguously wooded area within the Tewin Lands is ~81 ha. The Tewin Lands also include small areas of conifer plantations.
Waterfowl Nesting Area (candidate)	Criteria for Candidate SWH: All upland habitats adjacent to the following wetland ELC Ecosites: MAS1, MAS2, MAS3, SAS1, SAM1, SAF1, MAM1, MAM2, MAM3, MAM3, MAM5, MAM6, SWT1, SWT2, SWD1, SWD2, SWD3, SWD4. A waterfowl nesting area extends 120 m from a wetland.	The Tewin Lands include upland areas adjacent to units within MAS1, MAM1, MAM3, SWT3.
Bald Eagle and Osprey Nesting, Foraging and Perching Habitat (candidate)	Criteria for Candidate SWH: ELC Forest Community Series: FOD, FOM, FOC, SWD, SWM and SWC directly adjacent to riparian areas – rivers, lakes, ponds and wetlands.	The Tewin Lands include units within FOD, FOM, FOC, SWD, and SWM ELC Community Series that are adjacent to wetlands and/or watercourses or drains.
Woodland Raptor Nesting Habitat (candidate)	Criteria for Candidate SWH: All forested ELC; may also be found in SWC, SWM, SWD and CUP3 All natural or conifer plantation woodland/forest stands >30 ha with >10 ha of interior habitat.	The Tewin Lands include units within FOD, FOM, FOC, SWD and SWM ELC Community Series, some of which are >30 ha with >10 ha of interior habitat.
Turtle Nesting Areas (candidate)	Criteria for Candidate SWH: Exposed mineral soil (sand or gravel) areas adjacent (<100 m) or within the following ELC Ecosites: MAS1, MAS2, MAS3, SAS1, SAM1, SAF1, BOO1, FEO1. Note that areas on the sides of municipal or provincial road embankments and shoulders are not SWH.	The Tewin Lands include ELC units within MAS1 Ecosites, with adjacent exposed mineral soils.
Amphibian Breeding Habitat (woodland) (confirmed)	Criteria for Confirmed SWH: Studies confirming two or more of the listed frog species (Gray Treefrog, Spring Peeper, Western Chorus Frog, Wood Frog) with Call Level Codes of 3.	Anuran surveys undertaken in 2022 detected Spring Peeper and Wood Frog at a Call Level Code of 3 within FOC, FOM and SWM ELC Community Classes associated with MMP-S9.

Type of Significant Wildlife Habitat (candidate/confirmed[1])	MNRF Criteria for Candidate/Confirmed Significant Wildlife Habitat (MNRF, 2015) Satisfied within the Tewin Lands[2]	Rationale
Amphibian Breeding habitat (wetlands) (candidate)	Criteria for Candidate SWH: Classes SW, MA, FE, BO, OA, and SA. Wetlands >500 m^2	The Tewin Lands include ELC units within SW and MA ELC Community Classes that are >500m^2. No wetland areas, however, were observed to support large numbers of three of more anuran species.
Woodland Area-sensitive Breeding Bird Habitat (confirmed)	Criteria for Candidate SWH: All Ecosites associated with the following ELC Community Series: FOC, FOM, FOD, SWC, SWM, SWD Typically large, mature forest stands (>60 years old) or woodlots >30 ha.	The Tewin Lands include ELC units within FOC, FOM, FOD, SWM and SWD ELC Community Classes, including areas of mature forest and areas >30 ha in size.
Special Concern and Rare Wildlife Species (confirmed)	Criteria for Confirmed SWH: detection of the following Special Concern species during 2022: Eastern Wood-Pewee, Grasshopper Sparrow, and Wood Thrush.	The Ecosites within the Tewin Lands associated with the species observations would be considered SWH: SWM, FOCM6-1, SWDM4-3 and THD (Eastern Wood-Pewee); OAG (Grasshopper Sparrow); SWDM4-3 and FOCM6-1 (Wood Thrush). None of the habitat areas within the Tewin Lands supporting the candidate species for this SWH class, however, are considered unique in the region. They generally comprise disturbed or early successional land cover types.
Amphibian Movement Corridors (candidate)	Criteria for Candidate SWH: Corridors may be found in all ecosites associated with water, linking breeding habitat and summer habitat.	The Tewin Lands support areas of candidate amphibian breeding habitat, which may be linked to nearby areas of suitable summer habitat.
Deer Movement Corridors (candidate)	Criteria for Candidate SWH: All forested ecosites. A movement corridor must be determined when Deer Wintering Habitat is confirmed as SHW (see above)	The Tewin Lands support areas of candidate Deer wintering habitat, which may be connected by potential corridors.

[1] Candidate: MNRF identifies candidate SWH based on ELC ecosite codes and habitat criteria (MNRF, 2015a). Confirmed SWH is identified by MNRF as meeting defining criteria (e.g., obtained through specific studies). Note that protection of either candidate or confirmed SWH is the decision of the municipality.

[2] MNRF (2015) includes extensive criteria for candidate and confirmed SWH. This table includes only a subset of the criteria that are met within the Tewin Lands.

The two types of SWH that met the criteria for Confirmed SWH are described in greater detail in the sections below.

Significant Wildlife Habitat for Birds

Portions of the Tewin Lands meet the definition of confirmed SWH for Special Concern Species, specifically Eastern Wood-pewee, Grasshopper Sparrow, and Wood Thrush. In particular, portions of the SWM, FOCM6-1, SWDM4-2, and THD ELC units corresponding to occurrence records may provide SHW for Eastern Wood-pewee and Wood Thrush. Portions of the OAG ELC unit may provide SWH for Grasshopper Sparrow.

The Tewin Lands also contain areas identified as confirmed Woodland Area-sensitive Bird Breeding Habitat, such as the FOCM6-1 ELC unit in the northwest corner of the study area (naturalizing conifer plantation), in which several area-sensitive breeding birds were observed, including Red-breasted Nuthatch, Veery, and Ovenbird, all of which exhibited probable breeding behaviour.

Significant Wildlife Habitat for Amphibians

No at-risk frog species were observed during the 2022 anuran surveys. However, portions of the Tewin Lands (ELC units FOCM6-1, SWDM4-3, and THD) meet the definition for candidate Amphibian Breeding Habitat (woodland). Two of the listed frog species (Spring Peeper and Wood Frog) were detected at a Call Level Code of 3 at MMP-S9 (i.e., wooded areas adjacent to the Johnston Municipal Drain at Anderson

Road), indicating presence of breeding populations in woodland communities there generally. Their specific breeding grounds, however, were not fully delineated communities through the study area.

2.4.4.6 Other Natural Heritage Features

The Tewin Lands do not contain Significant Valleylands or Earth/Life Science Areas of Natural and Scientific Interest.

3.0 RAMSAY CREEK

3.1 Introduction

Ramsay Creek is a tributary of the Greens Creek located in the east end of Ottawa, Ontario, of which 0.4 km is encompassed within the northwest section of the Tewin Lands. The purpose of this section is to describe current ecological conditions of Ramsay Creek in the vicinity of the Tewin Lands. The subsections that follow include Section 3.2 Description of the Study Area, 3.3 Methods, and 3.4 Observations and Interpretation.

3.2 Description of the Study Area

Ramsay Creek is a tributary of Greens Creek and is part of the Rideau Valley watershed. It is approximately 10 km long, 0.4 km of which is encompassed within the northwest section of the Tewin Lands. Ramsay Creek flows from the northwest corner of the Tewin Lands to its confluence into Greens Creek (roughly 10 km downstream from the Tewin Lands) which eventually flows into the Ottawa River. The catchment of Ramsay Creek is comprised of wetlands, forest, meadows, and agricultural/rural lands, measuring 22.6 square kilometers (RVCA, 2019). RVCA (2019) provides a detailed description of Ramsay Creek and its catchment features.

3.3 Methods

3.3.1 Water Quality and Temperatures

Three of the fourteen water sample stations included in Section 2 were located within Ramsay Creek (S7, S10, and S11; Figure 60). As previously described in Section 2.3.4.2, water samples was collected from S7 (section of Ramsay Creek within the Tewin Lands), S10 (a tributary of Ramsay Creek just outside of the Tewin Lands), and S11 (section of Ramsay Creek located downstream of the Tewin Lands). Water chemistry data was compared with the PWQO values for Ontario when applicable (MOEE, 1994b). For certain metals (i.e., Aluminum, Cadmium, Copper, Lead, etc.), the PWQO values were determined by using the hardness or alkalinity values detected in the same sample. Additionally, JSFA installed one automated temperature logger in RC1 (encompassing S7) and RC5 (encompassing S11) to document variation in water temperature and to classify the thermal regime of the drain (Figure 60). JSFA also installed an automated temperature logger at S10, a section of one of the tributaries of Ramsay Creek (Figure 5, Figure 60). All temperature loggers in Ramsay Creek were installed on April 20 and removed on September 20, 2022. Using similar approaches to those described in Section 2.3.4.3, temperature data was used to conduct a thermal characterization of these two Reaches of Ramsay Creek to approximate their thermal regime and determine the species of fish that can tolerate the system.

Figure 60 Ramsay Creek study locations

Project: 1199
Map File: TEWIN199- 2404a
MTM Zone 9
(NAD 83)
Printed on: 2024-04-29

KILGOUR & Associates

3.3.2 Benthic Community Assessment

Benthic macroinvertebrates differ in their tolerance to various aquatic conditions and generally have limited mobility. Their community composition in a given location will thus integrate the effects of the stressors to which they are exposed to. Ecologists can look at different indices of composition (e.g., taxonomic richness) expressing various aspects of benthic community structure that can be indicative of the general health of the aquatic environment. As such, benthic macroinvertebrates are commonly used as indicators of the biological condition of waterbodies.

A benthic community sample was collected November 1, 2022, via a travelling kick and sweep method using a D-net at one station in Ramsay Creek located downstream of the Tewin Lands (S11-B,Figure 6; corresponding with S7, Figure 60). The sampling procedure followed the methods described in the Ontario Benthos Biomonitoring Network: Protocol Manual (Jones et al., 2007), covering 10 m in 3 minutes. Samples were transferred to a 500 µm sieve bucket, rinsed into 2 L sample jars, and preserved with approximately 500 mL of 70% ethanol. Supporting physical data were also collected from each sampling station. Field forms documented the relevant site description (e.g., channel morphology, surrounding riparian vegetation, substrate content, etc.) and time of day of the collection, while site photographs documented the view of each sampling station in the following ways: (1) upstream; (2) downstream; and (3) across. Sediment samples were collected and analyzed for grain size and total organic carbon (TOC). Additionally, a calibrated YSI Pro multiprobe water quality meter was used in the field during the time of sample collection to record water temperature, pH, conductivity, and dissolved oxygen concentrations.

Benthic macroinvertebrate samples were processed using the whole-sort or teaspoon method of OBBN (Jones et al., 2007). Sample jars were emptied onto a 250-µm sieve and rinsed to wash off residual ethanol. From the sieve, samples were emptied into a large white sorting tray, with a separate tray for each sampling station. With eyes closed, a random spoonful of sample was taken from the tray and transferred into a smaller clear petri dish. Petri dishes were observed under a dissection microscope and macroinvertebrates were identified to taxonomic order per OBBN protocol (Jones et al., 2007). This process was repeated until 300 organisms were identified and tallied per sample. If 300 organisms were reached within a sample before the entire sample was processed, then the weight of the sorted and unsorted portion of the sample were each taken to calculate the percent of the sample sorted and to estimate the total abundance per sample without processing the entire sample. If an entire sample was sorted and had less than 300 organisms, the total weight of the sorted sample was taken.

The proportion (percent) of the permanent aquatic organisms identified for each sampling station was calculated, which can indicate if the section of the surveyed watercourse is a permanent and stable aquatic ecosystem. For this study, Oligochaeta (aquatic earthworms), Hirudinea (leeches), Isopoda (sow bugs), Bivalvia (molluscs), Amphipoda (side-swimmers), Hydracarina (water mites), Hemiptera (true bugs), Coleoptera (beetles), and Gastropoda (snails) were considered to be permanent aquatic organisms.

The percentages of gravel, sand, silt, and clay in the inorganic fraction of the sediment samples were determined by a combination of dry sieving and gravimetric hydrometry following (Bouyoucos, 1962).

3.3.3 Fish Community Assessment and Habitat Characterization

Fish community assessment and habitat characterization for Ramsay Creek were based primarily on the fisheries work completed in September 23 and 29, 2022 within the portion of Ramsay Creek located within the Tewin Lands as well as a 3 km section downstream of the Tewin Lands (RC1 to RC4; Figure 60). A fish habitat assessment for an unnamed Ramsay Creek tributary (RC6), located just outside of the Tewin Lands and adjacent to Leitrim Road, was also conducted on June 16, 2023 (Figure 60). Non-lethal backpack electrofishing was used to assess the resident fish community within five reaches (broken up unevenly) of the Forrester Branch Drain, one of which (RC5) fell within the Tewin Lands while the other four (RC1 to RC4) were situated upstream of the Tewin Lands (Figure 7). Backpack electrofishing is effective at depths greater than 0.1 m, making RC4 unfishable as it was dry during the time of the fish survey. Captured fish were enumerated and identified to species before being returned to the water. Effort was recorded at each reach as electrofishing seconds and was used to estimate CPUE. Supporting information collected during the fish surveys included channel morphology information such as depth and width of the wetted channel, vegetation species present, and water quality data collected with a handheld meter (YSI Pro Plus). Additionally, data collected by GEO Morphix (2022) during their rapid geomorphological field assessments was used to complement the dataset to describe the general aquatic habitat characteristics. Some of the data used included observations on erosion as well as the calculated Rapid Geomorphological Assessment (RGA) and Rapid Stream Assessment Technique (RSAT) scores.

3.4 Observations and Interpretation

3.4.1 Water Quality

Surface water quality data for the water samples collected from Ramsay Creek (S7 and S11, Figure 60) on three occasions (spring, mid-summer, and fall) during the 2022 field study can be found in Appendix B. The intention was to collect water samples at S10, a tributary of Ramsay Creek, at the same frequency as S7 and S11. However, water samples could only be collected during the Spring as this tributary was dry during the summer and fall. As a result, an additional water sample was collected at S10 in 2023 to complement the 2022 dataset. This resulted in an 8-sample dataset for water samples collected within the Ramsay Creek watershed. Overall, PWQOs were exceeded for total phosphorus (100% of the water samples collected), total iron (100% of the water samples collected), total chromium (50% of the water samples collected), cobalt (25% of the water samples collected), and total vanadium (13% of the water samples collected). The elevated levels of phosphorus are explained by the surrounding agricultural land uses. The metal levels are considered to pose limited risks to biota considering the hardness of the water (which binds with and / or competes with biological uptake sites with metals).

Water collected from the most upstream station in Ramsay Creek (S7) classified as very hard water (hardness = 194 ± 51 mg $CaCO_3$/L; ±SD, n=3) while the water samples collected from the downstream section of Ramsay Creek (S11) and one of the tributaries of Ramsay Creek (S10) classified as hard water (hardness = 171 ± 59 mg $CaCO_3$/L; ±SD, n=3 and 128 ± 69 mg $CaCO_3$/L; ±SD, n=2, respectively). The average pH values for all the Ramsay Creek sample stations fell in between the PWQO range (between 6.5 and 8.5). Only one water sample collected from S7 in July had a pH value outside of the PWQO range (8.7). High pH can be an issue if ammonia levels are high because it can result in unionized ammonia levels increasing. In this case, and for a surface water tributary, a pH of 8.7 would pose negligible risk of elevated levels of unionized ammonia. Dissolved oxygen concentrations for all Ramsay Creek sample stations were

on average above the PWQO value (4 mg/L) but one water sample collected from S7 and S11 in July (1.9 mg/L and 3.7 mg/L, respectively) were below the PWQO.

Similar to the Bear Brook watershed, total phosphorus concentrations detected in the water samples collected from Ramsay Creek (S7 and S11) and one of its tributaries (S10) exceeded interim PWQO value for streams (0.03 mg/L). Total phosphorus concentrations for S7, S10, and S11 ranged from 0.040 mg/L to 1.05 mg/L (n=8) (Appendix B) and were, therefore, roughly 20 times higher than the PWQO value at S7 while they were ~6 times and 2 times higher than the PWQO value at S11 and S10, respectively. As in Ramsay Creek, the elevated phosphorus levels are most likely caused by runoff from agricultural fields (Riemersma et al. 2006).

Total iron concentrations detected in Ramsay Creek exceeded the PWQO value (0.3 mg/L). Total Iron concentrations ranged from 0.36 mg/L to 2.85 mg/L and was highest at S7 (1.28 ± 1.37 mg/L; ±SD, n=3) (Appendix B).

The hexavalent speciation of chromium (i.e., chromium VI) is much more toxic than chromium (III) (Katz & Salem, 1993), and since the Tewin Lands water samples were analyzed for total chromium, the chromium concentrations detected in the water samples were compared to the chromium (VI) PWQO value to be conservative. Total chromium concentrations detected in Ramsay Creek during the spring sampling event were below detection levels and as a result, also below the PWQO value for chromium VI (0.001 mg/L). However, the total chromium concentrations in the water samples collected from S7 and S11 during the Summer and Fall sampling events (all 0.002 mg/L) exceeded the PWQO value (Appendix B).

Only a few water samples collected from Ramsay Creek slightly surpassed total cobalt and total vanadium PWQO values (0.0009 mg/L and 0.006 mg/L, respectively). The water sample collected from S11 in the Spring had total cobalt (0.0011 mg/L) and total vanadium (0.007 mg/L) concentrations exceeding the PWQO values while water samples collected in the spring at S7 (0.0014 mg/L) had total cobalt concentrations exceeding the PWQO value (Appendix B).

Given that the water quality of the section of Ramsay Creek surveyed does not meet the PWQO, Ontario's Policy 2 would apply for any activities influencing surface waters, which states that Ramsay Creek "shall not be further degraded and all practical measures shall be undertaken to upgrade the water quality to the Objectives" (MOEE, 1994a).

3.4.2 Thermal Characterization of Ramsay Creek

From the JFSA water temperature data, the daily maximum water temperature between July 1 and August 31, 2022, in Ramsay Creek (S7 and S11) ranged from 17.6 °C to 27.4 °C (Table 19). As before, one of the surveyed tributaries of Ramsay Creek (S10) was dry or almost dry through July and August of 2022. Temperature nomograms for S7 (located in the Tewin Lands) and S11 (located downstream of the Tewin Lands) (Figure 61) indicate these sections of Ramsay Creek are cool-warm and warm-water systems, respectively.

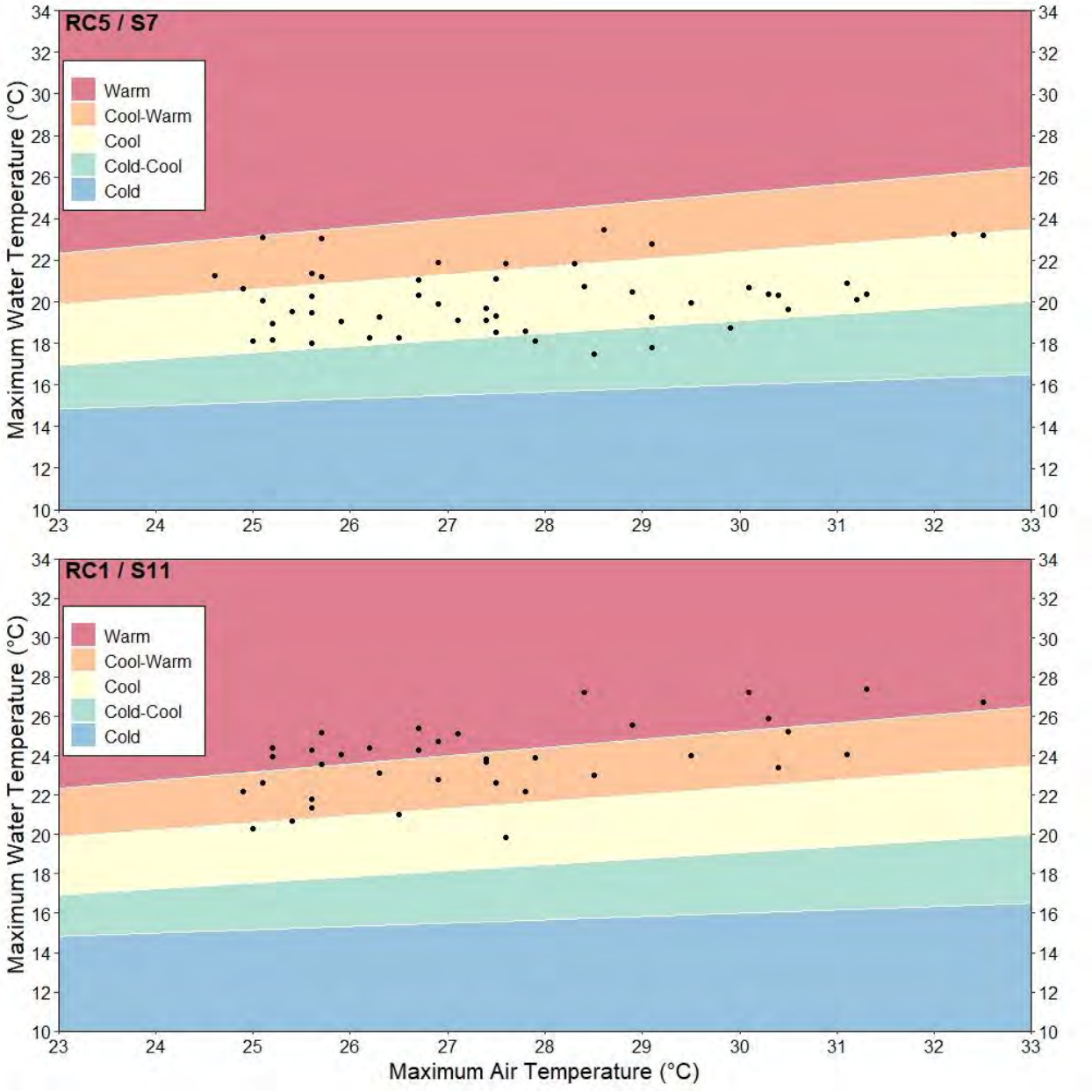


Figure 61 Nomogram for the S7 and S11 stations of Ramsay Creek

Table 19 Temperature regimes for two stations on Ramsay Creek

Station	Sample Size (Days)	Min Water Temperature from July to August (°C)	Max Water Temperature from July to August (°C)	Temperature Regime
S7	50	17.47	23.46	Cool-Warm
S11	37	19.84	27.36	Warm

3.4.3 Benthic Community Assessment

Physio-chemical Conditions of the Surveyed Watercourses

The water temperature recorded at the Ramsay Creek benthos sample station on November 1, 2022, was 7.2 °C. The pH value at the Ramsay Creek benthos sample station was 6.8 while the dissolved oxygen and specific conductivity were 12.1 mg/L and 1356 µS/cm, respectively.

Benthic Community Composition

Benthic community sampling was carried on November 1, 2022, at one sampling station in Ramsay Creek (S11,Figure 60) located downstream of the Tewin Lands, adjacent to Ramsayville Road and upstream of the Hwy 417 bridge. The total number of benthic invertebrates identified was 100 belonging to five taxonomic orders (Appendix J). The relative abundance of taxa representing the benthic community of the surveyed station within Ramsay Creek is provided in Table 20.

The benthic community assessment revealed that the surveyed station within Ramsay Creek is subjected to degraded environmental conditions. The benthic community was dominated by worms (Oligochaeta; 46.0%) and midges (Chironomidae; 40.0%) (Table 20), both of which are known to tolerant to degraded conditions. This is further supported by the relatively low taxonomic richness (6). Worms are also resistant to dryer environments but are still considered to be permanent aquatic organisms. The fish habitat characterization conducted at this station (further discussed in Section 3.4.5.1) revealed that this section of Ramsay Creek is a permanent watercourse which is also supported by the relatively high proportion of permanent aquatic organisms (52%). The benthic community assessment produced a benthic community typical for freshwater ecosystems and no Stoneflies were identified, indicating that there are no cold-water influences in this section of Ramsay Creek. All benthic macroinvertebrates identified in this section of Ramsay Creek are warm-water tolerant.

Table 20 Relative (percent) abundance of benthic families collected from the sample station in Ramsay Creek located upstream of the Tewin Lands, November 2022

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	S11
						2021
Arthropoda	Malacostraca	—	Isopoda	—	—	5
Arthropoda	Malacostraca	Eumalacostraca	Amphipoda	—	—	1
Arthropoda	Insecta	—	Trichoptera	—	—	5
Arthropoda	Insecta	—	Plecoptera	—	—	3
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	40
Annelida	Clitellata	Oligochaeta	—	—	—	46
Proportion of Aquatic Organism						**52**
Number of Taxa (Order & Family)						**6**

Table Notes: * Permanent aquatic organisms include: Amphipoda (side-swimmers), Bivalvia (molluscs), Coleoptera (beetles), Gastropoda (snails), Hemiptera (true bugs), Hirudinea (leeches), Isopoda (sow bugs), Hydracarina (water mites), and Oligochaeta (aquatic earthworms)

3.4.4 Electrofishing Results

From the fish community assessment of the Ramsay Creek completed in fall 2022, there were no invasive fish species, nor fish species that are currently listed under the *Endangered Species Act* or the *Species At Risk Act* that were caught. White Suckers were the only "sport fish" caught within Ramsay Creek. All fish captured are common to Eastern Ontario and are all tolerant to warm waters. Fourteen species of fish were captured in the section of Ramsay Creek located in and downstream of the Tewin Lands (S7; Table 21). The creek was broken up into five different reaches (Figure 7). For the reaches where fish were caught (i.e., excluding RC4, which was dry at the time of survey), the CPUE ranged from 0.24 fish/minute at RC5 to 20.3 fish/minute at RC2. Most fish captured in 2022 belong to the Cyprinidae (65%) and Catostomidae (25%) families, while the remaining families (Leuciscidae, Gasterosteidae, Percopsidae, and Centrarchidae) represented less than 5% of the total catch effort. The Cyprinids represented the most diverse family with seven species captured but the catch rates were highest for White Sucker (Catostomus family) representing 25% of the total catch. Overall, the species of fish most captured in the sections of Ramsay Creek surveyed were the White Sucker, Creek Chub, and Fathead Minnow. A summary of in-situ water quality and temperature data recorded in Ramsay Creek while conducting the fish community assessments is provided in Table 22. While most captured fish species prefer cool water conditions (Table 23, all species of fish captured are warm-water tolerant.

Table 21 Summary of fish species caught and fishing effort for Ramsay Creek

MNRF Code	Common Name	Scientific Name	Ramsay Creek Electrofishing Reaches			
			RC1	RC2	RC3	RC5
141	Central Mudminnow	*Umbra limi*	8	13	1	6
163	White Sucker	*Catostomus commersonii*	67	74	9	0
182	Northern Redbelly Dace	*Chrosomus eos*	0	1	0	0
183	Finescale Dace	*Chrosomus neogaeus*	3	0	0	0
189	Brassy Minnow	*Hybognathus hankinsoni*	1	4	1	0
198	Common Shiner	*Luxilus cornutus*	28	26	5	0
208	Bluntnose Minnow	*Pimephales notatus*	13	51	0	0
209	Fathead Minnow	*Pimephales promelas*	30	41	0	0
211	Longnose Dace	*Rhinichthys cataractae*	0	29	2	0
212	Creek Chub	*Semotilus atromaculatus*	62	50	19	0
281	Brook Stickleback	*Culaea inconstans*	1	15	0	0
291	Trout-perch	*Percopsis omiscomaycus*	8	4	0	0
313	Pumpkinseed	*Lepomis gibbosus*	5	4	1	0
341	Johnny Darter	*Etheostoma spp.*	2	9	0	0
Total Number of Species			12	13	7	1

MNRF Code	Common Name	Scientific Name	Ramsay Creek Electrofishing Reaches			
			RC1	RC2	RC3	RC5
Total Fish Catch			228	321	38	6
Total Effort (seconds)			1243	951	261	1456
Catch Per Unit Effort (CPUE; fish/minute)			10.98	20.28	8.76	0.24

Table 22 Summary of in-situ water quality data collected at each electrofishing reaches within Ramsay Creek during the fish community assessments on September 23 and 29, 2022

Reach	Date	Time	Water Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)
RC1	2022-09-29	11:00	12.35	8.30	8.36	809
RC2	2022-09-29	12:00	13.57	8.01	9.00	360
RC3	2022-09-29	14:00	11.32	7.99	7.86	706
RC4	Dry section of Ramsay Creek at the time of the fish community assessment					
RC5	2022-09-23	12:30	12.73	9.24	6.84	891

Table 23 Thermal preference and thermals tolerance of fish species captured in Ramsay Creek

Fish Species (*Taxonomic name*)	Thermal Class	Thermal Tolerance	
		Final Temperature Preferendum (FTP)	Upper Incipient Lethal Temperature (UILT)
Bluntnose Minnow (*Pimephales notatus*)	Warm	24.1	31.5
Brassy Minnow (*Hybognathus hankinsoni*)	Cool	—	—
Brook Stickleback (*Culaea inconstans*)	Cool	21.3	30.6
Central Mudminnow (*Umbra limi*)	Cool-Warm	—	33.5
Common Shiner (*Luxilus cornutus*)	Warm	21.9	30.4
Creek Chub (*Semotilus atromaculatus*)	Cool	24.9	29.1
Fathead Minnow (*Pimephales promelas*)	Warm	26.6	31.3
Finescale Dace (*Phoxinus neogaeus*)	Cool	24.1	30.3
Johnny Darter (*Etheostoma nigrum*)	Cool	22.8	—
Longnose Dace (*Rhinichthys cataractae*)	Cool	15.3	—
Northern Redbelly Dace (*Phoxinus eos*)	Cool-Warm	25.3	29.2
Pumpkinseed (*Lepomis gibbosus*)	Warm	27.7	31.7
Trout-Perch	Cold	13.4	—

Fish Species (*Taxonomic name*)	Thermal Class	Thermal Tolerance	
		Final Temperature Preferendum (FTP)	Upper Incipient Lethal Temperature (UILT)
(*Percopsis omiscomaycus*)			
White Sucker (*Catostomus commersonii*)	Cool	23.4	27.8

3.4.5 Fish Habitat Characterization

An aquatic habitat assessment was conducted of five reaches within Ramsay Creek as well as one of the tributaries of Ramsay Creek. One of the five reaches (RC5) is found within the Tewin Lands (most upstream section; Figure 7) while the other sections of Ramsay Creek as well as the assessed Ramsay Creek Tributary are located downstream of the Tewin Lands. The section of Ramsay Creek surveyed is an unconfined run throughout its entire length where the angles of the banks generally decrease going upstream. The average bankfull width and depth of the surveyed sections of the creek are 3.7 m and 1.6 m, respectively, and during the time of the assessment (September 23 and 29, 2022), the mean wetted depth ranged from 0.10 to 0.45 m. The dominant substrates along the drain included clay/silt and sand and a summary of physical attributes of the section of the creek surveyed are provided in Table 19. From the rapid geomorphological field assessments conducted by GEO Morphix (2022) and the fish habitat characterization completed in fall 2022, the section of Ramsay Creek surveyed could support the full life cycle of resident fish species except for RC4 and S10. These are intermittent or ephemeral watercourses and do not provide suitable habitat for fish throughout the summer months (discussed below). Ramsay Creek could also function as a fish migration corridor during elevated water levels.

Table 24 Channel morphology and physical attributes of the five electrofishing reaches in Ramsay Creek

Reach	Surrounding Land Use	Valley Type[1]	Channel Form	Bank Angle[1]	Mean Bankfull Width (m)[1]	Mean Bankfull Depth (m)[1]	Mean Wetted Depth (m)	Bank Substrate[1]	Bed Substrate[1]	Evidence of Erosion and Percent[1]	RGA Classification and Score[1]	RSAT Classification and Score[1]
RC1	Forest / Meadow	Unconfined	Run	60-90°	2.17	2.08	0.45	Clay/Silt, Sand	Clay/Silt, Sand, Gravel, Cobble	Undercutting, banks slumping (60-100%)	In Transition (0.28)	Fair (16)
RC2	Meadow	Unconfined	Run	60-90°	—	—	0.25	Clay/Silt, Sand	Clay/silt, Sand, Gravel, Cobble	—	—	—
RC3	Meadow	Unconfined	Run	60-90°	—	1.78	0.45	Clay/Silt, Sand	Clay/silt, Sand, Gravel, Cobble	Fluvial Entrainment (5-30%)	In Transition (0.40)	Fair (20)
RC4	Meadow	Unconfined	Flat/Run	30-60°	—	1.78	0	Clay/Silt, Sand, Gravel	Clay/Silt, Sand	Fluvial Entrainment (5-30%)	In Transition (0.34)	Good (26)
RC5	Forest	Unconfined	Flat/Run	0-30°	5.18	0.69	0.10	Clay/Silt, Sand	Clay/Silt, Hard/Dry Organic	N/A	In Regime (0.10)	Good (30)
RC6 (RC4-1-1)[1]	Meadow	Unconfined	Flat/Run	60-90°	3.83	2.20	—	Clay/Silt	Clay/Silt	Fluvial entrainment (<5%)	In Regime (0.18)	Fair (19)

[1] Information collected from GEO Morphix (2022)

3.4.5.1 Reach 1

On September 29, 2022, Reach 1 (RC1) of Ramsay Creek (Figure 62) was surveyed. The unconfined reach starts adjacent to the Ramsayville Road, upstream of the Hwy 417 bridge under which Ramsay Creek flows. This section of the creek was roughly 0.5 km long and encompassed a meadow/forested area. RC1 is mainly composed of a run, and the wetted width (average of 2.17 m) generally decreased going upstream. The average bankfull depth is 2.08 m, and on September 29, it had an average water depth of 0.45 m. RC1 is a perennial watercourse with a clearly defined bed and banks (60-90° angle), and evidence of sorted substrate. The bed substrate consisted of clay/silt, sand, gravel, and cobble while the banks substrate consisted of clay/silt, and sand. The sloping, undercut banks have been subjected to erosion (60-100%), and this section of the watercourse is classified as in transition (RGA score of 0.28), maintaining a fair degree of stream health (RSAT score of 16; GEO Morphix, 2022). Multiple tile drainage inputs into Ramsay Creek were observed, mainly downstream of the Reach, but no direct groundwater seeps were observed within the creek corridor. Emergent and submergent vegetation were scarce in this section of the creek where 5% of the Reach was covered by Common Duckweed (*Lemna minor*) and 10% was covered by Arrowhead (*Sagittaria* spp.). Riparian vegetation was dominated by herbaceous species, including *Phragmites* spp., Reed-canary Grass (*Phalaris arundinacea*), Canada Goldenrod (*Solidago canadensis*), Spotted Joe-Pye Weed (*Eutrochium maculatum*), and Purple Loosestrife (*Lythrum salicaria*). Based on the water quality data (not meeting the PWQO for several parameters), the fish habitat and community characterization (not critical habitat for endangered species), and benthic community assessment (dominated by Oligochaeta and Chironomidae as well as a relatively low number of taxa), this section of Ramsay Creek shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species and could function as a migration corridor.

Figure 62 Photo demonstrating Reach 1 within Ramsay Creek just adjacent to Ramsayville Road (photo taken on September 29, 2022)

3.4.5.2 Reach 2

Reach 2 (RC2) is roughly 0.5 km long and is located upstream of RC1 where Ramsay Creek starts to narrow moving further upstream. The water depth of RC2 was generally shallower than RC1, and the surrounding habitat transitions from a meadow area into more of a forested area where the canopy cover is generally higher (Figure 63). On September 29, RC2 had an average water depth of 0.25 m. No submergent or floating vegetation were observed while small portions of the creek had emergent vegetation (5% of the channel composed of Arrowhead). The upper section of the unconfined Reach is influenced by a beaver dam as well as a washout road (upstream of the old culvert; Figure 64) forming a barrier for fish movement when the survey was conducted. RC2 is a perennial watercourse with a clearly defined bed and banks, and evidence of sorted substrate. The substrate consisted of mainly silt/clay and sand. This section of Ramsay Creek shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species. It however unlikely functions as a migration corridor due to physical barriers.

Figure 63 Photo demonstrating Reach 2 within Ramsay Creek just upstream of Reach 1 (photo taken on September 29, 2022)

Figure 64 Photo demonstrating the physical barrier caused by the washed road within Reach 2 of Ramsay Creek (photo taken on September 29, 2022)

3.4.5.3 Reach 3

Reach 3 (RC3) is located just upstream of RC2 and is roughly 1.8 km long, encompassing a meadow area. This section of Ramsay Creek had no submergent, floating, nor emergent vegetation within the channel while the shoreline was covered by vegetation (same species as in RC1), shading 90-100% of the creek. The average bankfull depth is less than RC1 (1.78 m) but on September 29, water levels in RC3 were similar to RC1 (both 0.45 m). The bankfull width of RC3 was smaller than RC1, forming a V-shape creek rather than a U-shape creek as observed in RC1 (Figure 65). RC3 is an unconfined perennial watercourse with a clearly defined bed and banks, and evidence of sorted substrate. The bed substrate consists of clay/silt, sand, gravel, and cobble while the banks substrate consists of clay/silt and sand. The RGA and RSAT scores (0.40 and 20, respectively) for this section of the creek suggests that it is in transition and is maintaining a fair degree of stream health (GEO Morphix, 2022). No visible barriers were observed within RC3 of Ramsay Creek suggesting that it could be used as a migration corridor for fish species. This section of Ramsay Creek shows some degradation and is not a pristine watercourse but likely supports the full life cycle of resident fish species.

Figure 65 Photo demonstrating Reach 3 within Ramsay Creek just upstream of Reach 2 (photo taken on September 29, 2022)

3.4.5.4 Reach 4

Reach 4 (RC4) is located upstream of RC3 and is roughly 0.7 km long, falling just upstream of the Tewin Lands (Figure 66). This unconfined reach encompasses similar surrounding habitat to RC3, where the riparian vegetation are mainly herbaceous species (i.e., Reed-canary Grass). However, this reach exhibited increased tree cover, with Manitoba Maple (*Acer negundo*) also observed, as illustrated in Figure 66. The bank angle is shallower than the downstream reaches (30-60°), and the banks were composed of clay/silt, sand, and gravel. The banks also have experienced erosion (30-60%), and this section of watercourse is classified as in transition (RGA score of 0.34) but is maintaining a good degree of stream health (RSAT score of 26) (GEO Morphix, 2022). The bed substrate is composed of clay/silt and sand. A fish community assessment could not be conducted on September 29, as the entire reach was dry, suggesting that this portion of Ramsay Creek is an intermittent or ephemeral watercourse and does not provide suitable habitat for fish throughout the summer months.

Figure 66 Photo demonstrating Reach 4 within Ramsay Creek just upstream of Reach 3 (photo taken on September 29, 2022)

3.4.5.5 Reach 5

Reach 5 (RC5) is roughly 0.4 km long and is located upstream of RC4, just on the other side of Leitrim Road. This section of the Ramsay Creek is found within the Tewin Lands and encompasses a forested area (Figure 67), providing shade to the creek. The unconfined RC5 has an average bankfull width and depth of 5.18 m and 0.69 m, respectively, and on September 23, water levels were roughly 0.20 m deep. The bed substrate is composed of clay/silt and dry/hard organic material while the banks are composed of clay/silt and sand. The banks are stable where there is no evidence of erosion and this section of the creek is classified as in regime (RGA score of 0.10) and is maintaining a good degree of stream health (RSAT score of 30; GEO

Morphix, 2022). Only emergent plants were observed within this section of Ramsay Creek and was composed of *Phragmites* spp., Reed-canary Grass, Purple Loosestrife, Dotted Smartweed (*Persicaria punctata*), and *Typha* spp. The upstream end of the Reach is densely vegetated with segregated dry and wet areas with no connectivity or flow, making this section of Ramsay Creek an intermittent watercourse. At the time of survey, small channels and other draining features that would contribute water to Ramsay Creek were dry. Based on the water quality data (not meeting the PWQO for several parameters) as well as the fish community assessment (only one species of fish captured), this section of Ramsay Creek is not a pristine watercourse and does not provide critical habitat for endangered species but likely supports the full life cycle of resident fish species.

Figure 67 Photo demonstrating Reach 5 within Ramsay Creek just upstream of Reach 4, on the other side of Leitrim Road (photo taken on September 23, 2022)

3.4.5.6 Reach 6

Reach 6 (RC6) (identified as RC4-1-1 in the GEO Morphix (2022) report) is a section of one of the tributaries of Ramsay Creek located just outside of the Tewin Lands, adjacent to Leitrim Road. It is roughly 0.65 km long, with the first 0.5 km of the tributary (moving downstream) is surrounded by farmland (identified as an agricultural ditch by GEO Morphix (2022); Figure 68). The downstream reach of the tributary is encompassed by a deciduous dominant forest (Figure 69) and connects with Ramsay Creek where RC3 finished and RC4 started. The substrate of the bed of the tributary was consistent throughout and primarily composed of clay/silt. The banks have experimented negligible erosion (< 5%). GEO Morphix (2022) classified this tributary as being in a regime state based on its RGA score of 0.18 but is maintaining a fair degree of stream health (RSAT score of 19). The average bankfull width and depth is 3.83 m and 2.20 m, respectively (GEO Morphix, 2022).

Figure 68 Picture of the culvert locate in the upstream section of the unnamed Ramsay Creek tributary surrounded by the agriculture field, June 16, 2023

Figure 69 Picture of the downstream section of the unnamed Ramsay Creek tributary surrounded by the thicket, June 16, 2023

A fish habitat assessment was conducted on June 16, 2023, to complement the data collected by GEO Morphix (2022) during their rapid geomorphological field assessments in 2022. The intent was also to conduct non-lethal backpack electrofishing to assess the resident fish community within the unnamed Ramsay Creek tributary. However, the tributary was mostly dry during the field survey (Figure 70), even though there had been 12.6 mm of rainfall a couple of days prior (June 13 to June 14, 2023; Ottawa Weather Stats, 2023). The dry conditions rendered the tributary unsuitable for backpack electrofishing, as this method is only effective at water depths greater than 10 cm. This indicates that the unnamed tributary is an intermittent or ephemeral watercourse and, at most, provides marginal seasonal fish habitat during spring freshet as water was still present in the tributary at the beginning of May. The tributary also unlikely supports the full life cycle of resident fish species, especially during the drier summer months. Furthermore, the tributary is not spawning habitat for salmonid species as the required habitat characteristics (e.g., sufficient depth, suitable substrate, no physical barriers, etc.) were not present in sufficient quantity within the watercourse.

Figure 70 Picture demonstrating the water levels in the unnamed Ramsay Creek tributary (photo taken on June 16, 2023)

While no fish community assessment was conducted in 2023 during the fish habitat assessment, fish community assessments upstream (HDFs) and downstream (Ramsay Creek) of the surveyed tributary were conducted by KAL biologists in 2022 (Section 2.4.3.5). It is reasonable to assume that the same fish species identified in 2022, particularly the species captured in the upstream HDFs, could also be found in the unnamed Ramsay Creek tributary when water levels are elevated during spring freshet. The fish community assessments conducted in 2022 involved non-lethal backpack electrofishing, and the methodology used is described in Section 2.3.4.5. No invasive fish species or fish species that are currently

listed under the *Endangered Species Act* or the *Species At Risk Act* that were captured. White Suckers (*Catostomus commersonii*) were captured downstream of the unnamed Ramsay Creek tributary and were the only "sport fish" caught. All captured fish species are common to Eastern Ontario and are all tolerant to warm waters. Seven species of fish were captured in the upstream HDFs, with the most commonly captured species being Central Mudminnow (*Umbra limi*), Creek Chubb (*Semotilus atromaculatus*), and Northern Redbelly Dace (*Chrosomus eos*). Downstream of the unnamed Ramsay Creek tributary, fourteen species of fish were captured where the White Sucker, Creek Chubb, and Fathead Minnow (*Pimephales promelas*) were most commonly captured fish species.

Table 25 Fish species captured in 2022 upstream and downstream of the unnamed Ramsay Creek Tributary assessed in 2023

Common Name	Scientific Name	Upstream					Downstream					
		HDF1	HDF2	HDF3	HDF4	HDF5	HDF6	RC1	RC2	RC3	RC4	RC5
Bluntnose Minnow	*Pimephales notatus*	0	0	0	0	0	0	13	51	0	0	0
Brassy Minnow	*Hybognathus hankinsoni*	0	1	0	0	0	0	1	4	1	0	0
Brook Stickleback	*Culaea inconstans*	0	1	0	0	0	5	1	15	0	0	0
Central Mudminnow	*Umbra limi*	6	3	0	22	7	1	8	13	1	0	6
Common Shiner	*Luxilus cornutus*	0	0	0	0	0	0	28	26	5	0	0
Creek Chub	*Semotilus atromaculatus*	0	6	0	2	5	0	62	50	19	0	0
Fathead Minnow	*Pimephales promelas*	0	0	0	1	0	0	30	41	0	0	0
Finescale Dace	*Chrosomus neogaeus*	0	0	0	0	3	0	3	0	0	0	0
Johnny Darter	*Etheostoma nigrum*	0	0	0	0	0	0	2	9	0	0	0
Longnose Dace	*Rhinichthys cataractae*	0	0	0	0	0	0	0	29	2	0	0
Northern Redbelly Dace	*Chrosomus eos*	0	4	0	1	0	0	0	1	0	0	0
Pumpkinseed	*Lepomis gibbosus*	0	0	0	0	0	0	5	4	1	0	0
Trout-perch	*Percopsis omiscomaycus*	0	0	0	0	0	0	8	4	0	0	0
White Sucker	*Catostomus commersonii*	0	0	0	0	0	0	67	74	9	0	0
Total Number of Species		1	5	0	4	3	2	12	13	7	0	1
Total Fish Caught		6	15	0	26	15	6	228	321	38	0	6
Total Effort (seconds)		33	103	30	232	67	99	1243	951	261	0 - Dry	1456
Catch Per Unit Effort (CPUE; fish/minute)		10.91	8.74	0	6.72	13.43	3.64	10.98	20.28	8.76	0	0.24

The section of the tributary surrounded by agricultural fields was completely dry during the field assessment while the section of the tributary surround by a forest was wet with water levels lower than 10 cm deep. The dominant vegetation species in the first section of the tributary mainly consisted of Canadian Goldenrod (*Solidago canadensis*), Narrowleaf Cattail (*Typha angustifolia*), Broadleaf Cattail (*Typha latifolia*), Riverbank Grape (*Vitis riparia*), Fowl Mannagrass (*Glyceria striata*), Red Raspberry (*Rubus idaeus*), and Creeping Thistle (*Cirsium arvense*). Additionally, some larger trees including Box Elder (*Acer negundo*), Alder Buckthorn (*Frangula alnus*), and Black Cherry (*Prunus serotina*) were distributed sporadically throughout this section of the unnamed tributary, providing minimal shade. Furthermore, there is a small culvert that is predominantly buried that would need to be excavated to accommodate any increases in water levels (Figure 68).

The ticket surrounding the downstream section of the tributary mainly consisted of Box Elder, Alder Buckthorn, and American Elm (*Ulmus americana*), providing shade to the tributary. Most of the trees were blown down, making it difficult to walk alongside the tributary and may possibly act as barriers to fish migration, affecting their ability to move freely through the tributary (Figure 69). The ground cover in this section of the tributary mostly consisted of Common Chokecherry (*Prunus virginiana*), Fowl Mannagrass, Woodbine (*Parthenocissus vitacea*), Spotted Touch-me-not (*Impatiens capensis*), and Stinging Needle. The shade provided by larger trees in this section of the tributary is likely the reason it doesn't completely dry up, in contrast to the upstream section with minimal shade.

In the downstream section of the assessed Ramsay Creek tributary, there is an additional unnamed tributary that confluences with the assessed tributary. This tributary shares many characteristics with the downstream section of the assessed Ramsay Creek tributary, including the relative size and depth of the watercourse, substrate composition, and riparian vegetation. Water levels in this watercourse was also very low (< 10 cm) during the assessment, making this tributary unfishable by backpack electrofishing, suggesting that it also likely provides only marginal seasonal fish habitat during spring freshet.

4.0 SUMMARY OF PRELIMINARY OPPORTUNITIES: SYSTEM-BASED APPROACH TO SUSTAINABLE NATURAL HERITAGE

4.1 Tewin Perspective

The significant scale of Tewin allows for the implementation of a systems-based approach to environmental and open space planning. Potential opportunities may be guided by Algonquin values and principles, including respect for the earth, celebrating water as the source of life, integrating with nature, and achieving long-term ecological health over many generations.

Opportunities to more meaningfully integrate nature and green spaces into the community may be considered through the planning and design process. At Tewin, there is the potential to treat natural features as opportunities rather than constraints, allowing natural landscapes and water features to inform the design and character of the community. By allowing residents to access nature, Tewin can support human connection to the natural environment and its ecological systems, and promote stewardship and respect for the land.

As a new community, new parks, trails and recreational spaces can be closely integrated with the natural and open space system and designed to co-exist with natural spaces. At Tewin, there is the potential to create a cohesive system of green spaces that brings more residents closer to a variety of parks, passive open spaces, landscaped settings, recreational areas, and other open spaces. The potential integration of water and natural features into the community could also allow for the creation of an inter connected trail network that supports recreational activity and movement throughout the community and to surrounding green spaces. The integration of parks and natural lands can optimize the use of land, improve the quality of the natural environment, and enhance access to open spaces.

With these perspectives in mind, there is the potential to establish a robust, interconnected network of natural features and open spaces that extend throughout the Tewin Lands shown on the conceptual illustration in Figure 71. The green space network at Tewin could protect and enhance important natural features, while integrating parks, passive open spaces and recreational facilities with a network of streets, trailways, and rainwater management infrastructure. Within Tewin, development could occur alongside natural heritage features, with residents invited to be part of the natural system, encouraging stewardship and connection.

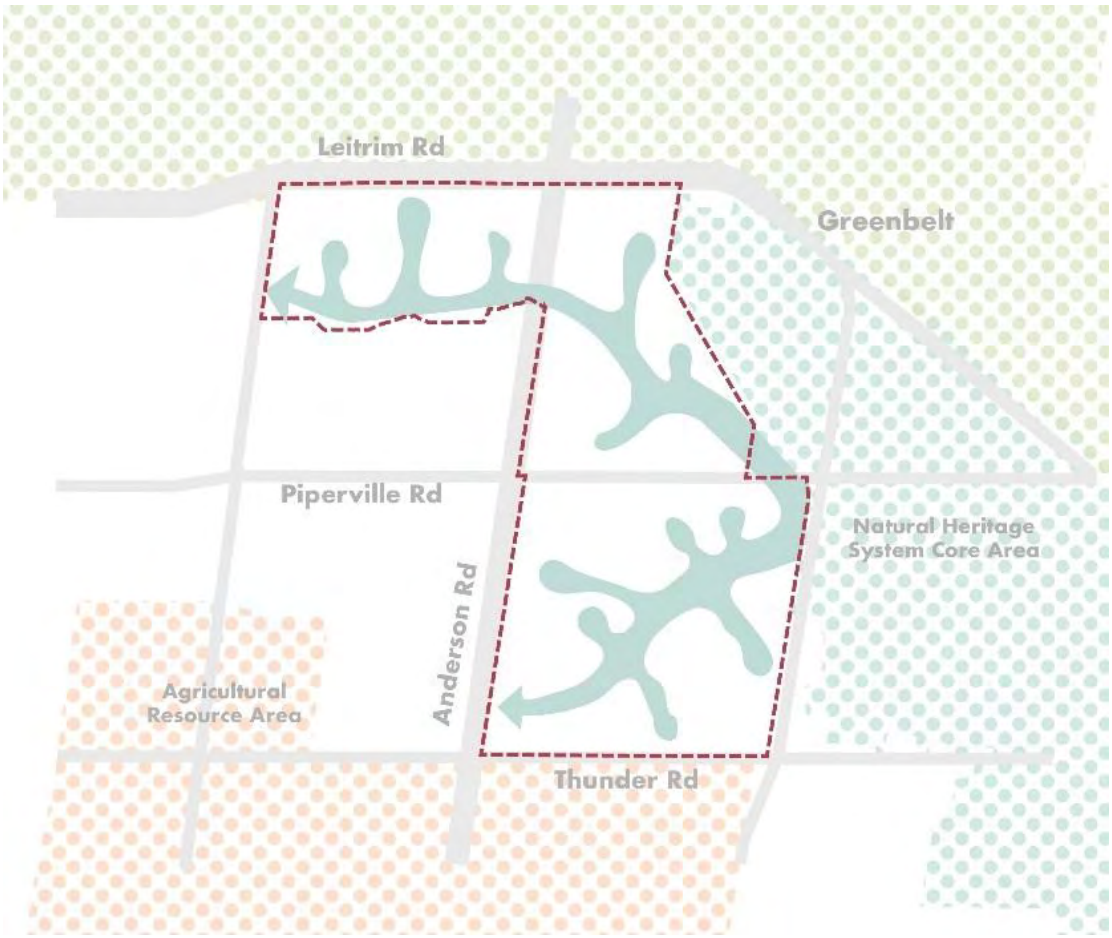


Figure 71. Opportunities for green space integration

4.2 Woodlands and Canopy

Within the 837 ha of Tewin Lands, 269 ha or 32.0% currently included forest-type cover (i.e., forests, swamps or mature plantations). Trees within the forested areas, along with smaller numbers of trees associated with other land cover types, provide an overall canopy coverage of 31.9%.

Forests within the Tewin Lands consist mostly of early successional or plantation trees that are relatively common across the region (i.e., none of forested areas are rare or unusual communities). Among the forested areas, there are ten areas of mature woodland (i.e., forested stands that have had continuous treed cover for more than 60 year). The two largest of these features are 8.9 and 10.3 ha in area. The other eight older forest stands are generally small – between 0.8 and 4.4 ha in area.

Local and provincial policies support the diversity and connectivity of Significant Woodlands, as well as their overall ecological function. The city has canopy cover targets, to support the broad benefits provided by vegetation cover which include habitat for wildlife, thermal moderation, stormwater mitigation and solar protection. The One Planet Living planning framework includes performance targets for carbon

sequestration, tree lined blocks, shaded streetscapes and canopy coverage which will promote an emphasis on planting, particularly through the urban development area to supplement natural spaces. The AOO have indicated that trees and forested areas are important cultural elements to be incorporated into the future community, with access to forest for people and long-term protection of forests. These values extend to succession planning for 7 generations (20 to 200 year forethought) and prioritizing culturally significant species such as the Eastern White Cedar, White Birch, Sugar Maple, Trembling Aspen, American Basswood, White Spruce and Tamarack.

In consideration of these diverse objectives, the community design plan for the Tewin Lands will be prioritizing the protection of the limited but substantive mature wooded areas, within a connected corridor that builds in succession, a range of natural communities, establishes long term canopy protection and integrates complimentary recreational, transportation and servicing elements. The planting of urban trees within the developed area and restoration planting in other natural areas will be an important part of the community design and sustainability component. The benefit of this approach which ties together a sustainable, robust, natural system is the efficient use of land, integration with the community and meeting multiple, mutually-supporting objectives.

4.3 Wetlands

Within the Tewin Lands, 243.6 ha or 29 % comprise wetland-type cover including marsh, meadow-marsh, thicket swamp or treed swamp (note that treed swamps also count as “forested” landcover in discussions above).

Wetland areas in the Tewin Lands occur almost entirely on formerly active agriculture fields. As such, these features are typically early successional in nature and still appear disturbed, having extensive networks of linear, agricultural ditching. Regardless, these wetlands do serve as habitat and corridors for wildlife and function as headwater areas for Ramsay Creek and Bear Brook. Municipal policies recognize the need to ensure the continuation of these ecosystem services but do not otherwise require the preservation of wetlands in their current configuration or existing (disturbed) state.

Wetlands are addressed in the One Planet Living planning framework as an important natural resource to be protected for the long term. The significant wetlands identified in the Tewin Lands to the east are being considered for conservation designation through planning instruments such as land trusts or easements. The integrated approach to supporting the diversity and connectivity of woodland features and watercourses within the green corridor network through the new community will also incorporate wetland elements. This will ensure habitat diversity and allow for wildlife corridor connections. The integration of wetlands into the overall stormwater management system for the new community can be anticipated to retain the headwater functionality of the Tewin Lands, per local and provincial policies, as both water sources and habitat areas. Combined, these approaches align with the AOO values of maintaining associations between community, nature, and water.

4.4 Watercourses

The northern edge of the Tewin Lands serves as the initial headwater area for the uppermost reaches of Ramsay Creek. The remainder of the Tewin Lands serves as a catchment area for Bear Brook through the Smith Gooding and Johnston Municipal Drains; both of those features originate upstream of Tewin.

The Ramsay Creek catchment provides habitat for 20 local fish species (RVCA, 2019), and the Bear Brook catchment supports at least 26 different species (Section 2.4.3.5). While the Smith Gooding and Johnston Municipal Drains, provide permanent fish habitat on the Tewin Lands, the remainder of the smaller channels and headwater features on the Tewin Lands in both major catchments are mostly linearized, former farm drains, with intermittent flow levels. Only two of these smaller channels were found to support fish (one in each catchment; Figure 47), each with only six, relatively-common species (Table 13). The linearized nature of the channels across the Tewin Lands is a product of the historical alteration of the landscape to support farming and does not appear to be reflective of the natural channels that once occurred there, either in length or location.

The most complete surveyed watercourse mapping from pre-agricultural disturbance is sourced from the Canadian Survey Division Department of Militia and Defence, dated 1908. In consideration of the pre-settlement landscape which reflects the natural watercourse distribution on the land, Tewin will be using this as a reference in establishing the presence of water networks throughout the Tewin Lands (Figure 72).

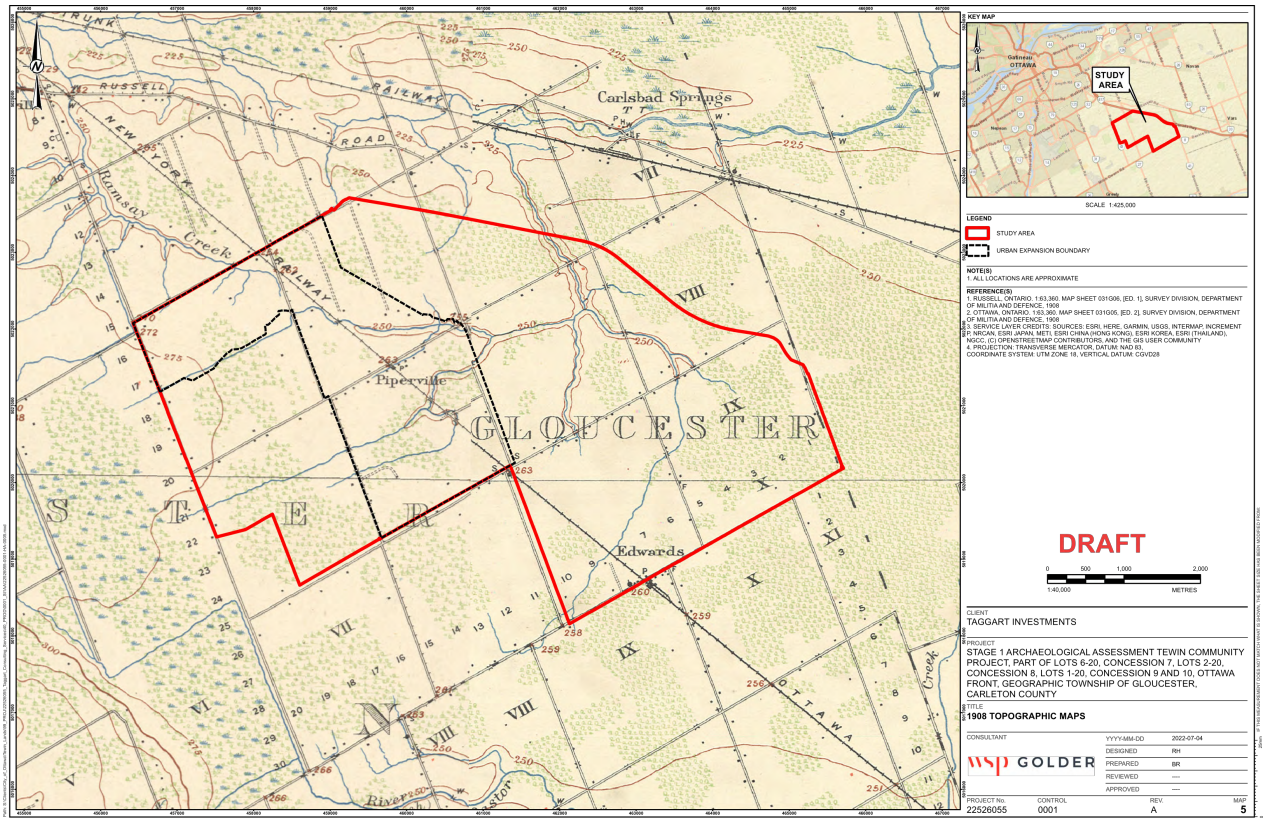


Figure 72. Historical water courses at Tewin

Existing and realigned watercourses within the Tewin Lands shall be located within green corridors forming the backbone of a natural system through the community. The associated green corridors, including a mix of wetland and forest cover, will support headwater functions and contain watercourses restored, enhanced or created with natural channel design and habitat. These will be designed to better support the broader fish communities of the Ramsay Creek and Bear Brook watersheds. In addition, services to manage and retain clean stormwater and provide access to water for recreational and cultural

interaction for the local residents will be promoted. Riparian corridors with varied buffer widths shall protect water quality and provide adjacent habitat for wildlife as prioritized by municipal and Provincial policies.

Algonquin consultation has emphasised the celebration of water, and the weaving of it through the community. Access to water is a priority, and there is an expectation that it will be integral to the green corridor system supporting passive recreational opportunities and in proximity to community nodes.

4.5 Species at risk

Species at risk that currently live, or may live, on the Tewin Lands include several species of birds, bats, and trees. Of the at-risk bird species, some species live in fallow fields (e.g., Bobolink and Meadowlark), but these areas can only provide habitat when they are actively kept as fallow fields. When fields are developed for crops (e.g., soy or corn), or lawns (e.g., residential yards, parks or golf courses), or are abandoned and evolve to successional tree growth, they cease to provide fallow field habitat. In order to successfully establish habitat long term, the Ontario Conservation Fund supports the development and maintenance of field habitats in the broader region as permanent habitat for such species, allowing current, temporary, habitat areas to be developed for other uses.

Some bird species (potentially) associated with Tewin are dependent on human structures (e.g., Chimney Swifts and Barn Swallows). The provincial government also provides approaches for the (re)creation of habitat for these birds as part of land development to support them in or near new communities.

For the remainder of at-risk bird species occurring near Tewin, as well as bat species, listed trees (such as Butternut and Black Ash), and other wildlife generally, provincial permitting processes would allow for the species to be accommodated in within the green corridors of the new Tewin community and in neighbouring forested areas ensuring their continued presence in the region.

Property to the east of the Tewin Lands, and which is owned by the Algonquins of Ontario is intended be set aside as conservation lands for wetland and other habitat opportunities. The expectation is that enhancement of these lands for species habitat will be explored.

5.0 CLOSURE

This report was prepared for exclusive use by Taggart Investments Inc. and may be distributed only by Taggart Investments Inc. Questions relating to the data and interpretation can be addressed to the undersigned.

Respectfully submitted,

KILGOUR & ASSOCIATES LTD.

Kesia Miyashita, MSc
Senior Biologist

Jon Séguin, MSc
Senior Biologist

Bruce Kilgour, PhD
President, Project Director

Anthony Francis, PhD
Senior Ecologist

6.0 LITERATURE CITED

Algonquins of Ontario and Taggart Group. 2022. Tewin: A generational opportunity to create one of Canada's most respectful and sustainable new communities Available online at: https://www.tewin.ca/

Birds Canada, Canadian Wildlife Service (Environment and Climate Change Canada), Ministry of Natural Resources and Forestry – Government of Ontario, Ontario Field Ornithologists (OFO), and Ontario Nature. 2009. Atlas of the Breeding Birds of Ontario 2001-2005. Available online at: https://www.birdsontario.org/jsp/datasummaries.jsp

Birds Canada, Environment Canada and United States Environmental Protection Agency. 2008. Marsh Monitoring Program: Participant's Handbook. Available online at: https://www.ohwetlands.org/uploads/5/0/6/9/50693061/handbook_mmp_amphibians_2009.pdf

Birds Canada, Federation of Ontario Naturalists, Ontario Field Ornithologists (OFO), Canadian Wildlife Service (Environment and Climate Change Canada), and Ministry of Natural Resources and Forestry – Government of Ontario. 2001. Ontario Breeding Bird Atlas - Guide for Participants. Available online at: https://www.birdsontario.org/jsp/download/obba_guide_en.pdf

Birds Canada, Ontario Field Ornithologists (OFO), Ministry of Natural Resources and Forestry – Government of Ontario, Environment and Climate Change Canada, and Ontario Nature. 2021. Ontario Breeding Birds Atlas: Instructions for General Atlassing. Available online at: https://www.birdsontario.org/wp-content/uploads/Instructions-for-General-Atlassing-2021-04-07-download.pdf

Bouyoucos GJ. 1962. Hydrometer Method Improved for Making Particle Size Analyses of Soils [1]. *Agronomy Journal*, *54*(5), 464–465. https://doi.org/10.2134/agronj1962.00021962005400050028x

Brownell VR and CS Blaney. 1997. Planning Our Region: Summary Natural Area Reports for Natural Areas East of Rideau River. Prepared for the Regional Municipality of Ottawa-Carleton, Planning & Development Approvals Department.

Brownell, VR and BMH Larson. 1995. An Evaluation Framework for Natural Areas in the Regional Municipality of Ottawa-Carleton Volume 2: Technical Appendices. Prepared for the Regional Municipality of Ottawa-Carleton, Planning and Property Services Department.

Cadman, M.D., P.F.J. Eagles, and F.M. Helleiner. 1987. Atlas of Breeding Birds of Ontario. University of Waterloo Press, Waterloo, Ontario.

Cadman, M.D, D.A. Sutherland, G.G. Beck, D. Lepage and A.R. Couturier. Atlas of the Breeding Birds of Ontario 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature (2007), 706 p.

California Academy of Sciences and National Geographic Society. 2022. iNaturalist. Available online at: https://www.inaturalist.org/

Chu, C., Jones, N. E., Piggott, A. R., & Buttle, J. M. 2009. Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily Maximum Air and Water Temperatures. North American Journal of Fisheries Management, 29(6), 1605–1619. https://doi.org/10.1577/M08-251.1

City of Ottawa. 2006. Greenspace Master Plan: Strategies for Ottawa's Urban Greenspaces. Available online at: https://documents.ottawa.ca/sites/documents/files/greenspace_master_plan_en.pdf

City of Ottawa. 2015. Environmental Impact Statement Guidelines. Available online at: https://documents.ottawa.ca/sites/documents/files/documents/eis_guidelines2015_en.pdf

City of Ottawa. 2021a. Official Plan. Available online at: http://ottawa.ca/en/planning-development-and-construction/official-plan-and-master-plans/official-plan.

City of Ottawa. 2021b. South Bear Brook Wetland Evaluation: Study Terms of Reference and Call-up Requirements. Prepared by: Nick Stow, Senior Planner, Natural Systems and Rural Affairs, City of Ottawa. Date: October 12, 2021

The Cornell Lab of Ornithology. 2022a. eBird: An online database of bird distribution and abundance. Available online at: https://ebird.org/home

The Cornell Lab of Ornithology. 2022b. All About Birds: Eastern Whip-poor-will. Available online at: https://www.allaboutbirds.org/guide/Eastern_Whip-poor-will

City of Ottawa. 2022. Geo Ottawa. Available online at: https://ottawa.ca/en/planning-development-and-construction/maps-and-zoning

Environment Canada. 2012. Canadian Aquatic Biomonitoring Network, field manual — Wadable streams. Environment Canada. https://publications.gc.ca/collections/collection_2012/ec/En84-87-2012-eng.pdf

Environment Canada. 2015. Recovery strategy for the Western Chorus Frog (*Pseudacris triseriata*), Great Lakes / St. Lawrence – Canadian Shield population, in Canada, Species at Risk Act Recovery Strategy Series, Environment Canada, Ottawa.

Environment and Climate Change Canada. 2022. Range map extents: Species at Risk – Canada. Available online at: https://open.canada.ca/data/en/dataset/d00f8e8c-40c4-435a-b790-980339ce3121

Fisheries and Oceans Canada (previously Department of Fisheries and Oceans, "DFO"). 2022. Aquatic Species at Risk Map. Available online at: https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html

Galli, J. 1996. Rapid Stream Assessment Technique, Field Methods. Metropolitan Washington Council of Governments.

GEO Morphix Ltd. (2022). Fluvial Geomorphology Study: Tewin Lands Secondary Plan - DRAFT Existing Conditions Summary Report Bear Brook and Ramsay Creek Watersheds.

Google LLC. 2022. Google Earth Pro. Available online at: https://www.google.com/earth/versions/

Government of Canada. 2021. Historical Climate Data. Available online at: https://climate.weather.gc.ca/

Government of Canada. 2022. Species at Risk Public Registry. Available online at: http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm

Government of Ontario. 2022. O. Reg. 23/22: Temporary Suspension of Statutory Protection for Black Ash. Filed January 25, 2022 under Endangered Species Act, 2007, S.O. 2007, c. 6. Available online at: https://www.ontario.ca/laws/regulation/r22023#:~:text=Despite%20any%20amendment%20to%20Ontario,and%20ends%20on%20January%2025%2C

Katz SA, Salem H. 1993. The toxicology of chromium with respect to its chemical speciation: a review. J Appl Toxicol. May-Jun; 13(3):217-24. doi: 10.1002/jat.2550130314. PMID: 8326093.

Hasnain, S. S., Minns, C. K., & Shuter, B. J. 2010. *Key ecological temperature metrics for Canadian freshwater fishes* (No. CCRR-17). Ontario Forest Research Institute. ISBN 978-1-4435-2279-3

Heagy, A., D. Badzinski, D. Bradley, M. Falconer, J. McCracken, R.A. Reid, and K. Richardson. 2014. Recovery Strategy for the Barn Swallow (*Hirundo rustica*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 64 pp. Available at: https://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_rs_brn_swl_en.pdf

Humphrey, C. 2017. Recovery Strategy for the Eastern Small-footed Myotis (*Myotis leibii*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 76 pp. Available online at: https://files.ontario.ca/mnrf_sar_rs_esfm_final_accessible.pdf

Humphrey, C., and H. Fotherby. 2019. Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*) and Tri-colored Bat (*Perimyotis subflavus*) in Ontario. Ontario Recovery Strategy Series. Prepared by the Ministry of the Environment, Conservation and Parks, Peterborough, Ontario. vii + 35 pp. + Appendix. Adoption of the Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), the Northern Myotis (*Myotis septentrionalis*), and the Tri-colored Bat (*Perimyotis subflavus*) in Canada (Environment and Climate Change Canada 2018). Available online at: https://files.ontario.ca/mecp-rs-bats-2019-12-05.pdf

Jones, C. F., Somers, K. M., & Reynoldson, T. B. (2007). Ontario Benthos Biomonitoring Network: Protocol manual. Dorset Environmental Science Centre. https://cdn.website-editor.net/a46ec8be333642209835c758be53898c/files/uploaded/OBBN%2520Protocol%2520Manual.pdf

Kaufman, K. 2019. Audubon Guide to North American Birds: Eastern Whip-poor-will. Available online at: https://www.audubon.org/field-guide/bird/eastern-whop-poor-will

Lee, H.R., W. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig, and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and its Application. Ontario Ministry of Natural Resources, North Bay. Available online at: https://www.researchgate.net/profile/Wasyl-

Bakowsky/publication/248626765_Ecological_Land_Classification_for_Southern_Ontario_First_Approximation_and_Its_Application/links/560e7abd08ae48337515fd59/Ecological-Land-Classification-for-Southern-Ontario-First-Approximation-and-Its-Application.pdf

McCracken, J.D., R.A. Reid, R.B. Renfrew, B. Frei, J.V. Jalava, A. Cowie, and A.R. Couturier. 2013. Recovery Strategy for the Bobolink (*Dolichonyx oryzivorus*) and Eastern Meadowlark (*Sturnella magna*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. viii + 88 pp. Available online at: https://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_rs_est_mdwlrk_en.pdf

Ministry of Environment (MOE). 2003. Ontario Ministry of Environment. Stormwater Management Guidelines.

Ministry of the Environment, Conservation, and Parks (MECP). 2021a. Barn Swallow General Habitat Description. Available online at: https://www.ontario.ca/page/barn-swallow-general-habitat-description#:~:text=Barn%20Swallows%20defend%20relatively%20small,nest)%20(M%C3%B8ller%201990)

Ministry of the Environment, Conservation, and Parks (MECP). 2021b. Bobolink General Habitat Description. Available online at: https://www.ontario.ca/page/bobolink-general-habitat-description

Ministry of the Environment, Conservation, and Parks (MECP). 2021c. Eastern Meadowlark General Habitat Description. Available online at: https://www.ontario.ca/page/eastern-meadowlark-general-habitat-description

Ministry of Environment, Conservation, and Parks (MECP). 2022. Species at Risk in Ontario. Available online at: https://www.ontario.ca/page/species-risk-ontario

Ministry of Natural Resources (MNR). 2010. Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005. Second Edition. Available online at: https://docs.ontario.ca/documents/3270/natural-heritage-reference-manual-for-natural.pdf

Ministry of Natural Resources and Forestry (MNRF). 2011. Survey Methodology under the Endangered Species Act, 2007: *Dolichonyx Oryzixorous* (Bobolink). Unpublished draft.

Ministry of Natural Resources and Forestry (MNRF). 2014a. Ontario Wetland Evaluation System: Southern Manual. 3rd Edition, Version 3.3. Available online at: https://files.ontario.ca/environment-and-energy/parks-and-protected-areas/ontario-wetland-evaluation-system-southen-manual-2014.pdf

Ministry of Natural Resources and Forestry (MNRF). 2014b. Draft Survey Protocol for Easter Whip-poor-will (*Caprimulgus vociferus*) in Ontario. OMNRF Species at Risk Branch, Peterborough, Ontario. iii + 10 pp.

Ministry of Natural Resources and Forestry (MNRF). 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E. OMNRF Regional Operations Division: Southern Region Resources Section, Peterborough, Ontario. 39 pp. Available online at: https://dr6j45jk9xcmk.cloudfront.net/documents/4775/schedule-6e-jan-2015-access-ver-final-s.pdf

Ministry of Natural Resources and Forestry (MNRF). 2022a. Natural Heritage Information Centre: Make Natural Heritage Map. Available online at: https://www.ontario.ca/page/make-natural-heritage-area-map

Ministry of Natural Resources and Forestry (MNRF). 2022b. Land Information Ontario. Available online at: https://www.ontario.ca/page/land-information-ontario

Ministry of Natural Resources and Forestry (MNRF). 2022c. Fish ON-Line. Available online at: https://www.lioapplications.lrc.gov.on.ca/fishonline/Index.html?viewer=FishONLine.FishONLine&locale=en-CA

Ministry of Environment and Energy (MOEE). 1994a. Water Management - Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy. MOEE.

Ministry of Environment and Energy (MOEE). 1994b. Water Management Policies Guidelines and Water Quality Objectives of the Ministry of Environment and Energy, July 1994. Queen's Printer for Ontario. ISBN 0-7778-8473-9 rev. Available online at: https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives#section-13

Ontario Nature. 2019. Ontario Reptile and Amphibian Atlas. Available online at: https://www.ontarioinsects.org/herp/index.html?Sort=0&area2=squaresCounties&records=all&myZoom=5&Lat=47.5&Long=-83.5

Riemersma, S., Little, J., Ontkean, G., and Moskal-Hébert, T. 2006. Phosphorus sources and sinks in watersheds: A review. 82 pp. In Alberta Soil Phosphorus Limits Project. Volume 5: Background information and reviews. Alberta Agriculture, Food and Rural Development, Lethbridge, Alberta, Canada. Available online at: https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag11864/$file/vol-5-watershed-review.pdf

Rideau Valley Conservation Authority. 2016. *McEwan Creek 2016 Summary Report* (p. 25). https://www.rvca.ca/media/k2/attachments/CSW2016_McEwan_FINAL.pdf

Rideau Valley Conservation Authority. 2019. *Ramsay Creek 2019 Catchment Report* (p. 27). https://www.rvca.ca/media/k2/attachments/CSW2019_RAMSAY_FINAL.pdf

Rideau Valley Conservation Authority. 2022. Interactive Mapping Portal. Available online at: https://gis.rvca.ca/html5/?viewer=rvcageoportal

Seburn, D.C. and K. Gunson. 2011. Has the Western Chorus Frog (*Pseudacris triseriata*) declined in Western Ottawa, Ontario? The Canadian Field Naturalist, 125:220-226.

South Nation Conservation. 2020. Public Geoportal. Available online at: https://www.nation.on.ca/resources/maps

Toronto Entomologists' Association. 2022. Ontario Butterfly Atlas. Available online at: https://www.ontarioinsects.org/atlas/

Vermont Agency of Natural Resources (VANR). 2007. Step 7: Rapid Geomorphic Assessment (RGA). Phase 2 Stream Geomorphic Assessment

Wildlife Preservation Canada et al. 2022. Bumble Bee Watch: Bumble Sightings Map. Available online at: https://www.bumblebeewatch.org/app/#/bees/map?filters=%7B%22sightingstatus_id%22:%5B%5D,%22species_id%22:%5B%2237%22%5D,%22province_id%22:%5B%5D%7D

Appendix A – SNC HDFA Information

Appendix B – Water Chemistry and Quality

Table B1 List of water quality parameters analyzed and their Provincial Water Quality Objectives (PWQO) values for the province of Ontario (Ministry of Environment and Energy, 1994b)

Parameter	Symbol	Unit	PWQO	Notes
Ammonia Total	NH_3 (total)	mg/L	—	—
Ammonia Un-Ionized	NH_3 (un-ionized)	mg/L	0.020	The percentages of un-ionized ammonia in aqueous ammonia solution for different temperature and pH conditions are listed in Table 2 (Ministry of Environment and Energy, 1994b).
Antimony	Sb	mg/L	0.020	—
Alkalinity	ALK	mg $CaCO_3$/L	—	—
Aluminum	Al	mg/L	0.075	• At pH 4.5 to 5.5, the Interim PWQO is 15 µg/L based on inorganic monomeric aluminum measured in clay-free samples. • At pH > 5.5 to 6.5, no condition should be permitted which would increase the acid soluble inorganic aluminum concentration in clay-free samples to more than 10% above natural background concentrations for waters representative of that geological area of the province that are unaffected by man-made inputs. • At pH > 6.5 to 9.0, the Interim PWQO is 75 µg/L based on total aluminum measured in clay-free samples.
Arsenic	As	mg/L	0.005	—
Barium	Ba	mg/L	—	—
Beryllium	Be	mg/L	1.1	• At hardness smaller than 75 (CaCO3 mg/L), the PWQO is 0.011 mg/L. • At hardness greater than 75 (CaCO3 mg/L), the PWQO is 1.1 mg/L.
Boron	B	mg/L	0.2	—
Bismuth	Bi	mg/L	—	—
Bromide	Br	mg/L	—	—
Cadmium	Cd	mg/L	0.0005	• At hardness smaller than 100 (CaCO3 mg/L), the PWQO is 0.0001 mg/L. • At hardness greater than 100 (CaCO3 mg/L), the PWQO is 0.0005 mg/L.
Calcium Dissolved	Ca (dissolved)	mg/L	—	—
Calcium Total	Ca (total)	mg/L	—	—
Chloride	Cl	mg/L	—	—
Chromium	Cr	mg/L	0.001	• For hexavalent Chromium (Cr VI), the PWQP is 0.0010 mg/L. • For trivalent Chromium (Cr III), the PWQP is 0.0089 mg/L.

Parameter	Symbol	Unit	PWQO	Notes
Cobalt	Co	mg/L	0.0009	—
Conductivity	—	µS/cm	—	—
Copper	Cu	mg/L	0.005	• At hardness smaller than 20 ($CaCO_3$ mg/L), the PWQO is 0.001 mg/L. • At hardness greater than 20 ($CaCO_3$ mg/L), the PWQO is 0.005 mg/L.
Dissolved Organic Carbon	DOC	mg/L	—	—
Dissolved Oxygen - Field	DO (field)	mg/L		Dissolved oxygen concentrations should not be less than the values specified in table 2 (Ministry of Environment and Energy, 1994b) for cold water biota (e.g., salmonid fish communities) and warm water biota (e.g., centrarchid fish communities).
E. Coli - Total	—	CFU/100ml	100	—
Hardness	—	mg/L	—	—
Iron	Fe	mg/L	0.3	—
Lead	Pb	mg/L	0.0005	• At hardness smaller than 30 ($CaCO_3$ mg/L), the PWQO is 0.0001 mg/L. • At hardness between 30 and 80 ($CaCO_3$ mg/L), the PWQO is 0.0003 mg/L. • At hardness greater than 80 ($CaCO_3$ mg/L), the PWQO is 0.0005 mg/L.
Magnesium Dissolved	Mg (dissolved)	mg/L	—	—
Magnesium Total	Mg (total)	mg/L	—	—
Manganese	Mn	mg/L	—	—
Mercury Total	Hg (total)	(µg/L)	0.2	—
Molybdenum	Mo	mg/L	0.04	—
Nickel	Ni	mg/L	0.025	—
Nitrate	NO_3^-	mg/L	—	—
Nitrite	NO_2^-	mg/L	—	—
Nitrite + Nitrate Total	$NO_2^- + NO_3^-$	mg/L	—	—
Nitrogen - Total Kjeldahl	TKN	mg/L	—	—
Nitrogen Total	$TKN + NO_3^-$	mg/L	—	—
Potassium Dissolved	K (dissolved)	mg/L	—	—
pH - Lab	—	—	6.5 to 8.5	—

Parameter	Symbol	Unit	PWQO	Notes
pH - Field	—	—	6.5 to 8.5	—
Phosphorus Extractable	P (extractable)	mg/L	—	—
Phosphorus Total	P (total)	mg/L	0.01	• To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 0.02 mg/L. • A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 0.01 mg/L or less. This should apply to all lakes naturally below this value. • Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 0.03 mg/L.
Phosphorus Reactive	P (reactive)	mg/L	—	—
Selenium	Se	mg/L	0.1	—
Silicon Dissolved	Si (dissolved)	mg/L	—	—
Silicon Total	Si (total)	mg/L	—	—
Silver	Ag	mg/L	0.0001	—
Sodium Dissolved	Na (dissolved)	mg/L	—	—
Sodium Total	Na (total)	mg/L	—	—
Strontium	Sr	mg/L	—	—
Sulphate	SO_4^{-2}	mg/L	—	—
Temperature	—	°C	—	—
Tin	Sn	mg/L	—	—
Titanium	Ti	mg/L	—	—
Thallium	Tl	mg/L	0.0003	—
Total Suspended Solids	TSS	mg/L	—	—
Tungsten	W	mg/L	0.03	—
Turbidity - Field	—	NTU	—	Suspended matter should not be added to surface water in concentrations that will change the natural Secchi disc reading by more than 10%.
Uranium	U	mg/L	0.005	—
Vanadium	V	mg/L	0.006	—
Zinc	Zn	mg/L	0.02	—

Parameter	Symbol	Unit	PWQO	Notes
Zirconium	Zr	mg/L	0.004	—

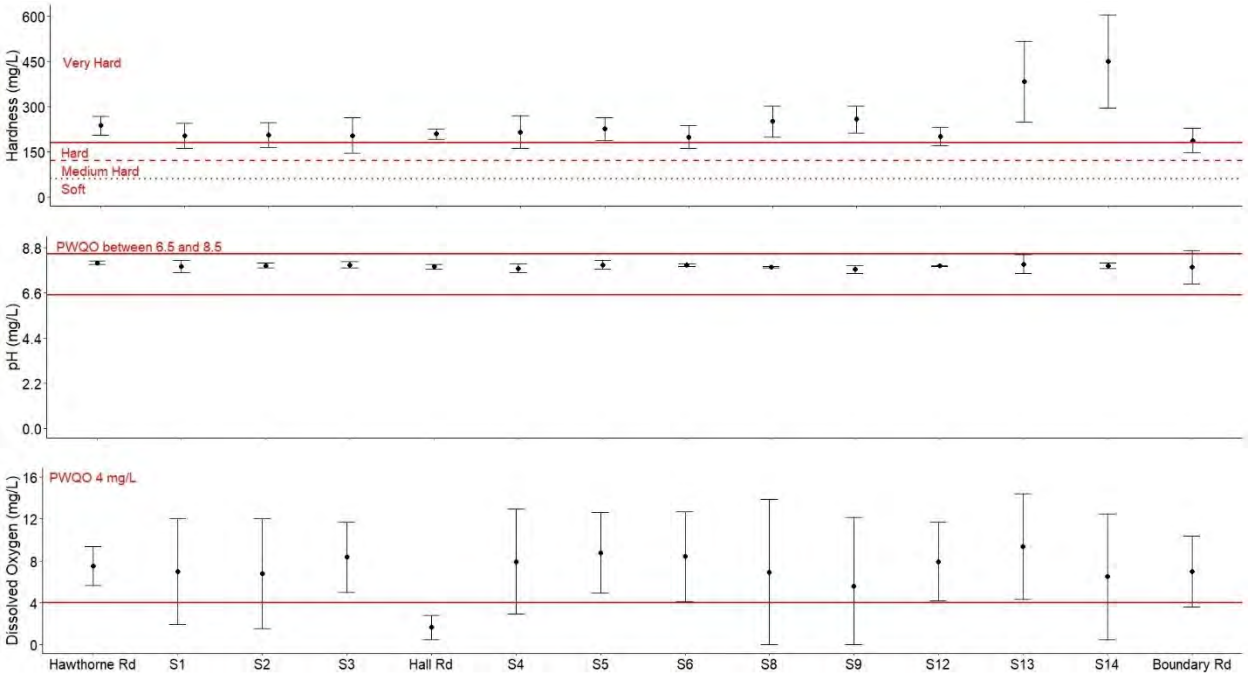


Figure B1 Harness, pH, and Dissolved Oxygen concentrations in the water samples collected from the Bear Brook Watershed. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

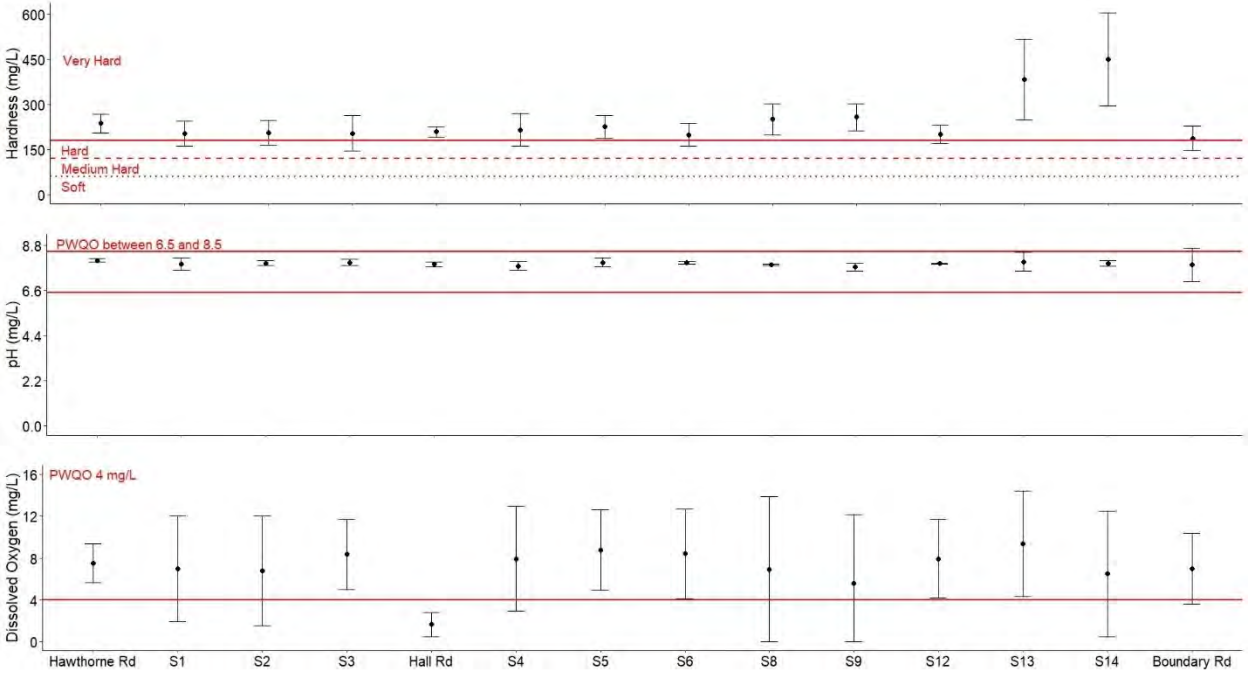


Figure B2 Total Phosphorus, Total Iron, and Total Chromium concentrations in the water samples collected from the Bear Brook Watershed. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

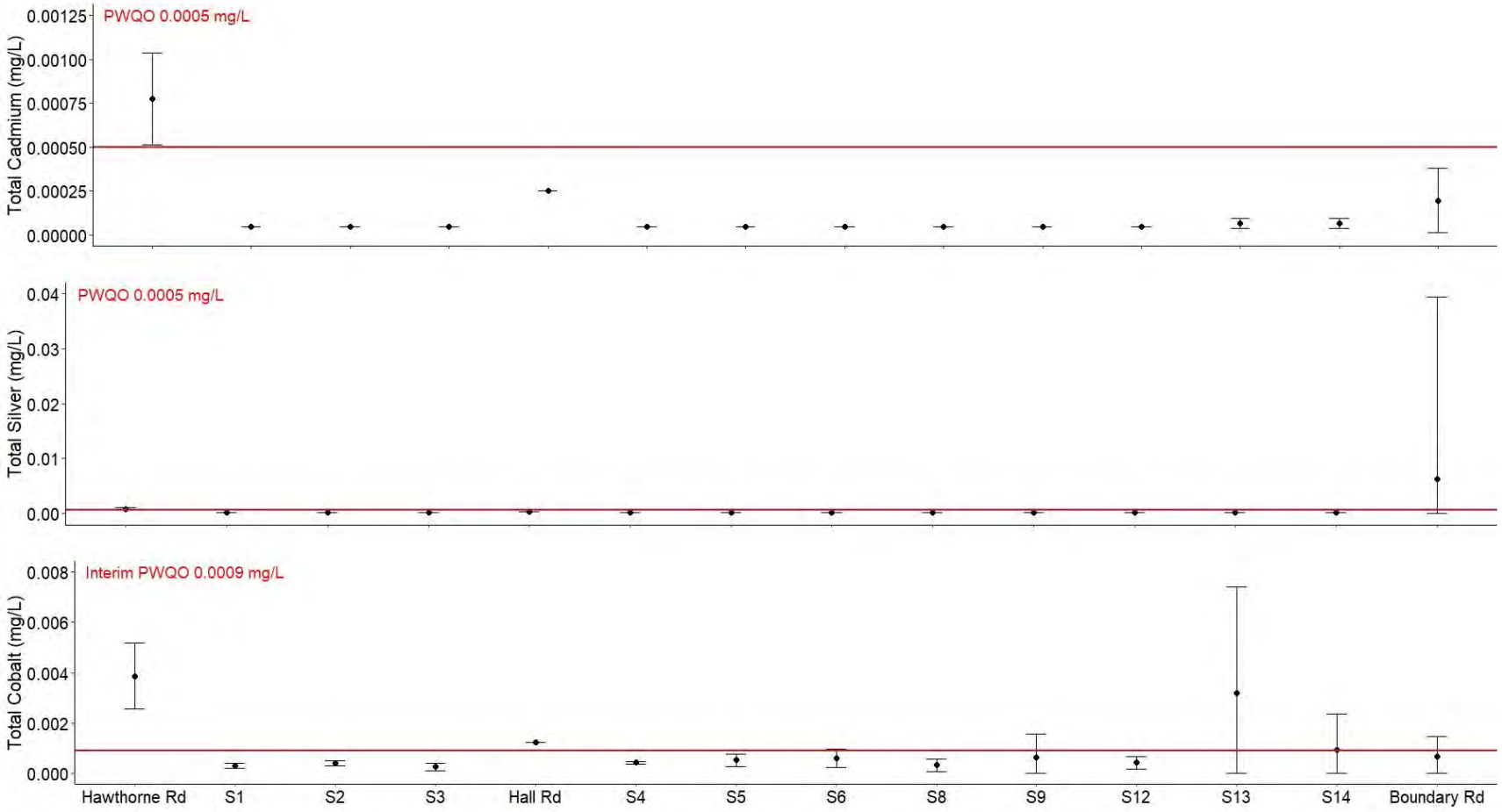


Figure B3 Total Cadmium, Total Silver, and Total Cobalt concentrations in the water samples collected from the Bear Brook Watershed. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

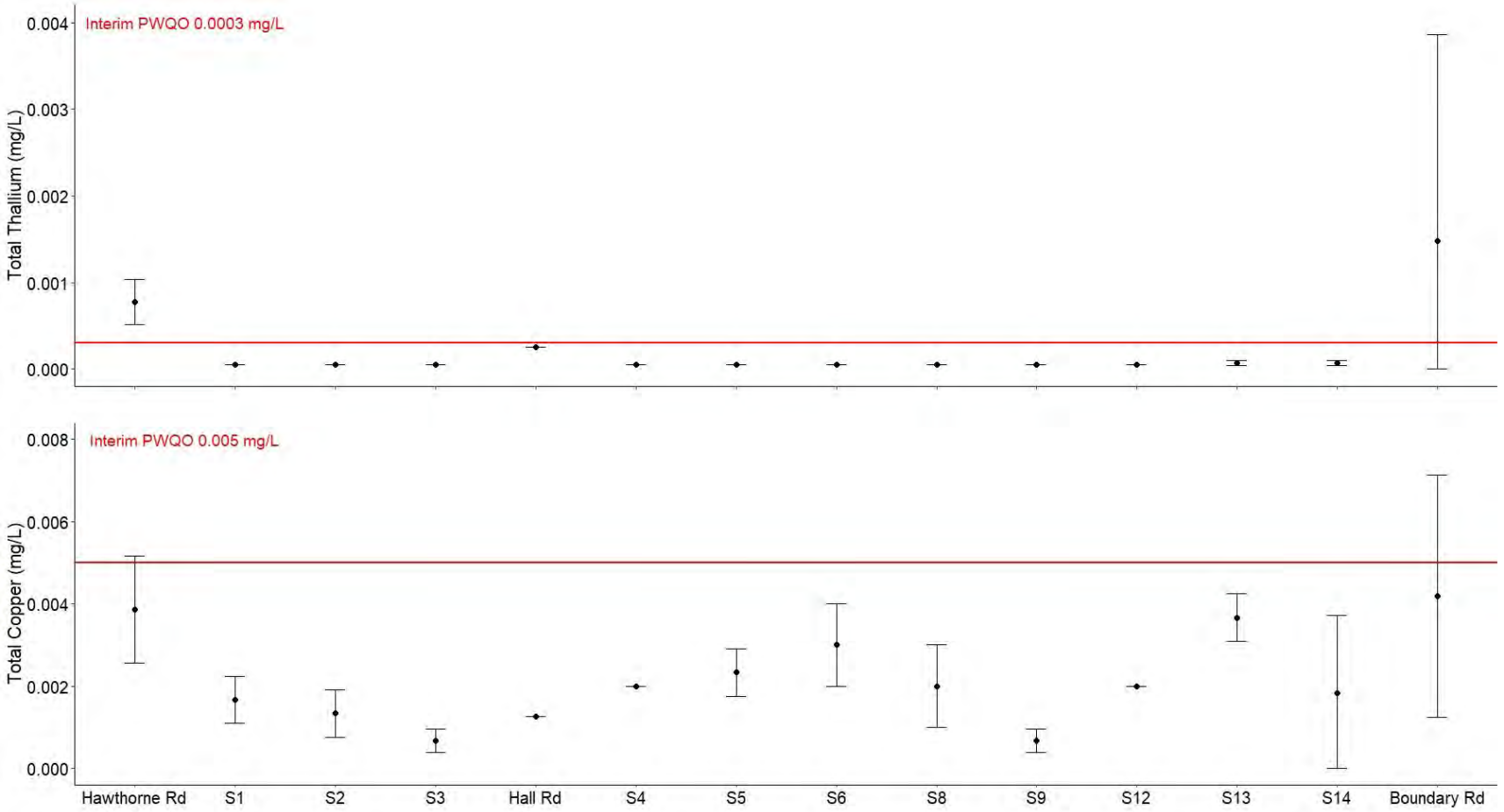


Figure B4 Total Thallium and Total Copper concentrations in the water samples collected from the Bear Brook Watershed. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

Figure B5 Harness, pH, and Dissolved Oxygen concentrations in the water samples collected from from Ramsay Creek. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

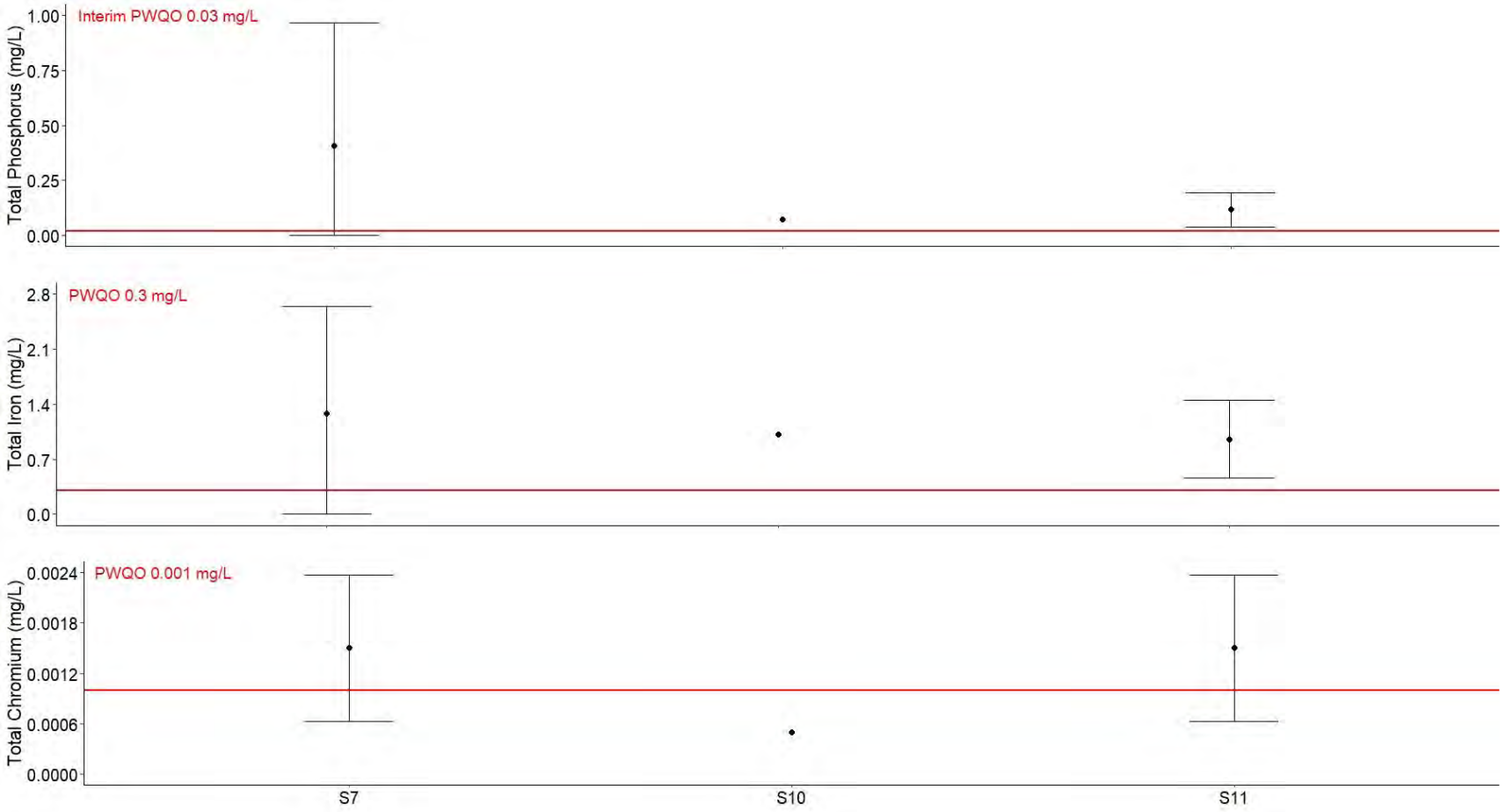


Figure B6 Total Phosphorus, Total Iron, and Total Chromium concentrations in the water samples collected from Ramsay Creek. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

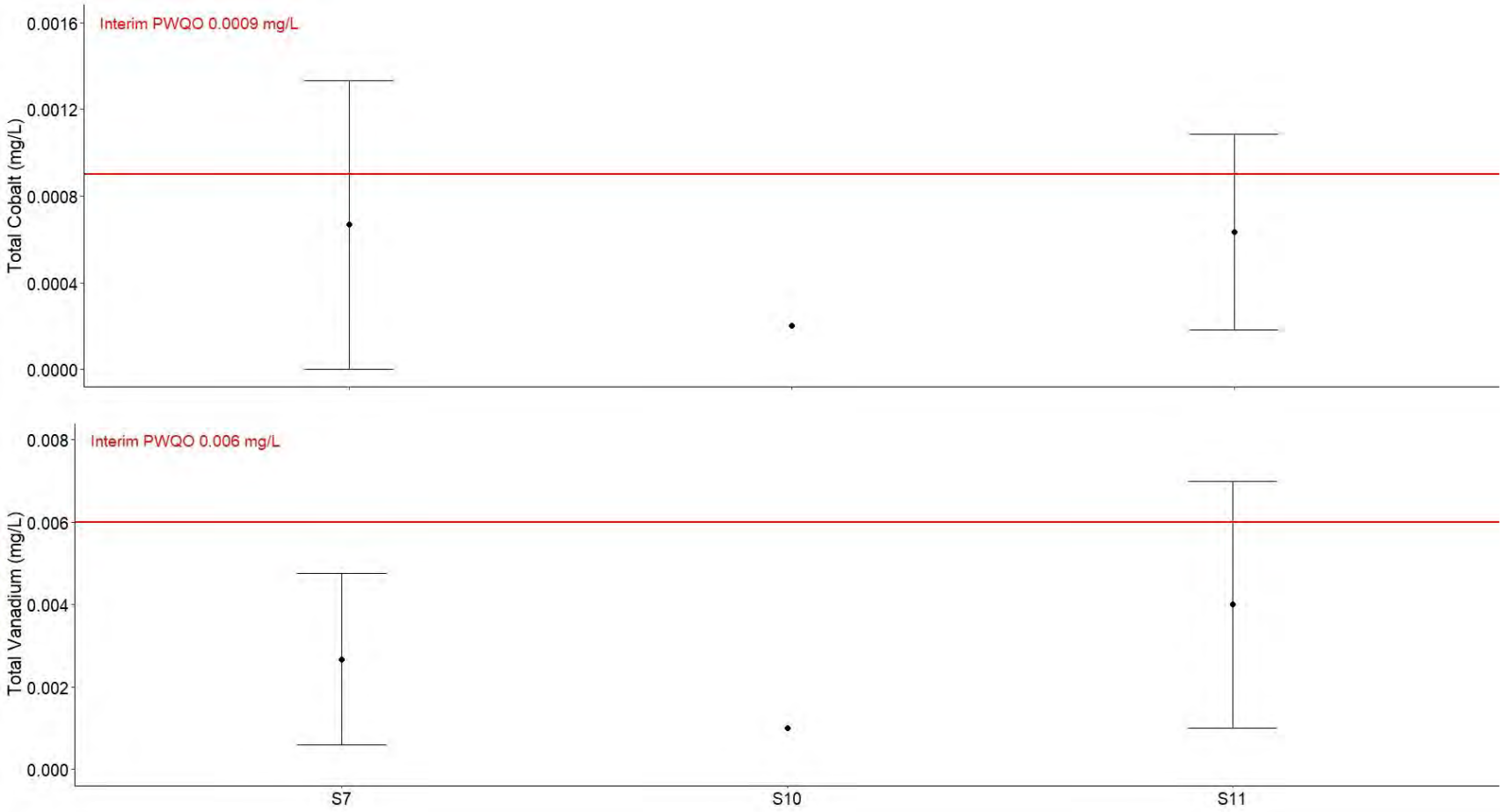


Figure B7 Total Cobalt and Total Vanadium concentrations in the water samples collected from Ramsay Creek. The red line dictates the Provincial Water Quality Objectives (PWQO) values. The whiskers depict the standard deviation

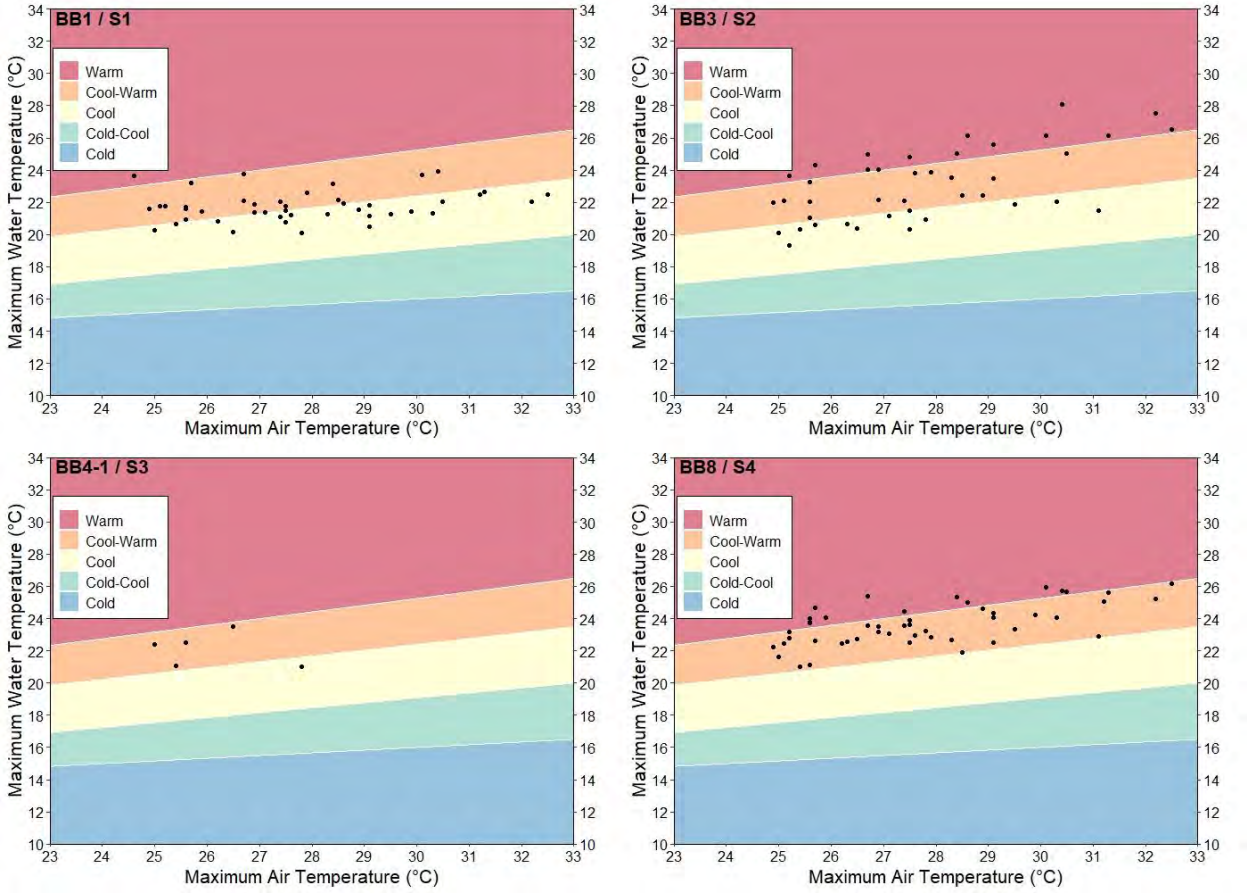


Figure B8 Nomograms for the S1, S2, S3, and S4 sample stations in the Bear Brook Watershed. Water temperature data was provided by JFSA. Following the model developed by Chu et al. (2009), the thermal regimes of the watercourses were determined by plotting the relationships between daily maximum water temperature and daily maximum air temperature (≥ 24 °C) from July 1 and August 31 when temperature loggers were fully submerged (i.e., logger depth of over 10 cm)

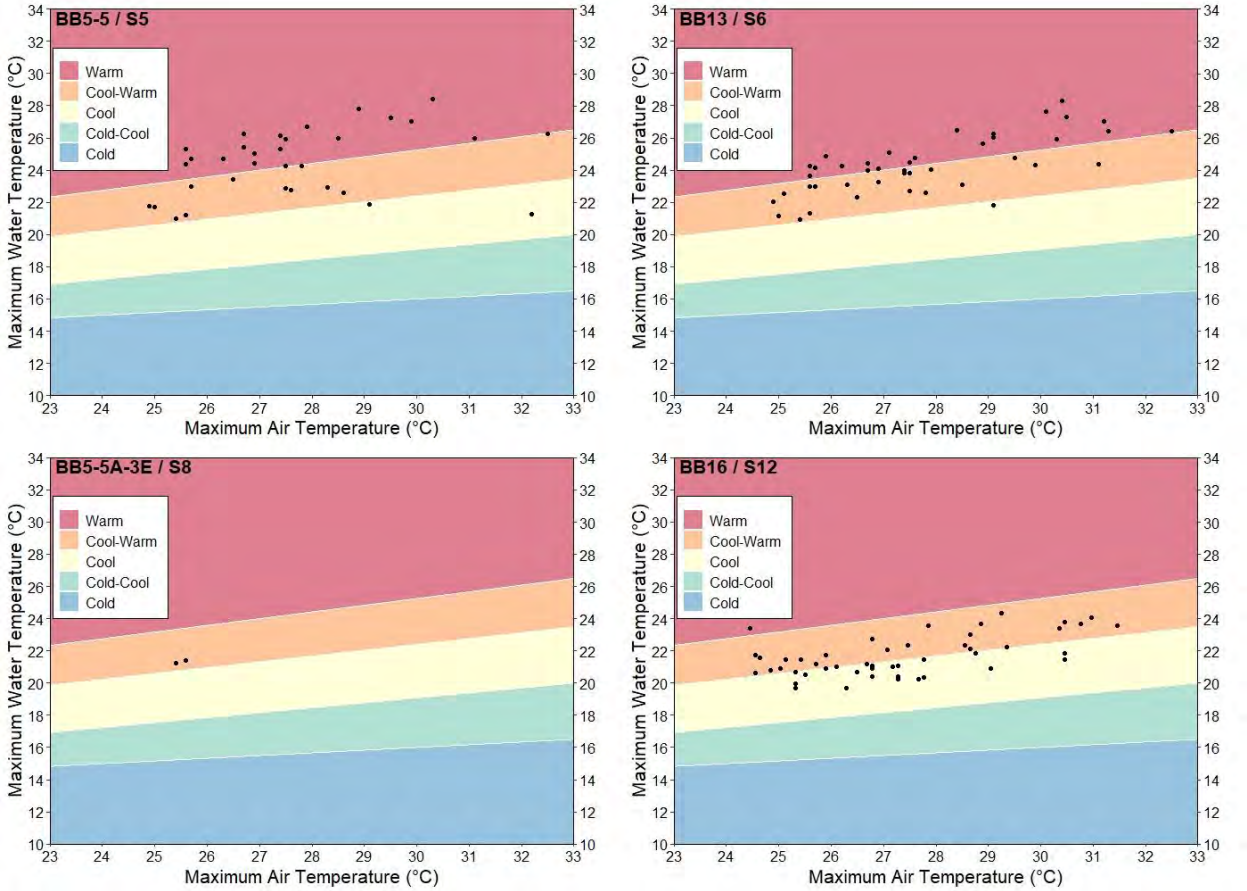


Figure B9 Nomograms for the S5, S6, S8, and S12 sample stations in the Bear Brook Watershed. Water temperature data was provided by JFSA. Following the model developed by Chu et al. (2009), the thermal regimes of the watercourses were determined by plotting the relationships between daily maximum water temperature and daily maximum air temperature (≥ 24 °C) from July 1 and August 31 when temperature loggers were fully submerged (i.e., logger depth of over 10 cm)

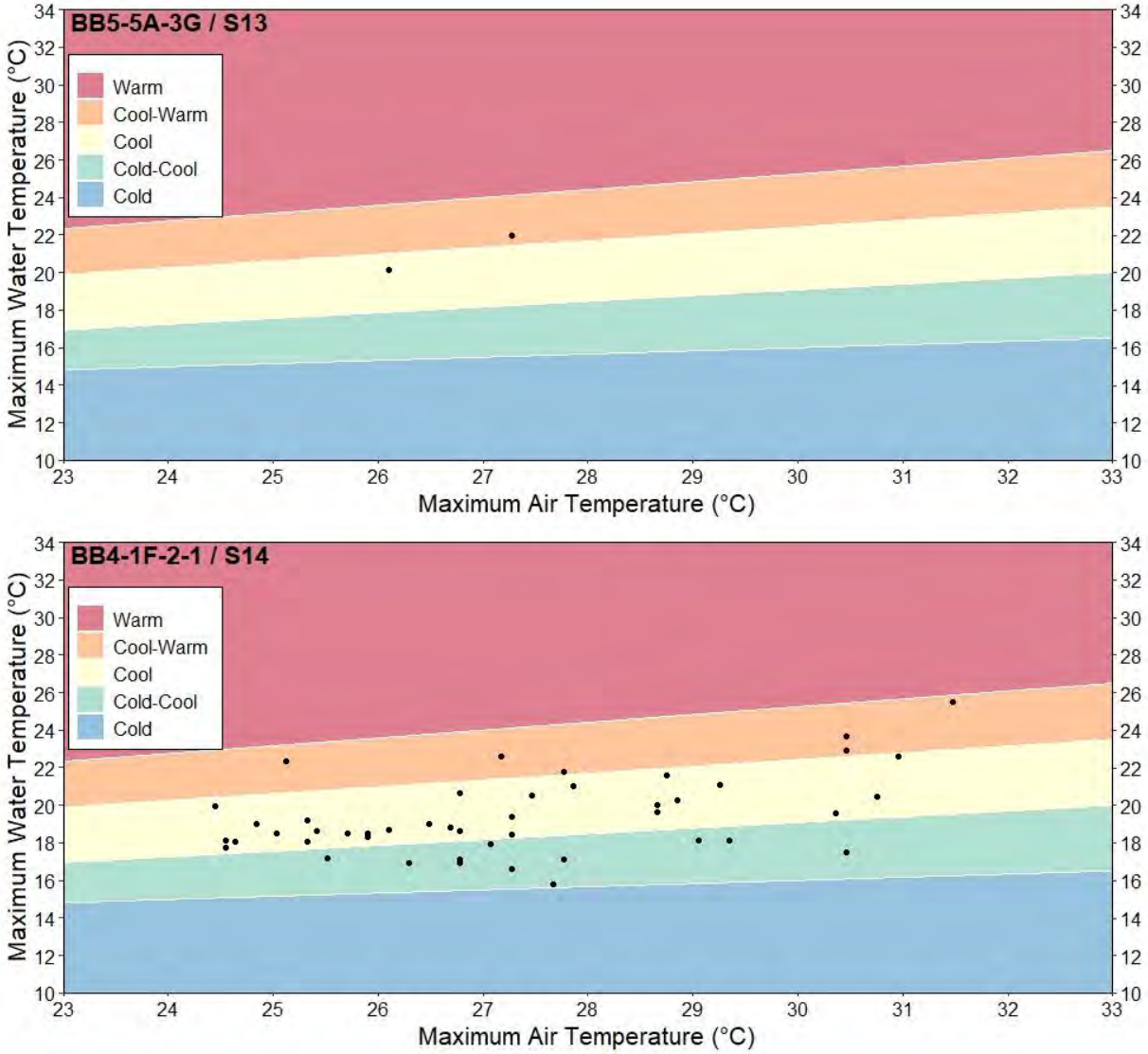


Figure B10 Nomograms for the S13 and S14 in the Bear Brook Watershed. Water temperature data was provided by GEO Morphix. Following the model developed by Chu et al. (2009), the thermal regimes of the watercourses were determined by plotting the relationships between daily maximum water temperature and daily maximum air temperature (≥ 24 °C) from July 1 and August 31 when temperature loggers were fully submerged (i.e., logger depth of over 10 cm)

Appendix C – Tewin Lands Vegetation List

Scientific Name	Common Name	Status in the City of Ottawa[7]	Notes
Trees			
Abies balsamea	Balsam Fir	Native	
Acer negundo	Manitoba Maple	Non-native	
Acer pensylvanicum	Striped Maple	Native	
Acer rubrum	Red Maple	Native	
Acer saccharum	Sugar Maple	Native	
Betula alleghaniensis	Yellow Birch	Native	
Betula papyrifera	White Birch	Native	
Betula pendula	Silver Birch	Non-native	
Fagus grandifolia	American Beech	Native	
Fraxinus pennsylvanica	Green Ash	Native	
Fraxinus sp.	Ash	Native	
Picea glauca	White Spruce	Native	
Pinus strobus	Eastern White Pine	Native	
Populus balsamifera	Balsam Poplar	Native	
Populus tremuloides	Trembling Aspen	Native	
Prunus serotina	Black Cherry	Native	
Thuja occidentalis	Eastern White Cedar	Native	
Tsuga canadensis	Eastern Hemlock	Native	
Ulmus americana	American Elm	Native	
Shrubs			
Alnus incana	Speckled Alder	Native	
Diervilla lonicera	Bush Honeysuckle	Native	
Myrica gale	Sweet Gale	Native	

[7] Brunton, DJ. 2005. City of Ottawa Urban Natural Areas Environmental Evaluation Study. Appendix A: Vascular Plants of the City of Ottawa, with the Identification of Significant Species. A report prepared for the Environmental Management Division, Planning & Growth Management Department, City of Ottawa

Scientific Name	Common Name	Status in the City of Ottawa[7]	Notes
Rhamnus alnifolia	Alder Buckthorn	Native	
Rhamnus frangula	Glossy Buckthorn	Non-native	
Ribes sp.	Gooseberry sp.	Undetermined	
Rubus idaeus	Wild Red Raspberry	Non-native	
Salix interior	Sandbar Willow	Native	
Salix sp.	Willow		
Spiraea alba	White Meadowsweet	Native	
Viburnum latanoides	Hobblebush	Native	
Viburnum opulus	Highbush Cranberry	Non-native	
Forbs			
Anemone canadensis	Canada Anemone	Native	
Aralia nudicaulis	Wild Sarsaparilla	Native	
Arisaema triphyllum	Jack-in-the-pulpit	Native	
Asclepias syriaca	Common Milkweed	Native	
Athyrium filix-femina	Lady Fern	Native	
Circaea canadensis	Eastern Enchanter's Nightshade	Undetermined	
Cirsium arvense	Creeping Thistle	Non-native	
Cirsium vulgare	Bull Thistle	Non-native	Noxious Weed (*Weed Act*)
Clematis virginiana	Virgin's Bower	Native	
Daucus carota	Queen Anne's Lace	Non-native	
Doellingeria umbellata	Flat-topped White Aster	Native	
Dryopteris carthusiana	Spinulose Wood Fern	Native	
Dryopteris sp.	Wood Fern	Native	
Equisetum arvense	Common Horsetail	Native	
Equisetum sp.	Horsetail	Native	
Equisetum sylvaticum	Woodland Horsetail	Native	
Euthamia graminifolia	Grass-leaved Goldenrod	Native	
Galium boreale	Northern Bedstraw	Native	
Galium triflorum	Sweet-scented Bedstraw	Native	

Scientific Name	Common Name	Status in the City of Ottawa[7]	Notes
Hieracium sp.	Hawkweed	Undetermined	
Leucanthemum vulgare	Oxeye Daisy	Non-native	
Linnea borealis	Twinflower	Native	
Lythrum salicaria	Purple Loosestrife	Non-native	
Maianthemum canadense	Wild Lily-of-the-Valley	Native	
Medeola virginiana	Indian Cucumber-root	Native	
Medicago sativa	Alfalfa	Non-native	
Osmunda claytoniana	Interrupted Fern	Native	
Osmunda sensibilis	Sensitive Fern	Native	
Oxalis sp.	Wood-sorrel	Native	
Pyrola elliptica	White Wintergreen	Native	
Rubus pubescens	Dewberry	Native	
Rumex acetosella	Sheep's Sorrel	Non-native	
Solidago canadensis	Canada Goldenrod	Native	
Solidago rugosa	Wrinkleleaf Goldenrod	Native	
Solidago sp.	Goldenrod	Native	
Taraxacum officinale	Common Dandelion	Non-native	
Toxicodendron radicans	Poison Ivy	Native	Noxious Weed (*Weed Act*)
Trifolium pratense	Red Clover	Non-native	
Trifolium repens	White Clover	Non-native	
Trifolium sp.	Clover	Non-native	
Urtica dioica	Common Nettle	Non-native	
Vicia americana	Purple Vetch	Native	
Vicia cracca	Cow Vetch	Non-native	
Vicia sp.	Vetch	Undetermined	
Graminoids			
Bromus inermis	Smooth Brome	Non-native	
Calamagrostis canadensis	Bluejoint Reedgrass	Native	
Carex crinita	Fringed Sedge	Native	

Scientific Name	Common Name	Status in the City of Ottawa[7]	Notes
Carex intumescens	Greater Bladder Sedge	Native	
Poaceae	Grass spp.	Undetermined	
Lolium perenne	Perennial Ryegrass	Non-native	
Phalaris arundinacea	Reed-canary Grass	Native and non-native	
Poa pratensis	Kentucky Bluegrass	Non-native	
Typha latifolia	Common Cattail	Native	

Appendix D – Bird Survey Data

Common Name	Scientific Name	Station(s) Observed	Date(s) Observed	Highest Breeding Evidence	Notes
Alder Flycatcher	*Empidonax alnorum*	BBS-S2, BBS-S4, BBS-S5, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
American Crow	*Corvus brachyrhynchos*	BBS-S1, BBS-S2, BBS-S3, BBS-S4, BBS-S6, BBS-S7, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
American Goldfinch	*Spinus tristis*	BBS-S1, BBS-S2, BBS-S3, BBS-S4, BBS-S5, BBS-S7, BBS-S8, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
American Redstart	*Setophaga ruticilla*	BBS-S1, BBS-S8, BBS-S10	2022-05-31, 2022-06-08, 2022-06-14, 2022-06-30	Possible	
American Robin	*Turdus migratorius*	BBS-S1, BBS-S2, BBS-S3, BBS-S4, BBS-S5, BBS-S6, BBS-S7, BBS-S8. BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Confirmed	
Barn Swallow	*Hirundo rustica*	NA	2022-05-31 (incidental), 2022-06-13 (incidental), 2022-06-30 (incidental)	Confirmed	Saw/heard while walking to BBS-S1 from parking lot near golf course building
Black-and-white Warbler	*Mniotilta varia*	BBS-S3, BBS-S5, BBS-S6, BBS-S8, BBS-S10	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-30	Probable	
Black-capped Chickadee	*Poecile atricapillus*	BBS-S1, BBS-S2, BBS-S4, BBS-S5, BBS-S6, BBS-S7, BBS-S9, BBS-S10,	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-30	Probable	

Common Name	Scientific Name	Station(s) Observed	Date(s) Observed	Highest Breeding Evidence	Notes
Blue Jay	*Cyanocitta cristata*	BBS-S2, BBS-S3, BBS-S4, BBS-S7, BBS-S9, BBS-S10	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-30	Probable	
Bobolink	*Dolichonyx oryzivorus*	BBS-S2	2022-05-31, 2022-06-13	Probable	Heard both days while walking to BBS-S1 from parking lot near golf course building
Broad-winged Hawk	*Buteo platypterus*	BBS-S3, BBS-S5, BBS-S7, BBS-S8, BBS-S10	2022-05-31, 2022-06-13, 2022-06-30	Probable	
Brown Thrasher	*Toxostoma rufum*	BBS-S3, BBS-S11	2022-05-31, 2022-06-30	Possible	
Canada Goose	*Branta canadensis*	BBS-S5, BBS-S10	2022-05-31, 2022-06-14	Possible	
Cedar Waxwing	*Bombycilla cedrorum*	BBS-S1, BBS-S3, BBS-S4, BBS-S6, BBS-S7, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Chestnut-sided Warbler	*Setophaga pensylvanica*	BBS-S4, BBS-S5, BBS-S6, BBS-S7, BBS-S8, BBS-S9, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Chipping Sparrow	*Spizella passerina*	BBS-S1, BBS-S4, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Common Grackle	*Quiscalus quiscula*	BBS-S1, BBS-S2, BBS-S8, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-30	Probable	
Common Yellowthroat	*Geothlypis trichas*	BBS-S1, BBS-S2, BBS-S3, BBS-S4, BBS-S5, BBS-S6, BBS-S7, BBS-S8, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Cooper's Hawk	*Accipiter cooperii*	BBS-S2	2022-06-30	Possible	
Double-crested Cormorant	*Nannopterum auritum*	BBS-S2	2022-06-13	Observed	
Downy Woodpecker	*Dryobates pubescens*	BBS-S9, BBS-S11	2022-06-30	Possible	

Common Name	Scientific Name	Station(s) Observed	Date(s) Observed	Highest Breeding Evidence	Notes
Eastern Kingbird	*Tyrannus tyrannus*	BBS-S1, BBS-S3, BBS-S4, BBS-S10, BBS-S11	2022-06-13, 2022-06-30	Probable	
Eastern Meadowlark	*Sturnella magna*	BBS-S2	2022-04-04 (incidental), 2022-05-31, 2022-06-13, 2022-06-30	Probable	Heard while walking to BBS-S1 from parking lot near golf course on 2022-05-31 and 2022-06-13; and while walking to BBS-5 on 2022-06-30 (east on golf course)
Eastern Phoebe	*Sayornis phoebe*	BBS-S1, BBS-S11	2022-06-13, 2022-06-30	Possible	
Eastern Wood-Pewee	*Contopus virens*	BBS-S3, BBS-S5, BBS-S6, BBS-S8, BBS-S9, BBS-S11	2022-05-31, 2022-06-13, 2022-06-30	Probable	
European Starling	*Sturnus vulgaris*	BBS-S1, BBS-S2, BBS-S3, BBS-S4	2022-05-31, 2022-06-13, 2022-06-30	Confirmed	
Grasshopper Sparrow	*Ammodramus savannarum*	BBS-S2	2022-05-31	Possible	
Gray Catbird	*Dumetella carolinensis*	BBS-S1, BBS-S3, BBS-S7, BBS-S8, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Confirmed	
Great Blue Heron	*Ardea herodias*	BBS-S1, BBS-S5, BBS-S7, BBS-S9	2022-05-31, 2022-06-13, 2022-06-30	Possible	
Great Crested Flycatcher	*Myiarchus crinitus*	BBS-S9, BBS-S10	2022-06-30	Possible	
Gull spp.	N/A	BBS-S2, BBS-S5	2022-05-31, 2022-06-30	Probable	
Hermit Thrush	*Catharus guttatus*	BBS-S6, BBS-S10, BBS-S11	2022-06-08, 2022-06-13, 2022-06-14	Probable	
House Wren	*Troglodytes aedon*	BBS-S1, BBS-S3, BBS-S4, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-13, 2022-06-30	Probable	
Killdeer	*Charadrius vociferus*	BBS-S2, BBS-S8, BBS-S10	2022-05-31, 2022-06-13, 2022-06-30	Probable	

Common Name	Scientific Name	Station(s) Observed	Date(s) Observed	Highest Breeding Evidence	Notes
Least Flycatcher	*Empidonax minimus*	BBS-S1, BBS-S2, BBS-S4, BBS-S10, BBS-S11	2022-05-31, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Mallard	*Anas platyrhynchos*	BBS-S1, BBS-S3	2022-05-31	Possible	
Mourning Dove	*Zenaida macroura*	BBS-S1, BBS-S2, BBS-S11	2022-05-31, 2022-06-08	Probable	
Northern Cardinal	*Cardinalis cardinalis*	BBS-S5, BBS-S8, BBS-S11	2022-05-31, 2022-06-30	Probable	
Northern Flicker	*Colaptes auratus*	BBS-S2, BBS-S3, BBS-S4, BBS-S5	2022-05-31, 2022-06-13, 2022-06-30	Probable	
Ovenbird	*Seiurus aurocapilla*	BBS-S3, BBS-S4, BBS-S5, BBS-S6, BBS-S7, BBS-S8, BBS-S9, BBS-S10	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Pine Warbler	*Setophaga pinus*	BBS-S6	2022-06-30	Probable	
Red-breasted Nuthatch	*Sitta canadensis*	BBS-S6, BBS-S7, BBS-S10	2022-05-31, 2022-06-13	Probable	
Red-eyed Vireo	*Vireo olivaceus*	BBS-S3, BBS-S5, BBS-S6, BBS-S8, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-30	Probable	
Red-winged Blackbird	*Agelaius phoeniceus*	BBS-S1, BBS-S2, BBS-S3, BBS-S4, BBS-S8, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Ring-billed Gull	*Larus delawarensis*	BBS-S11	2022-06-08	Possible	
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	BBS-S11	2022-06-08	Possible	
Ruffed Grouse	*Bonasa umbellus*	BBS-S11	2022-06-30	Possible	
Savannah Sparrow	*Passerculus sandwichensis*	BBS-S2, BBS-S4	2022-05-31, 2022-06-13, 2022-06-30	Probable	
Sharp-shinned Hawk	*Accipiter striatus*	BBS-S7	2022-05-31	Probable	

Common Name	Scientific Name	Station(s) Observed	Date(s) Observed	Highest Breeding Evidence	Notes
Song Sparrow	*Melospiza melodia*	BBS-S1, BBS-S2, BBS-S3, BBS-S4, BBS-S5, BBS-S6, BBS-S7, BBS-S8, BBS-S9, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Confirmed	
Swamp Sparrow	*Melospiza georgiana*	BBS-S7, BBS-S10	2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Tree Swallow	*Tachycineta bicolor*	BBS-S1	2022-05-31, 2022-06-13, 2022-06-30 (incidental)	Confirmed	
Turkey Vulture	*Cathartes aura*	BBS-S9	2022-06-13	Possible	
Upland Sandpiper	*Bartramia longicauda*	BBS-S2	2022-06-13	Possible	
Veery	*Catharus fuscescens*	BBS-S3, BBS-S4, BBS-S5 BBS-S6, BBS-S7, BBS-S8, BBS-S9, BBS-S10	2022-05-31, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Vesper Sparrow	*Pooecetes gramineus*	BBS-S1	2022-05-31, 2022-06-14 (incidental), 2022-06-30	Probable	Heard incidentally twice in the agricultural field while walking to BBS-S10
Warbling Vireo	*Vireo gilvus*	BBS-S1, BBS-S10	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14	Probable	
White-breasted Nuthatch	*Sitta carolinensis*	BBS-S4	2022-05-31	Possible	
White-throated Sparrow	*Zonotrichia albicollis*	BBS-S1, BBS-S2, BBS-S5, BBS-S6, BBS-S7, BBS-S8, BBS-S9 BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Wild Turkey	*Meleagris gallopavo*	BBS-S1, BBS-S2, BBS-S8, BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-30	Confirmed	
Wood Thrush	*Hylocichla mustelina*	BBS-S9, BBS-S10	2022-06-30	Possible	

Common Name	Scientific Name	Station(s) Observed	Date(s) Observed	Highest Breeding Evidence	Notes
Yellow Warbler	*Setophaga petechia*	BBS-S1, BBS-S2, BBS-S4, BBS-S5, BBS-S8, BBS-S9 BBS-S10, BBS-S11	2022-05-31, 2022-06-08, 2022-06-13, 2022-06-14, 2022-06-30	Probable	
Yellow-bellied Sapsucker	Sphyrapicus varius	BBS-S10	2022-06-30	Possible	
Yellow-rumped Warbler	*Setophaga coronata*	BBS-S7	2022-06-13	Possible	

Appendix E – Tewin Lands SAR Screening

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Birds								
Bald Eagle (*Haliaeetus leucocephalus*)	**Not at Risk (Special Concern at study outset)**	**Not at Risk**	Cornell Lab of Ornithology (2022) – ~425 m from Site	Nest in mature forests near open water. In large trees such as pine and poplar.	Mature forests occur on-site but do not occur near open water. Limited Suitability.	Low	Low	Low
Bank Swallow (*Riparia riparia*)	**Threatened**	**Threatened**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site in 1970. ~4 km from Site in 2022	Colonial nester; burrows in eroding silt or sand banks, sand pit walls, and human-made sand piles. Often found on banks of rivers and lakes.	The Site does not appear to contain ideal suitable habitat as there are no steep banks for nesting. Open and aquatic habitats on-site may provide suitable foraging habitat.	Negligible	Moderate	Low The Site is unlikely to provide suitable habitat; however, as Bank Swallow occur in the area there is potential for them to occur on the Site.
Barn Swallow (*Hirundo rustica*)	**Special Concern**	**Threatened**	This study (2022) – on-site	Nests on barns and other structures. Forages in open areas for flying insects. Lives in close association with humans and prefers to nest on structures such as open barns, under bridges, and in culverts.	The Site contains suitable habitat. Barn Swallow observed on the golf course carrying nesting material and travelling to and from buildings suitable for nesting.	High	High	High
Black Tern (*Chlidonias niger*)	**Special Concern**	**Not at Risk**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site	Build floating nests in loose colonies in shallow marshes with abundant emergent vegetation, especially in cattails.	The Site does not appear to contain suitable habitat. Although the wetlands on-site contain abundant emergent vegetation, they are graminoid (not cattail) dominated and relatively small. Black Terns prefer to nest in wetlands >20 ha but can use wetlands as small as 1.6 ha (Burke, 2012).	Negligible	Low	Low The Site is unlikely to provide suitable habitat; however, as Black Tern occur in the area there is potential for them to occur on the Site.
Bobolink (*Dolichonyx oryzivorus*)	**Threatened**	**Threatened**	This study (2022) – on-site	Breeds in hayfields, pastures, agricultural fields, and abandoned fields with tall grass that are ≥5 ha, and preferably >30 ha.	The Site contains suitable habitat. Bobolink detected in agricultural fields on-site.	High	High	High
Canada Warbler (*Cardellina canadensis*)	**Special Concern**	**Threatened**	Cornell Lab of Ornithology (2022) – ~510 m from Site	Prefers moist forests with dense shrub layers. Nests located on or near the ground on mossy logs or roots, along stream banks or on hummocks. Area-sensitive species that usually require a minimum of 30 ha of continuous forest for breeding habitat (OMNR, 2000).	The mixed forests and/or deciduous forests with a dense, complex understory that occur on-site would provide suitable habitat (Environment Canada, 2016a).	Moderate	Moderate	Moderate

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Cerulean Warbler (*Setophaga cerulea)*	**Threatened**	**Endangered**	n/a	Prefers mature deciduous forests. Area-sensitive species that require large forests (>100 ha) (OMNR, 2000).	The Site does not contain suitable habitat. The mature deciduous forests are not large enough to support breeding. The Site is also outside its main breeding range.	Negligible	Negligible	Negligible
Chimney Swift (*Chaetura pelagica*)	**Threatened**	**Threatened**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site	Nests in traditional-style open brick chimneys (and rarely in hollow trees). Tends to stay close to water.	Buildings on-site may provide suitable nesting/roosting habitat; however, it is unknown if they have traditional-style, uncapped chimneys. Snags in the mature forests on-site may provide additional nesting/roosting habitat. Further, the Site contains suitable foraging habitat.	Moderate	Moderate	Moderate
Common Nighthawk (*Chordeiles minor*)	**Special Concern**	**Special Concern**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site	Nests in a wide variety of open sites, including beaches, fields, and gravel rooftops with little to no ground vegetation. They also nest in cultivated fields, orchards, urban parks, mine tailings and along gravel roads/railways but tend to occupy more natural sites.	Open areas with very little ground cover on-site would provide suitable nesting habitat including meadows, open mixed or coniferous forests, clearcuts (e.g., hydro corridor), and the old railway. Open areas, particularly marshes, would provide suitable foraging habitat (Environment Canada, 2016b).	Moderate	Moderate	Moderate
Eastern Meadowlark (*Sturnella magna*)	**Threatened**	**Threatened**	This study (2022) – on-site	Breeds in hayfields, pastures, agricultural fields, and abandoned fields with tall grass that are ≥5 ha, and preferably >30 ha.	The Site contains suitable habitat. Eastern Meadowlark detected in agricultural fields on-site.	High	High	High
Eastern Whip-poor-will (*Antrostomus vociferus*)	**Threatened**	**Threatened**	Cornell Lab of Ornithology (2022) – ~3.3 km from Site but not observed during field studies.	Suitable breeding habitats generally include open and half treed areas and often exhibit a scattered distribution of treed and open space. Lays eggs directly on the forest floor. Roosts are typically located in forest habitat on a low branch or directly on the ground. Home range size varies from 20 to 500 ha (mean 136 ha) (ECCC, 2018a).	The mosaic of open and forested habitats on the Site provides suitable breeding habitat. Successional forests, forest edges, and sparse conifer plantations would provide suitable nesting habitat. The meadows, agricultural fields, thicket swamps, marshes, and regenerating clearcuts would provide suitable foraging habitat (ECCC, 2018a). Note that Eastern Whip-poor-will	Moderate	Low	Low Despite some habitat potential, the species was not found to occur on the Site.

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
					surveys were conducted, and none were detected.			
Eastern Wood-Pewee (*Contopus virens*)	**Special Concern**	**Special Concern**	This study (2022) – on-site	Woodland species often found in the mid-canopy layer near clearings and edges of intermediate age and mature deciduous and mixed forests with little understory.	The Site contains suitable habitat. Eastern Wood-Pewee detected in deciduous and mixed forests on-site.	High	High	High
Evening Grosbeak (*Coccothraustes vespertinus*)	**Special Concern**	**Special Concern**	Cornell Lab of Ornithology (2022) – on-site	Nests in trees or large shrubs. Prefers mature coniferous forests (fir and/or spruce dominated), but will also use deciduous forests, parklands, and orchards. Its abundance is strongly linked to the cycle of Spruce Budworm.	Open, mature coniferous and mixed forests on-site would provide suitable habitat during both the breeding and non-breeding season.	Moderate	Moderate	Moderate
Golden Eagle (*Aquila chrysaetos*)	**Endangered**	**Not at Risk**	n/a	Nests in remote, undisturbed areas, usually building their nests on ledges on a steep cliff/riverbank or large trees if needed. Most hunting is done near open areas such as large bogs or tundra. Migration only; no reported nests in Ottawa.	The Site does not appear to contain suitable habitat and would likely not provide suitable migratory stopover habitat.	Negligible	Low Transient occurrence near the project area is possible.	Negligible
Golden-winged Warbler (*Vermivora chrysoptera*)	**Special Concern**	**Threatened**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site	Ground-nests in areas of young shrubs surrounded by mature forest. Often found in areas that have recently been disturbed such as field edges, hydro or utility right-of-ways, or logged areas. Requires >10 ha of habitat (OMNR, 2000).	Open, shrubby areas (thickets, hydro corridor) surrounded by mature forest on the Site provide suitable habitat.	Low	Low	Low
Grasshopper Sparrow (*Ammodramus savannarum*)	**Special Concern**	**Special Concern**	This study (2022) – on-site	Lives in open grassland areas with well-drained sandy soil. Will also nest in hayfields and pastures, as well as alvars, prairies, and occasionally grain crops such as barley. It prefers areas that are sparsely vegetated, and its nests are well hidden in the field, woven from grasses in a small cup-like shape.	The Site contains suitable habitat. Grasshopper Sparrow detected in an agricultural field on-site.	High	High	High
Henslow's Sparrow (*Ammodramus henslowii*)	**Endangered**	**Endangered**	Cornell Lab of Ornithology (2022) – The most recent record near (~3.6 km)	Prefers poorly drained grasslands with tall, dense grass where it can easily conceal its small ground nest. Tends to avoid fields that have	The Site may contain suitable habitat; however, breeding was not reported in eastern Ontario during the second (most recent) OBBA	Negligible	None	None

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
			the Site was from 1980.	been grazed or are crowded with trees and shrubs. Prefer ≥50 ha areas, but can inhabit ≥5 ha.	from 2001 to 2005 (Birds Canada et al., 2009).			
Horned Grebe (*Podiceps auritus*)	**Special Concern**	**Special Concern**	n/a	Nest in small ponds, marshes, and shallow bays that contain areas of open water and emergent vegetation. Migrant only; no reported nests in Ottawa.	The Site does not appear to contain suitable habitat as the wetlands on-site are small and have limited open water. The Site would likely not provide suitable migratory stopover habitat.	Negligible	Negligible	Negligible
Hudsonian Godwit (*Limosa haemastica*)	**Threatened**	**No Status**	n/a	They use a wide variety of habitats during migration, such as freshwater marshes, saline lakes, flooded fields, shallow ponds, coastal wetlands, and mudflats. Migrant only; breeds in far north.	The Site does not appear to contain suitable habitat as the wetlands on-site are small and have limited open water. The Site would likely not provide suitable migratory stopover habitat.	Negligible	Negligible	Negligible
Least Bittern (*Ixobrychus exilis*)	**Threatened**	**Threatened**	Cornell Lab of Ornithology (2022) – ~2.3 km from Site	Found in a variety of wetland habitats, but strongly prefers cattail marshes with a mix of open pools and channels. They prefer larger marshes >5 ha in size and are intolerant of loss of habitat and human disturbance (OMNR, 2000).	The Site does not appear to contain suitable habitat. The wetlands on-site are <5 ha and are not cattail dominated.	Negligible	Low	Low The Site is unlikely to provide suitable habitat; however, as Least Bittern occur in the area there is potential for them to occur on the Site.
Lesser Yellowlegs (*Tringa flavipes*)	**Threatened**	**No Status**	Cornell Lab of Ornithology (2022) – ~2.4 km from Site	Breeds in boreal wetlands. Nests on dry ground or forest openings near peatlands, marshes, and ponds in the boreal forest and taiga (Government of Canada, 2021). Migrant only; nests in far north.	The Site does not appear to contain suitable habitat as the wetlands on-site are small and have limited open water. The Site would likely not provide suitable migratory stopover habitat.	Negligible	Low	Low The Site is unlikely to provide suitable habitat; however, as Lesser Yellowlegs occur in the area there is potential for them to occur on the Site.
Loggerhead Shrike (*Lanius ludovicianus*)	**Endangered**	**Endangered**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site in 1970. ~28 km from Site (Richmond area) in 2019	Prefers grazed pastures or other grasslands with scattered low trees and shrubs, especially hawthorns. Lives in fields or alvars (areas of exposed bedrock) with short grass, which makes it easier to spot prey.	The Site does not appear to contain suitable habitat and breeding was not reported on the Site during the second (most recent) OBBA from 2001 to 2005 (Birds Canada et al., 2009).	Negligible	Negligible	Negligible
Louisiana Waterthrush (*Seiurus motacilla*)	**Threatened**	**Threatened**	n/a	Found in large tracts of mature deciduous or mixed forests in steep, forested ravines with running streams. Clear headwater streams and associated wetlands are preferred sites, but it will also	The Site does not contain suitable habitat. The mature mixed forest with a stream below steep-sided slopes is likely too fragmented support breeding (Environment Canada, 2011). The Site is also outside its main breeding range.	Negligible	Negligible	Negligible

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
				inhabit wooded swamps (Environment Canada, 2011).				
Olive-sided Flycatcher (*Contopus cooperi*)	**Special Concern**	**Special Concern**	Cornell Lab of Ornithology (2022) – ~2.8 km from Site	Found along coniferous or mixed forest edges and openings. Will use forests that have been logged or burned if there are ample tall snags and trees to use for foraging perches.	Open, mature coniferous and mixed forests and forest edges near wetlands on-site would provide suitable habitat.	Moderate	Moderate	Moderate
Peregrine Falcon (*Falco peregrinus*)	**Special Concern**	**Not at risk**	Cornell Lab of Ornithology (2022) – ~1.6 km from Site	Nests on tall, steep cliff ledges close to large bodies of water. Urban peregrines raise their young on ledges of tall buildings, even in busy downtown areas.	The Site does not appear to contain suitable habitat.	Negligible	Low Transient occurrence near the project area is possible.	Negligible
Red Knot (*Calidris canutus rufa*)	**Endangered**	**Endangered**	Cornell Lab of Ornithology (2022) – ~3.3 km from Site in 1978. ~19 km from Site (near the Ottawa River) in 2021.	Prefer open beaches, mudflats, and coastal lagoons where they feast on molluscs, crustaceans, and other invertebrates. Migrant only; nests in far north.	The Site does not appear to contain suitable habitat as the wetlands on-site are small and have limited open water. The Site would likely not provide suitable migratory stopover habitat.	Negligible	Negligible	Negligible
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	**Endangered**	**Endangered**	Cornell Lab of Ornithology (2022) – ~4.8 km from Site	Lives in open woodland and woodland edges and is often found in parks, golf courses, and cemeteries. These areas typically have many dead trees, which the birds use for nesting and perching.	The golf course and open, mature deciduous forests with snags on-site would provide suitable habitat.	Moderate	Moderate	Moderate
Red-necked Phalarope (*Phalaropus lobatus*)	**Special Concern**	**Special Concern**	n/a	Lives in coastal and inland marshes where it feeds in shallow ponds and nests on the grassy edges. Always near water during migration. Migrant only; nests in far north.	The Site does not appear to contain suitable habitat as the wetlands on-site are small and have limited open water. The Site would likely not provide suitable migratory stopover habitat.	Negligible	Negligible	Negligible
Rusty Blackbird (*Euphagus carolinus*)	**Special Concern**	**Special Concern**	Cornell Lab of Ornithology (2022) – ~470 m from Site	Prefers wet wooded or shrubby areas. Nests at edges of boreal wetlands and coniferous forests. These areas include bogs, marshes, and beaver ponds.	Swamps, moist forests, and riparian areas on-site would provide suitable habitat; although, as the Site is outside its main breeding range it would likely serve as migratory stopover habitat (Environment Canada, 2015a).	Moderate	Moderate	Moderate
Short-eared Owl (*Asio flammeus*)	**Threatened**	**Special Concern**	Cornell Lab of Ornithology (2022) – ~1.7 km from Site	Prefer a mosaic of grasslands and wetlands. Lives in open areas such as grasslands, marshes, and tundra where it nests on the ground and hunts	Meadows, agricultural lands, and marshes on-site may provide suitable habitat during both the breeding and non-breeding season. The habitat on-site does not appear to be ideal as open native habitats	Low	Moderate	Moderate

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
				for small mammals (Environment Canada, 2016c).	are limited (Environment Canada, 2016c).			
Wood Thrush (*Hylocichla mustelina*)	**Special Concern**	**Threatened**	This study (2022) – on-site	Lives in mature deciduous and mixed forests. They seek moist stands of trees with well-developed undergrowth and tall trees for singing and perching. Prefers nesting in large forest mosaics, but will also use fragmented forests. Usually build nests in Sugar Maple or American Beech.	Wood Thrush detected in deciduous and mixed forests on-site.	High	High	High
Yellow Rail (*Coturnicops noveboracensis*)	**Special Concern**	**Special Concern**	n/a	Lives deep in the reeds, sedges, and marshes of shallow wetlands, where they nest on the ground. The marshy areas used by Yellow Rails have an overlying dry mat of dead vegetation that is used to make roofs for nests.	The Site contains small graminoid dominated shallow marshes and meadow marshes that may be suitable for breeding; however, due to their size and no Yellow Rail records within 10km of the Site the wetlands are unlikely to be used (Environment Canada, 2013).	Low	Low	Low
Mammals								
Algonquin Wolf (*Canis* sp.)	**Threatened**	**Special Concern**	n/a	Not restricted to a specific habitat type but typically occurs in deciduous and mixed forest landscapes.	This species only occurs in Algonquin Provincial Park and surrounding townships, along with other areas in central Ontario including in and around Killarney Provincial Park, Kawartha Highlands Signature Site, and Queen Elizabeth II Wildlands (MECP, 2019a).	None	None	None
Eastern Cougar (*Puma concolor*)	**Endangered**	**No Status**	n/a	Lives in large, undisturbed forests or other natural areas where there is little human activity.	The Site does not contain suitable habitat.	None	Negligible	Negligible
Eastern Small-footed Myotis (*Myotis leibii*)	**Endangered**	**Not Listed**	Humphrey (2017) – in region	In the spring and summer, Eastern Small-footed Myotis will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. Overwinters in caves and abandoned mines.	The forests and buildings on-site may provide suitable roosting habitat. Forests (including corridors), marshes, and meadows may provide suitable foraging habitat (Humphrey, 2017).	Moderate	Moderate	Moderate

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Gray Fox (*Urocyon cinereoargenteus*)	**Threatened**	**Threatened**	n/a	Lives in deciduous forests and marshes. Their dens are usually found in dense shrubs close to a water source, but they will also use rocky areas, hollow trees, and underground burrows dug by other animals.	The range of this species has recently been reduced to west of Lake Superior in the Rainy River District and on Pelee Island in west Lake Eerie (MECP, 2020a).	None	None	None
Little Brown Myotis (*Myotis lucifugus*)	**Endangered**	**Endangered**	Humphrey and Fotherby (2019) – in region	During the day they roost in trees and buildings. They often select attics, abandoned buildings, and barns for summer colonies where they can raise their young. They can squeeze through very tiny spaces (as small as six millimetres across) allowing them access to many different roosting areas.	The forests and buildings on-site may provide suitable roosting habitat. The marshes, meadows, and forest openings may provide suitable foraging habitat (Humphrey and Fotherby, 2019).	Moderate	Moderate	Moderate
Northern Myotis / Northern Long-eared Bat (*Myotis septentrionalis*)	**Endangered**	**Endangered**	Humphrey and Fotherby (2019) – in region	Associated with deciduous and mixed forests, choosing to roost under loose bark and in the cavities of trees. They forage along and within forests as well as in hayfields and pastures adjacent to mixed forests.	The forests and deciduous swamps on-site may provide suitable roosting and foraging habitat. The marshes, watercourses, and meadows may provide additional suitable foraging habitat (Humphrey and Fotherby, 2019).	Moderate	Moderate	Moderate
Tri-colored Bat / Eastern Pipistrelle (*Perimyotis subflavus*)	**Endangered**	**Endangered**	Humphrey and Fotherby (2019) – in region	Roosts mainly in trees during summer; overwinters in caves and mines along with other species, but often uses deeper parts of the hibernaculum. Foraging occurs in forested riparian areas, over water, and within gaps in forest canopies.	The forests on the Site may provide suitable roosting habitat. The marsh and watercourse may provide suitable foraging habitat (Humphrey and Fotherby, 2019).	Moderate	Moderate	Moderate
Amphibians								
Western Chorus Frog (*Pseudacris triseriata*)	**Not Listed**	Great Lakes/ St. Lawrence population: **Threatened**	MNRF (2022a) – within 5 km of Site	Inhabits forest openings around woodland ponds but can also be found in or near damp meadows, marshes, bottomland swamps, and temporary ponds in open country, or even urban areas.	Open, lowland habitats and forest openings may contain vernal pools that that could provide suitable breeding habitat. Further, the wetlands (marshes and swamps) on-site may also provide suitable habitat (Environment Canada, 2014a). Note that anuran surveys were conducted, and Western Chorus Frog was not detected.	Moderate	Moderate	Moderate
Reptiles								

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Blanding's Turtle (*Emydoidea blandingii*)	**Threatened**	**Endangered**	MNRF (2022a); MNRF (2022b) – within 5 km of Site	Quiet lakes, streams, and wetlands with abundant emergent vegetation. Also frequently occurs in adjacent upland forests.	The Site does not contain optimal habitat as there are no large permanents wetlands. However, marshes, swamps, watercourses, and terrestrial habitats on-site may provide suitable habitat to support all life stages (e.g., mating, foraging, nesting, overwintering). The watercourses and swamps may provide habitat as a corridor during seasonal movements. Vernal pools, swamps, and agricultural fields may be used as staging areas. Open areas including meadows and agricultural fields may be used for nesting (ECCC, 2018b).	Moderate	Moderate	Moderate
Eastern Milksnake (*Lampropeltis triangulum*)	**Not Listed**	**Special Concern**	MNRF (2022b) – within 5 km of Site	Found in a variety of open and edge habitats, including meadows, rocky outcrops, and forest edges. They can also inhabit forests. Further, they are often associated with human-made structures such as barns (Environment Canada, 2015b).	The mosaic of habitats (meadow, thicket, forest, wetland, agricultural fields) across the Site provide suitable habitat to support all life stages.	Moderate	Moderate	Moderate
Eastern Musk Turtle / Stinkpot (*Sternotherus odoratus*)	**Special Concern**	**Special Concern**	MNRF (2022b) – within 5 km of Site	Found in lakes, ponds, marshes, and rivers that are generally slow-moving, have abundant emergent vegetation, and muddy bottoms that they burrow into for winter hibernation.	The Site does not contain suitable habitat as the wetlands and watercourses on-site are not connected nearby to large permanent waterbodies.	Negligible	Negligible	Negligible
Eastern Ribbonsnake *(Thamnophis sauritus)*	**Special Concern**	**Special Concern**	This study (2022) – ~730 m from Site	The Eastern Ribbonsnake is semi-aquatic. It is most frequently found along the edges of shallow ponds, streams, marshes, swamps, or bogs bordered by dense vegetation that provides cover. Abundant exposure to sunlight is also required, and adjacent upland areas may be used for nesting.	The mosaic of wetlands, watercourses, vegetated riparian habitats, and adjacent terrestrial habitats (forests and open, sunny areas) on-site provide suitable habitat to support all life stages (Environment Canada, 2014b). Eastern Ribbonsnake observed on the lands adjacent to the Site (on the edge of the hydro corridor located between wetlands).	Moderate	Moderate	Moderate
Common Five-lined Skink (*Plestiodon fasciatus*)	Southern Shield population: **Special Concern**	Great Lakes/ St. Lawrence population: **Special Concern**	n/a	Common Five-lined Skinks can be found underneath rocks on open bedrock in forests.	The Site does not contain ideal habitat as there are no rocky outcrops in forests clearings (Seburn, 2010).	Negligible	None	None The Site is outside the species' range (Seburn, 2010).

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Gray Ratsnake (*Pantherophis spiloides*)	Frontenac Axis population: **Threatened**	Great Lakes/ St. Lawrence population: **Threatened**	n/a	Requires a mosaic of habitat features and prefer deciduous forest and edge habitat. They lay eggs in rotten interior cavities of large deciduous trees and stumps or compost piles. This species overwinters underground in communal hibernacula.	The mosaic of deciduous/mixed forests adjacent to open habitats (meadows, agricultural fields, wetlands) on-site may provide suitable habitat to support all life stages; however, it lacks rocky outcrops (Kraus et al., 2010).	Negligible	None	None The Site is outside the species' range (Kraus et al., 2010).
Midland Painted Turtle (*Chrysemys picta marginata*)	**Not Listed**	**Special Concern**	This study (2022) – on-site	Inhabits waterbodies, such as ponds, marshes, lakes, and slow-moving creeks that have a soft bottom and provide abundant basking sites and aquatic vegetation. Often bask on shorelines or on logs and rocks that protrude from the water.	Marshes, watercourses, and adjacent terrestrial habitats on-site provide suitable habitat to support all life stages. Midland Painted Turtle observed basking on the edge of a watercourse on the Site.	High	High	High
Northern Map Turtle (*Graptemys geographica*)	**Special Concern**	**Special Concern**	n/a	Lives in rivers and lakeshores where it basks on emergent rocks and fallen trees throughout the spring and summer. In winter, they hibernate on the bottom of deep, slow-moving sections of river.	The Site does not contain suitable habitat as the watercourses on-site are too small.	None	Negligible	Negligible
Snapping Turtle (*Chelydra serpentina*)	**Special Concern**	**Special Concern**	California Academy of Sciences and National Geographic Society (2022) – ~2.1 km from Site	Spend most of their lives in the water. Prefer shallow waters so they can hide under the soft mud and leaf litter with only their noses exposed to the surface to breathe.	Marshes, watercourses, swamps, and adjacent terrestrial habitats on-site may provide suitable habitat to support all life stages.	Moderate	Moderate	Moderate
Spiny Softshell (*Apalone spinifera*)	**Endangered**	**Endangered**	n/a	Found primarily in rivers and lakes but also in creeks, ditches, and ponds near rivers. Habitat requirements are open sand or gravel nesting areas, shallow muddy or sandy areas to bury in, deep pools for hibernation, areas for basking, and suitable habitat for crayfish and other food species.	Species is now believed to be extirpated from eastern Ontario. The Site does not contain suitable habitat.	None	None	None
Spotted Turtle (*Clemmys guttata*)	**Endangered**	**Endangered**	n/a	Semi-aquatic and prefers ponds, marshes, bogs, and even ditches with slow-moving, unpolluted water and an abundant supply of aquatic vegetation.	Although known to occur broadly in eastern Ontario the Site does not contain suitable habitat.	Negligible	Negligible	Negligible

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Wood Turtle (*Glyptemys insculpta*)	**Endangered**	**Threatened**	n/a	Prefers clear rivers, streams, or creeks with a slight current and sandy or gravelly bottom. Wooded areas are essential habitat, but they are found in other habitats such as wet meadows, swamps, and fields.	Although known to occur broadly in eastern Ontario the Site does not contain suitable habitat.	Negligible	Negligible	Negligible
Arthropods								
American Bumble bee (*Bombus pensylvanicus*)	**Special Concern**	**Special Concern**	COSEWIC (2018) – in region	Habitat generalist. Requires a variety of habitat throughout it's life stages. Often found in or adjacent to open fields and meadows, grasslands, farmlands, and other undisturbed open habitats (Government of Canada, 2019).	The meadows and agricultural fields on the Site may provide suitable habitat.	Moderate	Moderate	Moderate
Bogbean Buckmoth (*Hemileuca* sp. 1)	**Endangered**	**Endangered**	n/a	Restricted to open, chalky, low shrub fens containing large amounts of bogbean, an emergent wetland flowering plant.	The Site does not contain suitable habitat as there are no fens on-site.	None	Negligible	None
Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*)	**Endangered**	**Endangered**	MNRF (2022a); MNRF (2022b) – within 5 km of Site	Live in diverse habitats including open meadows, mixed farmlands, urban areas, boreal forest, and montane meadows. Host nests occur in abandoned underground rodent burrows and rotten logs.	Currently only known to occur in Pinery Provincial Park (MECP, 2019b).	None	None	None
Macropis Cuckoo Bee *(Epeoloides pilosulus)*	**Not Listed**	**Endangered**	n/a	Found in habitats supporting both Macropis bees and their food plant, Yellow Loosestrife (*Lysimachia*).	Has not been observed in Ontario in over 45 years (COSEWIC, 2011).	None	None	None
Monarch (*Danaus plexippus*)	**Special Concern**	**Special Concern**	California Academy of Sciences and National Geographic Society (2022) – on-site	Milkweeds are the sole food plant for Monarch caterpillars. These plants predominantly grow in open and periodically disturbed habitats such as roadsides, fields, wetlands, prairies, and open forests.	iNaturalist citizen scientist detected Monarch on the Site. Monarch detected on the lands southeast of the Site. Meadows and roadsides supporting milkweeds provide suitable habitat.	High	High	High
Mottled Duskywing (*Erynnis martialis*)	**Endangered**	**Endangered**	n/a	Requires host plants such as the New Jersey Tea and Prairie Redroot. These plants grow in dry, well-drained soils or alvar habitat within oak woodland, pine woodland, roadsides.	The Site does not contain suitable habitat, and host plants were not detected on-site	Negliible	Neglibible	Negliible

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
				riverbanks, shady hillsides, and tall grass prairies.				
Nine-spotted Lady Beetle (*Coccinella novemnotata*)	**Endangered**	**Endangered**	MNRF (2022a); MNRF (2022b) – within 5 km of Site	Occurs within agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, riparian areas, and isolated natural areas.	There have been no records of this species in Ontario since the mid-1990s (MECP, 2019c).	None	None	None
Rapids Clubtail *(Gomphus quadricolor)*	**Threatened**	**Endangered**	n/a	Inhabits a wide variety of riverine habitats ranging in size from the St. Lawrence River to small creeks. Larvae are typically found in microhabitats with slow to moderate flow and fine sand or silt substrates where they burrow into the stream bed. Adults disperse from the river after emerging and feed in the forest canopy and other riparian vegetation.	The Site does not appear to contain suitable habitat as the watercourses are too small.	Negligible	Negligible	Negligible
Rusty-patched Bumble Bee (*Bombus affinis*)	**Endangered**	**Endangered**	n/a	Can be found in open habitat such as mixed farmland, urban settings, savannah, open woods, and sand dunes.	The range of this species is limited to southwestern Ontario (MECP, 2019e).	None	None	None
Suckley's Cuckoo Bumble Bee (*Bombus suckleyi*)	**Endangered**	**No Status**	COSEWIC (2019) – in region	Habitat generalist. Host nests occur in meadows, old fields, farmlands, croplands, urban areas, and woodlands (COSEWIC, 2019).	The mosaic of forests, meadow, and agricultural fields on the Site may provide suitable habitat.	Moderate	Moderate	Moderate
Transverse Lady Beetle (*Coccinella transversoguttata*)	**Endangered**	**Special Concern**	MNRF (2022a) – within 5 km of Site	Able to live in a wide range of habitats, including agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, and riparian areas.	The Site may contain suitable habitat; however, there have been no records of the species in Ontario since 1990 (MECP, 2020b).	None	None	None
West Virginia White butterfly (*Pieris virginiensis*)	**Special Concern**	**No Status**	n/a	Lives in moist, deciduous woodlots. Requires a supply of toothwort, a small, spring-blooming plant that is a member of the mustard family, since it is the only food source for larvae.	Toothwort was not identified on-site; however, as it is a small plant that can go undetected it may occur on-site. Therefore, the moist deciduous forests on-site may provide suitable habitat.	Low	Low	Low

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Yellow-banded Bumble Bee (*Bombus terricola*)	**Special Concern**	**Special Concern**	ECCC (2022) – in region	This species is a forage and habitat generalist, able to use a variety of nectaring plants and environmental conditions. Can be found in mixed woodlands, particularly for nesting and overwintering, as well as a variety of open habitat such as native grasslands, farmlands, and urban areas.	The mosaic of mixed forests and open habitats (meadow and agricultural lands) on-site may provide suitable habitat.	Moderate	Moderate	Moderate
Fish								
American Eel (*Anguilla rostrata*)	**Endangered**	**No Status**	n/a	Primarily nocturnal, hiding in soft substrate or submerged vegetation during the day.	The Site does not appear to contain rivers that could provide suitable habitat and connectivity for migration.	None	None	None
Bridle Shiner (*Notropis bifrenatus*)	**Special Concern**	**Special Concern**	n/a	Prefers clear water with abundant vegetation over silty or sandy substrate.	The Site does not appear to contain suitable rivers and lakes that could provide suitable habitat.	None	Non	None
Channel Darter (*Percina copelandi*)	**Special Concern**	**Special Concern**	n/a	Prefers clean streams and lakes with moderate current over sandy or rocky substrate.	The Site does not appear to contain suitable habitat, such as deeper water during winter and riffle areas in spring.	None	None	None
Cutlip Minnow (*Exoglossum maxillingua)*	**Threatened**	**Special Concern**	n/a	Lives in warmer rivers and creeks with clear, slow-moving water, and a rocky or gravel bottom.	The Site does not appear to contain suitable rivers and creeks that could provide suitable habitat.	None	None	None
Lake Sturgeon (*Acipenser fulvescens*)	**Endangered**	**No Status**	n/a	Only found in large lakes and rivers. Forages in cool water, 4-9 m deep over soft substrate; spawns in shallower, fast-flowing areas over rocks or gravel.	The Site does not appear to contain suitable habitat, as there are no large lakes and rivers on-site.	None	None	None
Northern Brook Lamprey (*Ichthyomyzon fossor*)	**Special Concern**	**Special Concern**	n/a	Inhabits clear, coolwater streams. The larval stage requires soft substrates such as silt and sand for burrowing which are often found in the slow-moving portions of a stream. Adults are found in areas associated with spawning, including fast flowing riffles comprised of rock or gravel.	The Site does not appear to contain suitable habitat, as clear, cool-water streams with slow-moving areas and areas of riffles are lacking on the Site.	None	None	None
Northern Sunfish (*Lepomis peltastes*)	**Special Concern**	**Special Concern**	n/a	Lives in shallow vegetated areas of quiet, slow flowing rivers and streams, as well as	The Site does not appear to contain suitable habitat, as slow-flowing rivers are lacking on the Site.	None	None	None

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
				warm lakes and ponds with sandy banks or rocky bottoms.				
River Redhorse (*Moxostoma carinatum*)	**Special Concern**	**Special Concern**	n/a	Prefers fast-flowing, clear rivers over rocky substrate.	The Site does not appear to contain suitable habitat, as watercourses on-site are not sufficiently large and are lacking substantial flows.	None	None	None
Silver Lamprey (*Ichthyomyzon unicuspis*)	**Special Concern**	**Special Concern**	n/a	Requires clear water where they can find fish hosts, relatively clean stream beds of sand and organic debris for larvae to live in, and unrestricted migration routes for spawning. Larvae live 4-7 years in burrows (prefer soft substrates); filter-feed on plankton.	The Site does not appear to contain suitable habitat, as watercourses on-site are not sufficiently clear and do not present unrestricted migration routes.	None	None	None
Molluscs								
Hickorynut (*Obovaria olivaria*)	**Endangered**	**Endangered**	MNRF (2022a) – within 5 km of Site	Live on the sandy beds in large, wide, deep rivers – usually more than two or three metres deep – with a moderate to strong current.	The Site does not appear to contain suitable habitat, as watercourses on-site are not sufficiently deep.	Negligible	Negligible	Negligible
Vascular Plants								
American Chestnut (*Castanea dentata*)	**Endangered**	**Endangered**	n/a	Typical habitat is upland deciduous forests on sandy acidic soils. Occurs with Red Oak, Black Cherry, Sugar Maple, and beech. In Ontario, it is only found in the Carolinian Zone between Lake Erie and Lake Huron.	The Site does not appear to contain suitable habitat.	Negligible	Negligible	Negligible
American Ginseng (*Panax quinquefolius*)	**Endangered**	**Endangered**	n/a	Grows in rich, moist, but well-drained, and relatively mature, deciduous woods dominated by Sugar Maple, White Ash, and American Basswood.	The Site does not appear to contain suitable habitat.	Negligible	Negligible	Negligible
Black Ash (*Fraxinus nigra*)	**Endangered**	**No Status**	This study (2022) - ~1.26 km southeast of Site	Predominantly a wetland species found in swamps, floodplains, and fens.	Treed swamps on the Site may provide suitable habitat.	Moderate	Moderate	Moderate
Butternut (*Juglans cinerea*)	**Endangered**	**Endangered**	California Academy of Sciences and National Geographic Society (2022) – ~150 m from Site	Commonly found in riparian habitats but is also found on rich, moist, well-drained loams and well-drained gravels, especially those of limestone origin.	Moist deciduous forests and riparian communities on the Site may provide suitable habitat.	Moderate	Moderate	Moderate

Species Name (*Taxonomic Name*)	Status under *Endangered Species Act* (ESA)	Status under Schedule 1 of the *Species at Risk Act* (SARA)	Closest Species Occurrence Record to the Tewin Lands	General Habitat Requirements	Suitability of Tewin Lands Habitats	Potential for Protected Elements[1]		Assessed Potential for Overall Negative Interactions with Protected Elements[2]
						Habitat	Individuals	
Eastern Prairie Fringed-orchid (*Platanthera leucophaea*)	**Endangered**	**Endangered**	n/a	Populations are found in three main habitat types: fens, tallgrass prairie, and moist old fields.	The Site does not appear to contain suitable habitat, as fens, tallgrass prairie and moist old fields were not detected on-site	Negligible	Negligible	Negligible
Lichens								
Black-foam Lichen (*Anzia colpodes*)	**No Status**	**Threatened**	MNRF (2022b) – within 5 km of Site	Grows on the trunks of mature deciduous trees growing on level or sloped land where high humidity is supplied by nearby wetlands, lakes, or streams. The most common host is Red Maple but it also occurs on White Ash, Sugar Maple, Red Oak, and very occasionally on other species.	Assumed to no longer occur in Ontario (COSEWIC, 2015).	None	None	None
Flooded Jellyskin (*Leptogium rivulare*)	**No Status**	**Special Concern**	n/a	Grows in seasonally flooded habitats, typically on the bark of deciduous trees, on rocks along the margins of seasonal ponds, and on rocks along shorelines and stream/riverbeds.	The Site does not appear to contain suitable habitat.	Negligible	Negligible	Negligible
Pale-bellied Frost Lichen (*Physconia subpallida*)	**Endangered**	**Endangered**	n/a	Typically grows on the bark of hardwood trees such as White Ash, Black Walnut, and American Elm. Can also be found growing on fence posts and boulders.	There are no recent records of the species in the Ottawa area (MECP, 2019f).	None	None	None

Table Notes: the term “site” refers to the Tewin Lands

Appendix F – Benthic Macroinvertebrates Identified within the Tewin Lands

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	S2	S3 (UB143004)	S4 (UB11715)	S4 (SBB_FW/ Piperville)	S5 (UB02731)	S5 (SBB_FW/ Thunder)	S6 (UB102147)	S8	S9	S12 (UB042156)	S12 (UB042156)	S13	S14
						2022	2020	2020	2021	2020	2021	2020	2022	2022	2020	2021	2022	2022
Annelida	Clitellata	Hirudinea	—	—	—	0	1	0	1	1	1	1	0	2	2	3	0	0
Annelida	Clitellata	Oligochaeta	—	—	—	9	19	28	17	49	2	64	12	16	45	59	3	9
Arthropoda	Insecta	—	Coleoptera	—	Chrysomelidae	0	0	0	0	0	0	0	0	0	0	1	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Dryopidae	0	0	0	0	0	0	0	0	0	2	5	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Dytiscidae	0	5	0	12	0	0	0	0	0	11	1	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Elmidae	0	0	385	58	253	71	47	0	0	220	436	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Haliplidae	0	60	3	1	0	0	4	0	0	6	0	0	0
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Hydrophilidae	0	11	0	0	2	0	0	0	0	2	0	0	0
Arthropoda	Insecta	—	Diptera	Nematocera	Ceratopogonidae	0	59	93	52	37	28	0	0	0	0	12	0	13
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	26	143	237	269	160	329	66	57	6	588	36	5	16
Arthropoda	Insecta	—	Diptera	—	Culicidae	0	18	0	0	0	0	1	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Empididae	0	0	0	0	0	0	0	0	0	0	5	0	0
Arthropoda	Insecta	—	Diptera	Nematocera	Psychodidae	0	0	0	0	16	1	2	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Simuliidae	0	0	90	0	17	0	0	0	0	60	30	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Stratiomyidae	0	0	0	0	1	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Tabanidae	0	0	1	2	6	0	0	0	0	1	1	0	0
Arthropoda	Insecta	—	Diptera	—	Tipulidae	0	0	6	8	25	1	0	0	0	3	81	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Baetidae	0	95	41	0	0	0	1	0	0	1	1	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pannota	Caenidae	0	3	179	268	78	51	0	0	0	24	3	0	0
Arthropoda	Insecta	—	Ephemeroptera	Schistonota	Ephemeridae	0	0	0	0	1	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Heptageniidae	0	0	10	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Belostomatidae	0	10	2	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Corixidae	0	10	297	11	74	1	15	0	0	20	4	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Hydrometridae	0	1	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Mesoveliidae	0	11	2	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Naucoridae	0	2	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Notonectidae	0	8	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	—	Pleidae	0	39	1	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Veliidae	0	0	0	0	1	0	0	0	0	1	0	0	0
Arthropoda	Insecta	—	Megaloptera	—	Sialidae	0	0	8	2	2	1	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Aeshnidae	0	0	6	1	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Libellulidae	0	11	2	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Odonata	—	Calopterygidae	0	0	0	0	0	0	0	0	0	5	1	0	0
Arthropoda	Insecta	—	Odonata	Zygoptera	Coenagrionidae	0	18	44	0	0	0	1	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Hydropsychidae	0	0	374	5	257	0	0	0	0	48	200	0	0
Arthropoda	Insecta	—	Trichoptera	Integripalpia	Lepidostomatidae	0	0	0	0	0	0	0	0	0	40	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Leptoceridae	0	0	0	0	8	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	Limnephilidae	0	0	1	0	1	0	0	0	0	0	9	0	0
Arthropoda	Insecta	—	Trichoptera	—	Phryganeidae	0	1	7	7	15	0	1	0	0	30	11	0	0
Arthropoda	Insecta	Pterygota	Ephemeroptera	—	—	6	0	0	0	0	0	0	0	0	0	0	0	18
Arthropoda	Insecta	—	Odonata	Zygoptera	—	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	—	—	4	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	—	—	5	0	0	0	0	0	0	1	0	0	0	3	2
Arthropoda	Insecta	—	Lepidoptera	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Insecta	—	Coleoptera	NA	—	5	0	0	0	0	0	0	10	1	0	0	3	3
Arthropoda	Insecta	—	Diptera	—	—	2	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Crangonyctidae	0	0	8	1	2	0	6	0	0	11	14	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Gammaridae	0	0	108	353	254	55	0	0	0	42	74	0	0
Arthropoda	Malacostraca	NA	Amphipoda	NA	Hyalillidae	0	6	27	0	0	4	9	0	0	2	0	0	0
Arthropoda	Malacostraca	—	Decapoda	—	—	0	0	1	1	1	1	2	0	0	4	1	0	0
Arthropoda	Malacostraca	—	Isopoda	Asellota	Asellidae	0	14	30	257	352	72	105	0	0	241	235	0	0
Arthropoda	Malacostraca	—	Isopoda	—	—	1	0	0	0	0	0	0	18	0	0	0	0	0
Arthropoda	Malacostraca	Eumalacostraca	Amphipoda	—	—	1	0	0	0	0	0	0	0	5	0	0	0	2

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	S2	S3 (UB143004)	S4 (UB11715)	S4 (SBB_FW/ Piperville)	S5 (UB02731)	S5 (SBB_FW/ Thunder)	S6 (UB102147)	S8	S9	S12 (UB042156)	S12 (UB042156)	S13	S14
						2022	2020	2020	2021	2020	2021	2020	2022	2022	2020	2021	2022	2022
Mollusca	Bivalvia	—	Sphaeriida	—	Sphaeriidae	0	0	167	95	103	63	25	0	0	36	53	0	0
Mollusca	Bivalvia	—	Unionida	—	Unionidae	0	0	0	2	1	2	0	0	0	2	0	0	0
Mollusca	Bivalvia	—	—	—	—	0	0	0	0	0	0	0	1	2	0	0	19	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Amnicolidae	0	0	56	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Lymnaeidae	0	14	24	0	12	1	0	0	0	22	8	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Physidae	0	1	47	87	58	12	5	0	0	82	110	0	0
Mollusca	Gastropoda	—	Basommatophora	—	Planorbidae	0	41	24	60	11	42	1	0	0	24	0	0	0
Mollusca	Gastropoda	—	Heterostropha	—	Valvatidae	0	0	16	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	—	—	—	—	2	0	0	0	0	0	0	1	70	0	0	7	41
NA	NA	NA	Hyrachnida	NA	NA	1	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	—	—	—	—	—	0	0	0	0	0	0	0	1	1	0	0	0	3
Total						**65**	**601**	**2325**	**1570**	**1798**	**738**	**356**	**101**	**103**	**1575**	**1394**	**40**	**107**

Appendix G – Benthic Macroinvertebrates Identified Upstream and Downstream of the Tewin Lands

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	Upstream of the Tewin Lands				Downstream of the Tewin Lands				
						UB122145 (Smith Gooding MD)	SBB_Davidson (Smith Gooding MD)	UB092158 (Smith Gooding MD)	UB092158 (Smith Gooding MD)	UB13643 (South Bear Brook)	UB13643 (South Bear Brook)	UB13643 (South Bear Brook)	UB08644 (South Bear Brook)	UB063142 (South Bear Brook)
						2022	2021	2020	2021	2019	2020	2021	2020	2021
Annelida	Clitellata	Hirudinea	—	—	—	1	0	0	2	0	3	0	0	1
Annelida	Clitellata	Oligochaeta	—	—	—	4	0	41	24	63	8	2	18	6
Arthropoda	Malacostraca	—	Amphipoda	—	Crangonyctidae	3	0	1	1	10	2	0	0	0
Arthropoda	Malacostraca	—	Amphipoda	—	Gammaridae	0	1	494	2	124	235	629	184	18
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Dryopidae	0	0	0	0	0	3	0	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Dytiscidae	31	0	1	2	0	13	0	1	1
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Elmidae	2	6	108	359	219	150	915	535	209
Arthropoda	Insecta	—	Coleoptera	Adephaga	Gyrinidae	0	0	0	0	0	0	1	0	0
Arthropoda	Insecta	—	Coleoptera	Adephaga	Haliplidae	4	1	24	0	0	0	52	14	42
Arthropoda	Insecta	—	Coleoptera	Polyphaga	Hydrophilidae	1	0	2	0	0	0	0	0	0
Arthropoda	Insecta	—	Diptera	Nematocera	Ceratopogonidae	0	0	50	28	169	119	101	165	140
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	27	146	194	244	333	340	32	821	177
Arthropoda	Insecta	—	Diptera	—	Culicidae	0	0	1	0	0	1	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Empididae	0	0	0	0	8	0	16	0	0
Arthropoda	Insecta	—	Diptera	—	Ephydridae	0	0	0	1	0	0	0	0	1
Arthropoda	Insecta	—	Diptera	Nematocera	Psychodidae	0	0	0	0	59	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Simuliidae	0	0	0	0	0	3	0	0	0
Arthropoda	Insecta	—	Diptera	Brachycera	Stratiomyidae	2	0	1	0	2	0	0	0	0
Arthropoda	Insecta	—	Diptera	—	Tabanidae	0	1	0	0	12	5	0	2	4
Arthropoda	Insecta	—	Diptera	—	Tipulidae	0	1	0	0	45	4	0	36	2
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Baetidae	12	0	26	1	1	9	20	56	29
Arthropoda	Insecta	—	Ephemeroptera	Pannota	Caenidae	0	0	410	438	432	529	528	465	165
Arthropoda	Insecta	—	Ephemeroptera	Pisciforma	Heptageniidae	0	0	0	0	0	1	0	0	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Belostomatidae	0	0	5	0	0	0	7	1	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Corixidae	0	0	1	6	0	1	0	3	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Mesoveliidae	0	0	0	1	0	1	2	15	0
Arthropoda	Insecta	—	Hemiptera	Heteroptera	Notonectidae	0	0	0	1	0	0	0	0	0
Arthropoda	Insecta	—	Hemiptera	—	Pleidae	0	0	0	0	0	0	0	1	1
Arthropoda	Insecta	—	Megaloptera	—	Sialidae	0	0	0	2	0	0	6	0	0
Arthropoda	Insecta	—	Odonata	—	Aeshnidae	0	2	1	0	2	7	4	3	0
Arthropoda	Insecta	—	Odonata	—	Corduliidae	0	0	0	0	0	0	4	0	0
Arthropoda	Insecta	—	Odonata	—	Libellulidae	0	0	0	0	0	0	0	6	7
Arthropoda	Insecta	—	Odonata	Zygoptera	Coenagrionidae	0	0	11	0	1	18	58	110	126
Arthropoda	Insecta	—	Odonata	Zygoptera	Lestidae	0	0	0	0	0	0	0	1	1
Arthropoda	Insecta	—	Plecoptera	—	Capniidae	0	0	0	0	2	0	0	0	0
Arthropoda	Insecta	—	Plecoptera	—	Taeniopterygidae	0	0	0	0	4	0	0	0	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Hydropsychidae	4	2	1	1	195	26	0	1	0
Arthropoda	Insecta	—	Trichoptera	Spicipalpia	Hydroptilidae	0	0	0	0	0	0	0	22	0
Arthropoda	Insecta	—	Trichoptera	—	Leptoceridae	0	0	0	0	0	8	184	82	0

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	Upstream of the Tewin Lands				Downstream of the Tewin Lands				
						UB122145 (Smith Gooding MD)	SBB_Davidson (Smith Gooding MD)	UB092158 (Smith Gooding MD)	UB092158 (Smith Gooding MD)	UB13643 (South Bear Brook)	UB13643 (South Bear Brook)	UB13643 (South Bear Brook)	UB08644 (South Bear Brook)	UB063142 (South Bear Brook)
						2022	2021	2020	2021	2019	2020	2021	2020	2021
Arthropoda	Insecta	—	Trichoptera	—	Limnephilidae	11	0	0	0	58	6	0	1	0
Arthropoda	Insecta	—	Trichoptera	—	Phryganeidae	8	2	3	1	10	52	3	20	0
Arthropoda	Insecta	—	Trichoptera	Annulipalpia	Polycentropodidae	0	0	0	0	0	0	22	5	0
Arthropoda	Malacostraca	NA	Amphipoda	NA	Hyalillidae	0	0	143	24	5	0	54	84	9
Arthropoda	Malacostraca	—	Decapoda	—	—	0	0	0	3	0	0	0	0	0
Arthropoda	Malacostraca	—	Isopoda	Asellota	Asellidae	145	26	109	58	89	475	167	76	0
Mollusca	Bivalvia	—	Sphaeriida	—	Sphaeriidae	370	117	10	5	147	191	130	128	33
Mollusca	Bivalvia	—	Unionida	—	Unionidae	0	0	0	0	0	1	2	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Amnicolidae	1	0	0	0	52	44	28	225	100
Mollusca	Gastropoda	Caenogastropoda	Neotaenioglossa	—	Bithyniidae	52	22	5	8	0	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Littorinimorpha	—	Hydrobiidae	0	0	0	0	0	0	1	0	0
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Lymnaeidae	170	3	4	15	9	64	5	4	31
Mollusca	Gastropoda	Heterobranchia	Basommatophora	—	Physidae	14	2	0	0	0	9	23	9	16
Mollusca	Gastropoda	—	Basommatophora	—	Planorbidae	6	11	0	0	144	118	17	24	3
Mollusca	Gastropoda	—	Heterostropha	—	Valvatidae	0	0	2	3	1	0	24	62	435
Mollusca	Gastropoda	Caenogastropoda	Architaenioglossa	—	Viviparidae	0	0	0	0	0	0	1	0	1
Total						**868**	**343**	**1648**	**1230**	**2196**	**2446**	**3038**	**3180**	**1558**

Table Notes: Smith Gooding Municipal Drain = Smith Gooding MD

Appendix H – Benthic Macroinvertebrates Identified in Ramsay Creek

Taxonomic Phylum	Taxonomic Class	Taxonomic Subclass	Taxonomic Order	Taxonomic Suborder	Taxonomic Family	S11
						2021
Arthropoda	Insecta	—	Diptera	Nematocera	Chironomidae	40
Arthropoda	Insecta	—	Plecoptera	—	—	3
Arthropoda	Insecta	—	Trichoptera	—	—	5
Arthropoda	Malacostraca	—	Isopoda	—	—	5
Arthropoda	Malacostraca	Eumalacostraca	Amphipoda	—	—	1
Annelida	Clitellata	Oligochaeta	—	—	—	46
Total						**100**