REPORT

ECOLOGICAL CHARACTERIZATION OF AN AREA OF INTEREST IN HUDSON, QUÉBEC

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Prepared for: Nature Hudson
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1 Executive Summary

A 10.35 ha forested wetland situated on the shores of the Ottawa River in the town of Hudson, Québec, has recently been targeted for residential development. In the spring of 2021, Nature Hudson, and the Legacy Fund for the Environment mandated TerraHumana Solutions to conduct an ecological evaluation of this area (the study area). The study area included the natural space between Royalview street and Jack Layton Park (Lot MH2 or eastern block), and the area called Sandy Beach (Lot MH3 or western block). Previous studies have listed this area as the highest priority for conservation. We completed 26 field surveys to assess plants, insects, amphibians, reptiles, birds, and bats from 4 April to 22 July 2021. The objectives of this ecological characterization were to delimit the wetlands, inventory the flora and fauna, identify species at risk, and provide recommendations based on the study's findings. We observed and positively identified 354 species of flora and fauna, including a total of 29 species at risk. Among the species at risk, we identified 13 plant species, three insect species, three turtle species, six bird species, and four bat species. We therefore conclude that the area is of ecological significance. We would recommend that the town of Hudson take the findings of this study into account and consider revisiting its plan to develop the study area.

2 Introduction

Canada's biodiversity is declining at an alarming rate (World Wildlife Fund Canada – WWF – Canada 2020). WWF-Canada's annual Living Planet Reports have revealed startling data on the state of Canadian wildlife. For example, in 2017, they revealed that half of the nearly 900 species monitored from 1970 to 2014 have experienced population declines at an average of 83%. Habitat loss is considered the primary cause impeding species survival, especially because of urbanization and agriculture. Perhaps the most significant finding in the Living Planet Reports is the continued decline of species that are legally protected under the Species at Risk Act (SARA) (WWF-Canada 2017). Besides its critical role in providing food, fibre, water, energy, medicines and other genetic materials, biodiversity also regulates climate, improves water quality and pollination, and reduces pollution, flooding and storm surges(Watson 2019, WWF-Canada 2020). Human health is thus also severely impacted by this loss. In 2018, over 90 people died in the Montreal area from record-breaking heat[1]. Because green and natural spaces are proven low-cost mitigation measures against the effects of Urban Heat Islands (urban areas that are significantly warmer than rural counterparts, Mathey et al. 2011), L'Institut national de santé publique du Québec (INSPQ) has asked that the Quebec government dedicate 1% of its budget toward creating green spaces for the health of its citizens[2]. In the Montreal metropolitan area, green spaces are declining at a rate of 11km^2 per year (Communauté Métropolitaine de Montréal – CCM – 2018). Despite the presence of progressive environmental laws at both the federal and provincial levels, Canada is losing nature. Citizens are therefore stepping in as its custodians.

Furthermore, wetlands near urban centres have also declined significantly. Over 80% of original wetland habitat in and adjacent to urban centres has been converted to other uses (WWF – Canada 2017). Yet, the ecological and socio-economic value of wetlands are numerous and undeniable (reviewed in Kennedy and Mayer 2002): water quality amelioration, contaminant removal, and offering life support for the very biodiversity that we are losing. But perhaps most importantly for municipalities, wetlands are natural flood control systems and thus prevent flood damage and associated economic consequences. For example, a loss of only one hectare of wetland was calculated to equate to an increase of US $33,000 in storm damage (Constanza et al. 2017). In Alberta, wetland loss equates a loss of $3,650 per hectare[3]. Wetland ecosystems are

[1] The Star, 18 July 2018. More than 90 deaths now linked to heat wave in Quebec. Available from https://www.thestar.com/news/canada/2018/07/18/89-deaths-now-linked-to-heat-wave-in-quebec.html Accessed 25 July 2021.
[2] La Presse, 30 June 2018. Plus de vert, moins de béton, plaide l'Institut national de santé publique. Available from http://www.lapresse.ca/actualites/201806/30/01-5187786-plus-de-vert-moins-de-beton-plaide-linstitut-national-de-sante-publique.php accessed 25 July 2021.
[3] Wetlands Alberta. Available from https://wetlandsalberta.ca/wetland-loss/. Accessed 18 July 2021.

fundamental to the social, economic, and ecological health of our country. Their disappearance will put Canadians more at risk of flooding – amongst other risks – especially in the face of the current climate crisis and associated significant socio-economic impacts.

Municipalities, which often decide the fate of these green spaces at the local level, are forced to follow the dominant capitalistic economic model (Ring et al. 2010). As a result, municipalities must prioritize economic decision making above anything else, which often leaves green spaces vulnerable to developers (Ring et al. 2010). However, the current social climate has led to some environmental protections being set in place by provincial and federal governments. Various articles and acts, such as the 2019 Impact Assessment Act (SC 2019, c.28, s.1) now help protect the environment with stricter regulations than previous versions. Nevertheless, urban green spaces are still disappearing at an alarming rate (CMM 2018).

Here, we report on an ecological characterization conducted for a 10.35 ha forested wetland situated on the shores of the Ottawa River in the town of Hudson, Québec. The town of Hudson is located West of the island of Montreal on the edge of the Ottawa River. While part of the Greater Montreal area, Hudson is a small suburban community with less than 5,500 residents (2016 census). Past the town's community centre, the Viviry River flows under the railroad track, built in 1887, and into the forested wetland historically called Sandy Beach, before emptying into the Ottawa River. The forested wetland under study here has been targeted for residential development, which has raised concerns amongst the citizens of Hudson regarding its environmental and socio-economic impact. In the spring of 2021, Nature Hudson and the Legacy Fund for the Environment mandated TerraHumana Solutions to conduct the evaluation in the targeted area (the study area). The study area included the natural space between Royalview street and Jack Layton Park (Lot MH2 or eastern block), and the area called Sandy Beach (Lot MH3 or western block) (Figure 1, Figure 2). Previous studies have listed this area as the highest priority for conservation.

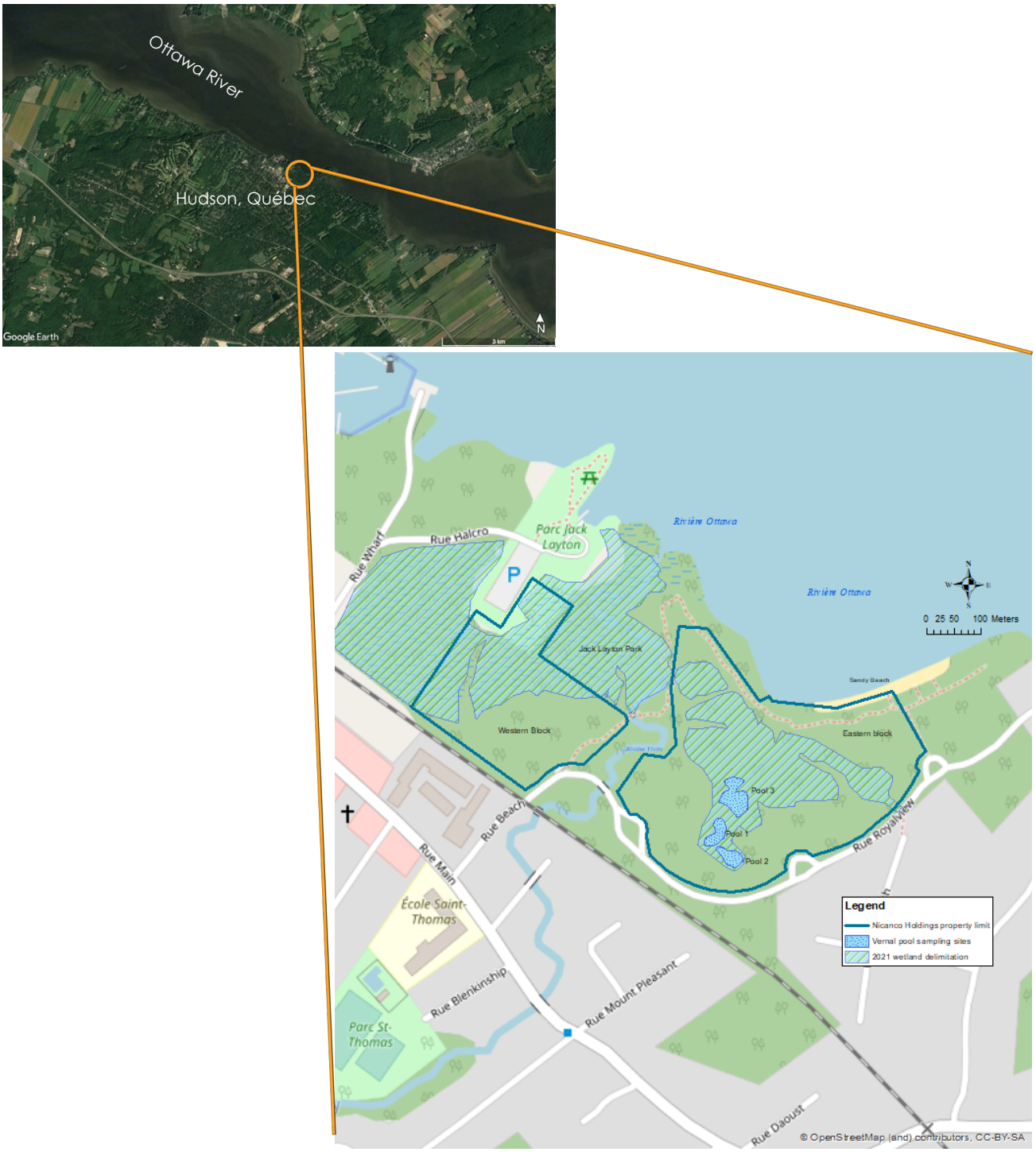

Figure 1. Map of the 2021 study area in Hudson, Québec, showing georectified developer property lines, the wetland delimitation measured in this study, and the sampled vernal pool locations. Georectification is a mapping tool used to align the proposed development plans to the coordinates on the maps. Some differences will occur. Only a land surveyor is authorized under the law to conduct delimitation or positioning of properties. Map prepared with OpenStreetMap (in French), Nicanco Holdings Plan 2: Plan d'Implantation, 30 June 2020 (in French).

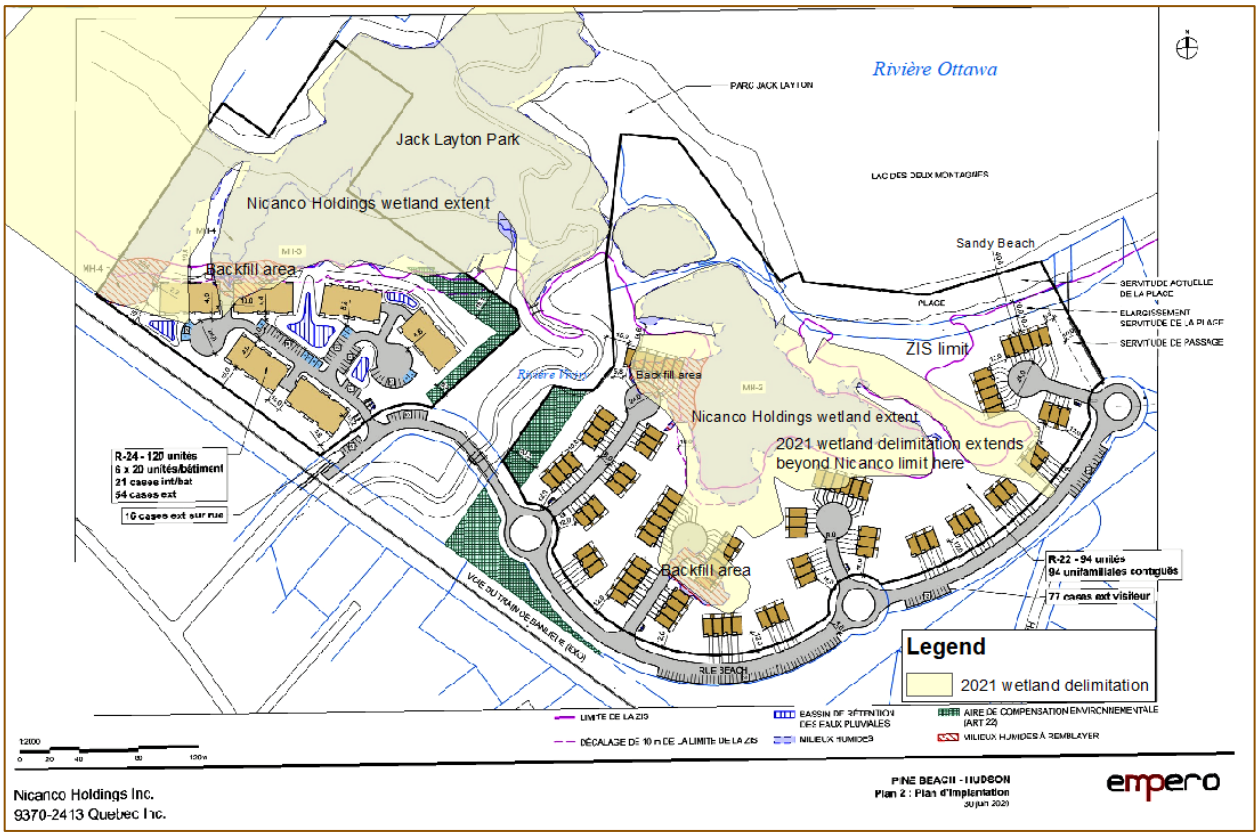

Figure 2. Georectification comparing Nicanco wetland limit and 2021 delimitation. Map prepared with OpenStreetMap (in French), Nicanco Holdings Plan 2: Plan d'Implantation, 30 June 2020 (in French).

3 Objectives

The goal of the mandate is to conduct an ecological characterization of the study area, including a delimitation of the existing wetlands to better understand the potential impacts of the proposed development and to provide recommendations.

The objectives are to:

1. Characterise the area based on existing information and field surveys of the flora and fauna as well as the existing wetlands;
2. Review and analyse documentation on the study area, including existing environmental surveys and other supporting research;
3. Provide recommendations based on the study's findings.

4 Study Area

4.1 General description and regional landscape

The study area is in the municipality of Hudson, Québec in the Vaudreuil-Soulanges Regional County Municipality, to the west of the island of Montreal. It is bordered on the southwest by Rue Wharf, to the northwest by the Ottawa River, to the southeast by the Vaudreuil-Hudson commuter train track, and to the east by Rue Royalview and housing (Figure 1). The area is experiencing development pressure from residential homes built on formerly natural landscapes. (AMEC 2014).

Figure 3: Geographic distribution of Great Lakes-St Lawrence Forest region. Source: https://www.thecanadianencyclopedia.ca /e n/article/forest-regions.

The study area is located in the northern temperate zone and the hardwood forest subzone, and more specifically, the sugar maple/bitternut hickory bioclimatic zone (Gouvernement du Québec 2003), which is characterised by one of the longest growing seasons in the province (Robitaille and Saucier 1998). We therefore find highly diversified forests, with species at the northernmost limit of their range, such as bitternut hickory, shagbark hickory, swamp white oak, and black maple, combined with species that grow further north, such as spruce and birch (Gouvernement du Québec 2003). It includes trees of several species large enough to qualify as old growth.

Other orders of classification place the study area as part of the Great Lakes – St-Lawrence Forest region (Figure 3). Ninety-five percent of this ecoregion has been lost to suburban development and the pollution of the St-Lawrence River[4]. The World Wildlife Fund has assigned a critical/endangered status to these forests; however, they do not hold special status at the provincial or the federal level.

According to data from Ducks Unlimited (2020), the area contains extensive marsh and swamp ecosystems (Figure 4), as well as the outlet of the Viviry River. Important areas for bird conservation (IBA - QC131 / Beauharnois Dam) are located within 10 km of the Beauharnois Canal[5]. IBAs are sites that provide habitat for one or more

[4] Eastern Great Lakes lowland forests, World Wildlife Fund. Available from https://www.worldwildlife.org/ecoregions/na0407 accessed 11 September 2021.
[5] Important Bird Areas Canada. Site Summary for QC131. Available from https://www.ibacanada.ca/site.jsp?siteID=QC131. Accessed on 15 September 2021.

bird species. Together, they form a network of strategic locations for the preservation of birdlife.

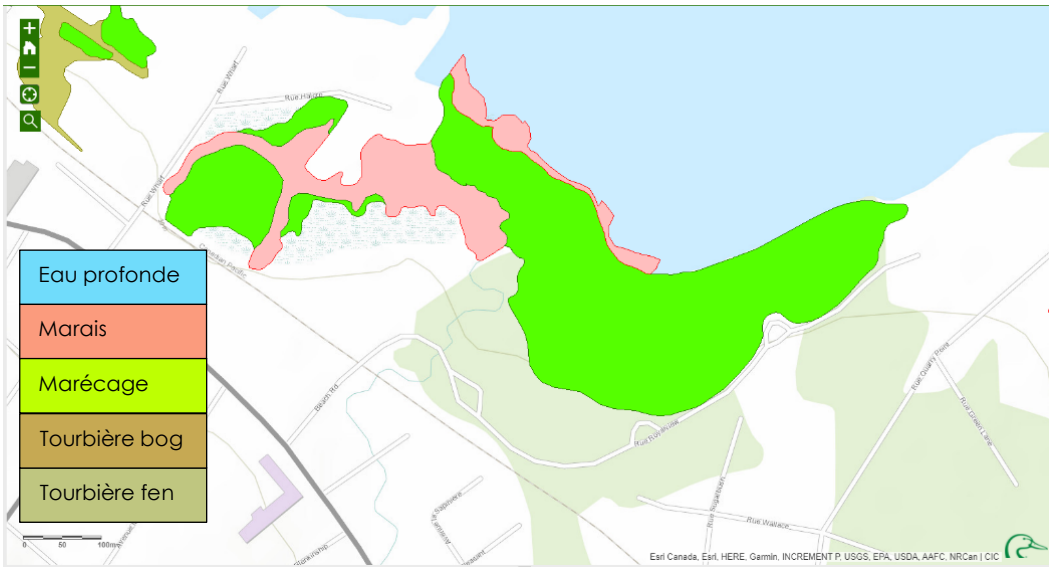

Figure 4. Study area in map of wetlands in the Montéregie. Source: Ducks Unlimited 2020.

4.1.1 Climate

Robitaille and Soucier (1988) define the Montreal region's climate as moderate subhumid continental. Winters are long and cold in a continental climate, spring, and autumn short, and the summer is hot and rainy. It is among the mildest climates in Quebec, with abundant precipitation.

4.1.2 Geomorphology

Hudson is in the St. Lawrence Lowlands region of Québec, a low and uniform plain laid down by the Champlain Sea, broken only by the igneous intrusions of Mont Rigaud and Mont Royal, and the hills of Oka to the north. The soils in the region are mostly marine clays or glacial till over a bedrock of sedimentary shale and sandstone (Robitaille and Saucier 1998).

4.1.3 Hydrography and watershed

Hudson is in the Viviry River watershed, which feeds into the Ottawa River on the northern shore of Hudson in Jack Layton Park. The Ottawa River meets the St. Lawrence River east of Hudson at the western tip of the Island of Montréal. Several streams feed into the Viviry in the study area, and the region also has several other

smaller rivers and streams. The eastern section of the study area also contains vernal pools. Vernal pools are shallow temporary wetlands caused by spring snow melt and seasonal changes in precipitation (Piché et al. 2017). An important source of nutrition and shelter to local and migrating species, their ecological importance has been undervalued. Work is currently underway to value and improve identification of this resource.

5 Methods

5.1 Research and analysis of existing information

A complete synthesis of past studies and research conducted on Hudson's remaining natural area is summarised in Gillies and Bisson 2019.

We further consulted online databases to document species of flora and fauna potentially present specifically in the study area prior to conducting field surveys. These included:

1. iNaturalist, a repository of information on biodiversity uploaded by naturalists, community scientists, and biologists;
2. eBird, an online database for bird identification operated by Cornell University's Lab of Ornithology;
3. Québec Breeding Bird Atlas, an online database on the occurrence of breeding bird species for the province of Quebec.
4. Atlas of amphibians and reptiles of Québec (AARQ) the authoritative database for the province's Herpetofauna.

5.2 Species at risk determination

The Centre de données sur le patrimoine naturel du Québec (CDPNQ) is the repository for provincial biodiversity information and is administered by both the ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) and the Ministère des Forêts, de la Faune et des Parcs (MFFP). Species at risk are designated as: "menacées", "vulnérables", "susceptible d'être designées menacées ou vulnérables", or "espèces floristiques vulnérables à la récolte".

Federal species at risk (SARA) and those assessed under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) were assessed for the region of Southern Quebec. Species are designated as "endangered", "threatened" or of "special concern". On private lands, SARA contains prohibitions that apply only to migratory birds listed in the Migratory Birds Convention Act, 1994 and listed as endangered,

threatened, or extirpated in Schedule 1 of SARA and aquatic species listed as endangered, threatened, or extirpated in Schedule 1 of SARA[6].

As the province does not include invertebrates in its listing, Wild Species: *The General Status of Species in Canada* listing was used to assess insects at the provincial level.

5.3 Ecological characterization of the natural environment

5.3.1 Wetland delimitation

The contours of wetland sites were traced following the "Identification et délimitation des milieux humides du Québec méridional" (Bazoge, Lachance et al. 2014), using the simplified method for wetland delimitation. This method requires walking along the edge of a potential wetland, where the inside edge of the delimitation is characterized by wetland plant species while the outside edge is characterized by predominantly upland terrestrial species. The contour of each site was recorded using a Garmin GPS. The resulting GPS files were later transferred to ArcGIS and projected on to a map of the forest.

Wetland sites were also characterised using a suite of biophysical markers to identify both the validity of the wetland designation as well as the type of wetland being described. The assessment included a description of the site's terrain, hydrology, soil composition and vegetation. The predominance of vegetation hydrophytic species (plants associated with wetlands), hydrological indicators and hydromorphic soils determine whether the area should be designated as a wetland or not.

Because the plant species found in vernal pools are those found in the surrounding humid forest who opportunistically enter as the water recedes, delimitation in these areas was determined by the presence of water in the early spring, the presence of aquatic species in areas wet for some part of the year, and by the assessment performed by vernal pool experts (D. Fletcher, C. Hudon, G. Methot, and A. Cattaneo).

5.3.2 Field surveys

We conducted 26 field surveys to assess plants, aquatic invertebrates in the vernal pools, insects, amphibians, reptiles, birds, and mammals from 4 April to 22 July 2021 (Table 1). Mobile species who would use the study area, but were observed along the borders, such as the Ottawa River beachfront or Jack Layton Park, are included.

[6] Species at Risk Act: information for landowners. Available from: https://www.canada.ca/en/environment-climate-change/services/species-risk-education-centre/your-responsibility/landowners.html#toc0. Accessed on 21 July 2021.

Table 1. Details on the fieldwork conducted in the study area from 4 April to 22 July 2021.

Survey type	Date	Project team members
Site survey	21-04-04	M. MacNair, M. Bohle
Site survey	21-04-13	B. Lalor, I.-A. Bisson, M. MacNair
Plant survey(ephemerals)E block	21-04-19	M. MacNair
Plant survey(ephemerals)W block	21-05-03	M. MacNair
Bird survey	21-05-03	I.-A. Bisson, A. Hackney, M. MacNair
Wetland delimitation, E block	21-05-07	M. MacNair
Bird survey	21-05-13	A. Hackney, M. MacNair
Amphibian survey (day, night)	21-05-13	M. MacNair
Wetland delimitation, vernal pool survey	21-05-13	M. MacNair, D. Fletcher
Plant survey	21-05-13	M. MacNair
Bird survey	21-05-21	A. Hackney, M. MacNair
Wetland delimitation, E block	21-05-21	M. MacNair, D. Gwilliam, T. Devanneaux
Vernal pool survey	21-05-27	A. Cattaneo, G. Methot, C. Hudon, M. MacNair,
Wetland delimitation, W block	21-05-27	M. MacNair
Plant survey (trees)	21-06-01	M. MacNair, I.-A. Bisson, D. Gwilliam, T. Devanneaux, E. Karim
Wetland delimitation W block	21-06-01	M. MacNair
Plant survey (trees)	21-06-04	M. MacNair
Wetland delimitation W block	21-06-04	M. MacNair
Herpetofauna/Plant survey(trees)	21-06-11	M. MacNair, D. Gwilliam, N. Bhat
Bat/herpetofauna/plant survey	21-06-25	M. MacNair, I.-A. Bisson, D. Gwilliam, T. Devanneaux, M. Bohle
Bat/plant survey	21-06-28	M. MacNair, I.-A. Bisson
Bat/bird/plant/herpetofauna survey	21-07-02	M. MacNair, I.-A. Bisson, T. Devanneaux, M. Bohle
Bat/insect survey	21-07-05	M. MacNair, M. Larrivée
Herpetofauna/Plant survey	21-07-12	M. MacNair, P. Galois
Bird survey	21-07-14	I.-A. Bisson
Plant survey	21-07-22	M. MacNair, F. Beauregard

5.3.2.1 Flora (botanical)

Eleven botanical inventories, and five opportunistic surveys were conducted to document at-risk plants (Table 1). Because the area is relatively small (10.35 ha), a census-survey method is recommended by the Canadian Wildlife Service Protocol

(Henderson 2010). The species of interest occupy wetland, riverine and deciduous forest habitats.

The eastern and western sections of the property were sampled opportunistically and as a function of the environmental heterogeneity of the terrain. Transects were walked from the Ottawa River or the wetland, the eastern edge of the Viviry, and Rue Royalview on the eastern sections, and from the Viviry wetland along the survey stakes of the property to the fence protecting the train track on the western section. These transects were performed for spring ephemerals and tree species. Subsequent opportunistic plant surveys were conducted as part of fauna surveys or transects were repeated to identify species that bloom later in the year. Plant specimens were identified to species on the terrain to the extent possible, including all taxonomic groups present (e.g., trees, shrubs, herbs, graminoids, ferns, fern allies). Abundant unidentifiable specimens were collected for identification using botanical keys, specifically Go Botany (Native Plant Trust 2021), Vascular plants of Canada (Vascan, Brouillet et al. 2010), The Global Biodiversity Information Facility (GBIF) (GBIF 2019), and Flora of North America (FNA 1993+). Geographical coordinates were recorded for positively identified at-risk plant species, unidentified specimens, and the end and start points of the transects. No attempt was made to estimate the relative abundance of the different botanical species present at the site; the objective of the assessment was to collate a species list of the flora present at the forest in the spring and summer.

5.3.2.1 Insects

An insect survey was conducted on the morning of 5 July 2021 (Table 1). A transect was walked through rich humid woods and along open wetlands and riverbanks. Insects were identified visually, or captured, examined, and released. Opportunistic observations were also conducted throughout the study. Opportunistic insect photos were uploaded to online biodiversity repository iNaturalist (iNaturalist 2021) to confirm identification. Please note that given the diversity of insects found in such a short survey, the survey is considered preliminary, and many more at-risk insects may be present.

5.3.2.2 Aquatic invertebrates and vernal pools

Vernal pools in the eastern section were surveyed May 13 and 27, 2021 (Table 1). On May 13 water samples were taken from two pools and analysed. May 27, 1 L water samples from three different pools were strained through a plankton net (0.15mm mesh size) and crustaceans, insects, algae, and other microorganisms identified. Photos of opportunistic observations of invertebrates were identified in iNaturalist (2021). Molluscs were observed and identified opportunistically.

5.3.2.3 Fish fauna

We did not perform fish surveys. However, we anecdotally recorded fish by consulting knowledgeable people who were fishing in the study area.

5.3.2.4 Herpetofauna (reptiles and amphibians)

Herpetofauna were surveyed following the Protocole d'inventaire des anoures du Québec (Ministère des forêts, de la Faune et des Parcs – MFFP 2019) and the Protocole standardisé pour l'inventaire de la rainette faux-grillon au Québec (MFFP 2020). Diurnal and evening (30 minutes after sunset) surveys were carried out from early April to early July 2021 (Table 1). Both diurnal and evening surveys consisted of 5-minute acoustical surveys at listening stations near wetlands, as well as opportunistic observations. Logs and rocks were temporarily displaced along tree survey transects in the forest and the edges of water bodies. Open areas near water bodies were examined for turtle reproduction sites. The geographic coordinates of each site were noted along with the observations of frogs, toads, salamanders, and turtles. Herpetofauna were identified using the online Atlas for amphibians and reptiles of Québec (AARQ 2021).

5.3.2.5 Avifauna

Bird surveys were carried out from 5:30am to 8:30am from April to July 2021 (Table 1). Observers walked for two minutes to 18 pre-established listening stations, auditory and visual observations were recorded for five minutes at each station. Opportunistic observations were also recorded throughout the study. A photo and geographic coordinates were recorded for each station. Birds were identified using field guides and the Cornell University's Lab of Ornithology online identification tool (http://www.birds.cornell.edu). Breeding status for each species identified was also recorded using the Breeding evidence codes in the Quebec Breeding Bird Atlas (2019+).

5.3.2.6 Mammal fauna

Bats emit species-specific echolocation calls (Jones and Teeling 2006). These calls were recorded using an Anabat Express bat detector (v. 1.8) on a continuous basis from dusk until dawn for six nights from 25 June to 8 July 2021 (Table 1). We placed the Anabat in two different open locations at the edge of the wetland. The geographic coordinates of each site were recorded, and echolocation calls were analyzed using the Analook Insight software (v 4.4.a). Each call was a separate bat pass defined as a sequence of echolocation pulses. The survey method was adapted from the MFFP protocol for bat acoustic inventories in the context of windmill installations (MFFP 2008).

Other terrestrial mammals were observed and identified opportunistically.

6 Results

6.1 Analysis of existing information

The CDPNQ reports a total of 17 species at risk (3 flora and 14 fauna) observed within an 8km radius of the study area. The remaining species are listed in the separate appendices and marked if they were reported in either of the databases used (CDPNQ, iNaturalist, eBird, etc.).

A recent study conducted for the town of Hudson ranked natural areas into 20 conservations indices according to data from field inventories and geospatial data processing (Eco^{2}Urb 2020). These indices were presented on a map of the town of Hudson with colour gradients showing the importance of each conservation index in every forested area. The study area was attributed a range of results for each conservation index (Table 2). It ranked high for seven indices.

Table 2. Ranking attributed to the study area for each conservation index identified for the remaining natural areas in Hudson, Québec (Eco^{2}Urb 2020).

Conservation Index	Results
Bird observation hotspot	HIGH
Herpetofauna observation hotspot	MEDIUM
Species at risk presence	YES
Regional connectivity	MEDIUM
Local connectivity	MEDIUM
Forest maturity	INTERMEDIATE
Anthropogenic disturbance	LOW
Exotic species presence	LOW
Tree functional diversity	MEDIUM
Vulnerability to future biotic threats	MEDIUM
Waterlogging tolerance	MEDIUM
Drought tolerance	MEDIUM
Development susceptibility	LOW
Flood mitigation	HIGH
Carbon storage	MEDIUM
Recreation importance	HIGH
Historical importance	HIGH
Municipal ranking for conservation priority	HIGH
Citizen ranking for conservation priority	HIGH
Consensus conservation priorities	HIGH

The report presented six possible development scenarios based on different strategies the municipal council may want to adopt. These strategies centered around business as usual, protecting 20% of natural spaces, protecting 25% of natural spaces, and protecting 30% of natural spaces, as well as regional conservation plans established by the Metropolitan Land Use and Development Plan and the Vaudreuil-Soulanges Regional Municipal County. In these scenarios, a map of the town was presented highlighting the areas that should be protected according to that scenario's objectives and requirements. Regardless of the scenario presented, the study area was consistently recommended for conservation as Tier 1: the highest conservation priority. Furthermore, every development scenario, including business as usual, opted to conserve the study area. "[…]perhaps most essential to ensuring the connectivity of terrestrial and aquatic habitats in Hudson is the conservation of natural areas associated with the Viviry River[...]" (Eco^{2}Urb 2020).

6.2 Wetland delimitation

Biophysical markers used to identify the wetlands include the site being flooded or saturated with water in the first 20 cm, waterlines on the trunks of trees, presence of debris carried by water, black leaf litter, exposed tree roots, lines of moss on the trunks and shallow root systems. Hydromorphic soil comprised of black organics and sand were apparent within the first 20 cm of each wetland site.

Though the extent of the wetland defined by the Nicanco Holdings plan in the western block differs slightly from our own delimitation, there are more marked variations in the eastern section (Figure 5). We identified an entire wetland area extending from rue Royalview to the Ottawa River waterfront that is not described in the development plan. The wetland occupies a similar area to that delineated in the zone d'intervention spéciale (ZIS) by the Affaires des municipales et de l'Habitation Québec (MAMH 2019). The floods of 2017 and 2019 would likely have inundated portions of this planned development as it is now described.

An extended series of vernal pools sits beneath the forest on the eastern block, and forms part of the floodplain for the Ottawa River (Figure 5). The vernal pool designation at the eastern sites was determined by the analysis of flora and fauna conducted by Dr. A. Cattaneo, aquatic ecologist at Université de Montréal, and two associates who sampled biota in three of the pools in the wetland (Appendix 3). The richest biota was found in pool 1 (Figure 5), slated to be backfilled (Figure 2). The vernal pool area in the forest under the proposed second and third subdivisions is much more extensive than that described by the plans and will entail backfilling and the destruction of a more extensive area than described.

Figure 5. Developer property lines, wetland delimitation and sampled vernal pool locations in the study area. Map prepared with OpenStreetMap (in French), Nicanco Holdings Plan 2: Plan d'Implantation, 30 June 2020 (in French).

6.3 Flora and fauna inventories

We observed and positively identified 354 species of flora and fauna, including a total of 29 species at risk (Table 3). Among the species at risk, we identified 13 plant species, three insect species, three turtle species, six bird species, and four bat species. It is important to note that our inventories are far from complete, as many phyla have not been surveyed, or only briefly.

Table 3. Number of species at risk (according to both federal and provincial designations) across all taxa observed in the study area from April to July 2021. A total of 29 species at risk were observed in the study area. Note that a single species can be listed both at the federal and provincial levels.

Species at risk status level	Number
Federal	
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)	
COSEWIC endangered	3
COSEWIC threatened	3
COSEWIC special concern	5
Species At Risk (SARA)	
SARA Endangered	2
SARA threatened	3
SARA special concern	6
Canada Wild Species Insect listing[a]	
Wild Species critically imperilled	1
Wild Species vulnerable	1
Province of Quebec	
Menacée	1
Vulnérable	2
Susceptible d'être désignée comme menacée ou vulnérable	9
Vulnérable à la récolte	7

[a]Canada lists only a few insect Orders, Quebec does not list any.

6.3.1 Flora (botanical)

We identified 213 plant species (Appendix 1), including 13 species at risk (one federal and 12 provincial designations, Table 4), and a plant so rare, toothed bittercress (*Cardamine dentata*), it is not listed in Quebec.

A total of 49 tree species were identified. The site is classified as second growth but contains large diameter "old-growth sized" trees and stands of federally threatened black ash (*Fraxinus nigra*) that appear to have some resistance to the emerald ash borer (*Agrilus planipennis*). The American Forest Service encourages people to report such trees, to begin a recovery program for resistant ash (United States Department of Agriculture – USDA 2021).

Table 4. At-risk plants observed in the study area from April to July 2021.

Common Name	Scientific name	COSEWIC status[a]	SARA status[a]	Provincial status[b]	Date observed
Northern maidenhair fern*	*Adiantum pedatum*			*vulnérable à la récolte*[c]	2021-05-13
Canada wild ginger*	*Asarum canadense*			*vulnérable à la récolte*	2021-06-01
two-leaved toothwort*	*Cardamine diphylla*			*vulnérable à la récolte*	2021-04-04
black ash*	*Fraxinus nigra*	threatened			2021-06-01
ostrich fern*	*Matteuccia struthiopteris*			*vulnérable à la récolte*	2021-06-01
two-leaved miterwort*	*Mitella diphylla*			*susceptible*	2021-05-13
swamp white oak*	*Quercus bicolor*			*susceptible*	2021-04-04
yellow water buttercup	*Ranunculus flabellaris*			*susceptible*	2021-06-11
narrow-leaved blue-eyed-grass	*Sisyrinchium angustifolium*			*susceptible*	2021-07-12
white trillium*	*Trillium grandiflorum*			*vulnérable à la récolte*	2021-04-04
red trillium*	*Trillium erectum*			*vulnérable à la récolte*	2021-04-04
rock elm	*Ulmus thomasii*			*menacée*	2021-07-12
large-flowered bellwort*	*Uvularia grandiflora*			*vulnérable à la récolte*	2021-05-13
toothed bittercress	*Cardamine dentata*	VASCAN excluded[d]			2021-06-11

*Indicates that the species was also reported in iNaturalist.
[a]Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed 14 July 2021.
[b]Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
[c]Sensitive to commercial harvesting for horticulture or other reasons.
[d]VASCAN, the database of vascular plants of Canada. Available from https://data.canadensys.net/vascan/taxon/3965?lang=en. Accessed 05 September 2021.

6.3.1.1 Information on species at risk

Trees at risk include rock elm (*Ulmus thomasii*), provincially *menacée*, and provincially susceptible swamp white oak (*Quercus bicolor*) and COSEWIC threatened black ash (*Fraxinus nigra*). Plants include the provincially susceptible two-leaved mitrewort (*Mitella diphylla*), yellow water buttercup (*Ranunculus flabellaris*), narrow-leaved blue-eyed-grass (*Sisyrinchium angustifolium*) and seven species *vulnérable à la* récolte (Table 4). The toothed bittercress (*Cardamine dentata*) is a species so rare it is not listed in

Quebec (Brouillet et al. 2010). Habitat loss is cited as the main cause of most species' rarity (Brooks et al. 2002).

The black walnut (*Juglans nigra*) found here may be part of a remnant population along the Ottawa River thought to be a relic of a warmer climate period (Farrar 1995). Remnant populations continue to exist because microclimate conditions in that area are suitable, even if the region is no longer appropriate for the species. The location makes it unlikely to have been planted.

Other at-risk species observed (Northern maidenhair fern, *Adiantum pedatum*), wild ginger (*Asarum canadense*), red trillium (*Trillium erectum*) and white trillium (*Trillium grandiflorum*), ostrich fern (*Matteuccia struthiopteris*), two-leaved toothwort (*Cardamine diphylla*) are listed by the CDNPQ as "espèces floristiques vulnérables à la récolte". Provincial regulations limit the number of individuals of these species that can be harvested from the wild.

6.3.2 Insects

Forty-one species of insects were observed in a single morning's survey and opportunistic observations made during the study period (Appendix 2). Many more species may be present here.

6.3.2.1 Information on species at risk

Only 13 Quebec insect species are listed at risk federally; the province does not list invertebrates. At the suggestion of the Montreal Insectarium, we relied on Wild Species Canada (WSC) (Canadian Endangered Species Conservation Council 2016), a federal and provincial body tasked with listing all species at risk nationally for some insect species. We identified three species at risk (Table 5), including the monarch butterfly (*Danaus plexippus*), classified as COSEWIC endangered and a federal species of special concern, the Dion skipper (*Euphyes dion*) listed as vulnerable (WSC), and the fraternal potter wasp (*Eumenes fraternus*, Figure 6) considered critically imperilled (WSC).

Figure 6. Fraternal potter wasp (*Eumenes fraternus*) found in the study area, June 2021. Source: M. MacNair

Table 5. At-risk insect species observed in the study area from April to July 2021.

Common Name	Scientific name	COSEWIC status[a]	SARA status[a]	Wild Species status	Date observed
monarch	*Danaus plexippus*	endangered	special concern		2120-06-28
fraternal potter wasp	*Eumenes fraternus*			critically imperilled	2120-07-12
Dion skipper	*Euphyes dion*			vulnerable	2120-07-05

[a]Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed 16 July 2021.

The monarch butterfly (*Danaus plexippus*) is an iconic species known for its epic migration. Adults hatched here in Quebec, the species' northern extent, travel nearly 5000km to the overwintering site in Mexico. In recent years the species' population plummeted by over 80% (Brower et al. 2012). Climate change and habitat degradation are blamed for this reduction (Agrawal and Inamine 2018, Zylstra et al. 2021). As agriculture methods degrade habitat in the Midwest (Thogmartin et al. 2017), northeastern North America, including Quebec, has occupied a growing proportion of the monarchs arriving at the over-wintering grounds, and has been an important reservoir on years when conditions were difficult elsewhere (Flockhart et al. 2017).

The Dion skipper (*Euphyes dion*) has been observed in only a few locations in Quebec (GBIF 2019). This small butterfly frequents wetlands where its caterpillars feed on sedges (Lotts and Naberhaus 2021).

The fraternal potter wasp (*Eumenes fraternus*) is limited to only a few locations in Quebec (GBIF 2019). The female builds a tiny pot out of mud, inserts an egg and a paralyzed caterpillar, which feeds the developing larva, before sealing the chamber (Grissell 2007). It frequents woodland edges and shrubby fields[7].

6.3.3 Aquatic invertebrates and vernal pools

Quebec reports observations of the at-risk spike mollusc (*Eurynia dilatata*) within 8km of the study area. The federally endangered hickorynut (*Obovaria olivaria*) is also potentially found in the region. iNaturalist observations indicate a diversity of mussel species found in this area (Appendix 3).

6.3.4 Fish fauna

Although we did not conduct a fish survey, our research revealed 64 potentially present and observed fish species, including 17 species at risk at the federal and/or provincial level (Appendix 4). Fishers consulted in the study area caught a total of six species:

[7] Species *Eumenes fraternus* - Fraternal Potter Wasp. Bug Guide. Available from https://bugguide.net/node/view/32193. Accessed on 25 July 2021.

Northern pike (*Esox lucius*), muskellunge (*Esox masquinongy*), bluegill sunfish (*Lepomis macrochirus*), catfish, (order *Siluriformes*), amu-darya trout (*Salmo trutta*), walleye (*Sander vitreus*). One individual reported catching a redhorse (Genus *Moxostoma*) near the Viviry River mouth but was unsure which species. Two of the four redhorse species potentially found in the area are at risk.

6.3.5 Herpetofauna

We observed 13 of the 20 species of amphibians and reptiles potentially present in the area (Appendix 5), including three at-risk turtles either nesting or with juveniles (two federal and one federal and provincial designation, Table 6). Please note that certain of these species, especially the frogs, were seen or heard repeatedly over the spring.

Table 6. At-risk herpetofauna observed in the study area from April to July 2021.

Common Name	Scientific name	COSEWIC status[a]	SARA status[a]	Provincial status[b]	Date observed
snapping turtle (+nests)	*Chelydra serpentina*	special concern	special concern		2120-07-12
midland painted turtle (+nests)	*Chrysemys picta marginata*	special concern			2120-07-12
Northern map turtle (+juveniles)*	*Graptemys geographica*	special concern	special concern	*vulnérable*	2120-07-12

*Indicates that the species was also listed in CDPNQ.
[a]Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm . Accessed 16 July 2021.
[b]Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.

6.3.5.1 Information on species at risk

Snapping turtles can live 100 years and grow to 50cm in carapace length. They feed on a variety of plants and animals, and can range more than a kilometer from the nearest body of water (AARQ). Adult snapping turtles have few predators, but the chances of an egg surviving to adulthood are 0.1%. Damage and predation of nests is often the cause[8].

Midland painted turtles can live more than 60 years in the wild, but they have such a slow reproductive rate that is takes 29-44 years to successfully breed a new generation. Rapid environmental change brought on by humans undermines the long-term scale of their life history. Females can nest as far as 1200 m away from their aquatic habitats[9].

[8] Snapping turtle (*Chelydra serpentina*) Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/1033-710. Accessed on 21 July 2021.
[9] Midland painted turtle (*Chrysemys picta marginata*). Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/1403-1016. Accessed on 21 July 2021.

Northern map turtles are a wary nocturnal species who spend much of their day basking in the sun on protected rocks or logs. Females may move a considerable distance inland to lay their eggs. As its range coincides with the most densely populated and industrialized areas of Ontario and Quebec, factors such as loss of habitat and use of waterways for recreation threaten its survival[10].

These species do not live solely in the water. Turtles need up to 500m (Steen et al. 2012), and frogs use 300m (MFFP 2020) of natural habitat around their wetland. Female turtles can range even further in search of suitable nest sites. The furthest distance across the study area is almost 650m. Both the snapping turtle and the painted turtle are nesting in heavily used public areas of the park. Increasing residents in the immediate area will impact their breeding success (Steen et al. 2012).

Frogs are particularly sensitive to aquatic perturbations (Sacerdote and King 2009), so to backfill large sections of this wetland will impact their survival. Juveniles were observed in pools and wetlands slated to be backfilled for the development.

Although we did not detect the presence of the at-risk chorus frog (*Pseudacris triseriata*) due to an early warming event in the first week of April 2021, a meta-population of the species is present on nearby Île-Perrot. It is possible that we missed it because the frog calls very early in the spring, and is difficult to detect thereafter (MFFP 2020).

6.3.6 Avifauna

We observed 70 of the 175 potentially present bird species in the area (Appendix 6), including six species at risk (Table 7). The wetland is a hunting ground for at-risk raptors, including the red-shouldered hawk (*Buteo lineatus*) and the bald eagle (*Haliaeetus leucocephalus*), who was observed perched on trees in the forest, while such species as the Eastern wood pewee (*Contopus virens*) and the chimney swift (*Chaetura pelagica*) use the forest of the study area as a breeding or feeding site.

All migratory birds and their breeding sites are subject to the Migratory Birds Convention Act (S.C. 1994, c. 22) and the Canada Wildlife Act (R.S.C. 1985, C. W-9). Our research in existing databases revealed the potential presence of 21 species at risk within an eight-kilometer radius of the study area (Appendix 6). Fifty-two of the 64 species identified were probable breeders according to the Quebec Breeding Bird Atlas' Breeding evidence codes (2019+); and four were confirmed breeders: black-capped chickadee (*Poecile atricapillus*), mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), and song

[10] Northern map turtle (*Graptemys geographica*). Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/712-76. Accessed on 21 July 2021.

sparrow (*Melospiza melodia*). It is important to note that many more species were most likely breeding in the study area because of their presence throughout the breeding season (approximately from April to August) but confirming the breeding status for each species was beyond the scope of this current mandate.

Table 7. At-risk avifauna observed in the study area from April to July 2021.

Common Name	Scientific name	COSEWIC status[a]	SARA status[a]	Provincial status[b]	Migratory status[c]	Breeding Evidence Code	Date observed
red-shouldered hawk	*Buteo lineatus*		special concern		M	T	2021-05-03
chimney swift	*Chaetura pelagica*	threatened	threatened	*susceptible*	M		2021-07-05
olive-sided flycatcher	*Contopus cooperi*	special concern	threatened	*susceptible*	M		2021-05-21
Eastern wood pewee	*Contopus virens*	special concern	special concern		M	T	2021-05-21
bald eagle	*Haliaeetus leucocephalus*			*vulnérable*	M		2021-07-02
wood thrush	*Hylocichla mustelina*	threatened	threatened		M	T	2021-05-13

[a]Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed 16 July 2021.
[b]Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
[c]Quebec Breeding Bird Atlas: Breeding evidence codes. Available from https://www.atlas-oiseaux.qc.ca/explications_indices_en.jsp. Accessed 07 July 2021.

6.3.6.1 Information on species at risk

We observed one bald eagle adult hunting over Sandy Beach with a juvenile on 2 July 2021. This species may be nesting in the Kanesatake Mohawk community across the Ottawa River.

A pair of red-shouldered hawks were repeatedly observed using trees next to the Viviry River wetland as a hunting perch. Ongoing presence in the forest indicates probable breeding (Quebec Breeding Bird Atlas breeding evidence code P "pair observed in suitable nesting habitat during the species' breeding season"). The study area fits the species' preferred breeding habitat, which is described as "deciduous or mixed forests containing shade-tolerant hardwood trees close to wetland areas". The primary threat is habitat loss – as it is for many species at risk – and the loss of available prey from the filling in of wetlands[11].

[11] Red-shouldered hawk (*Buteo lineatus*) Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/58-398. Accessed on 21 July 2021.

A colony of chimney swifts were observed near the community center at approximately 0.09 km from the study area. They were often observed flying over the study area, potentially using it as a food source. Chimney swifts are insectivores.

Eastern wood pewees were heard repeatedly throughout the study period. The species profile reports that the species is most "abundant in forest stands of intermediate age and mature stands with little understory vegetation". Therefore, the study area represents good breeding habitat for the species. The Québec Breeding Bird Atlas lists it as a Probable T nester for the area, which designates a "presumed territory based on the presence of an adult bird, whether producing sounds associated with breeding or not, at the same place, in suitable nesting habitat, on at least two visits, one week or more apart, during the species' breeding season". The exact cause of the decline in this species' population has yet to be determined but, possible threats include: 1) loss and degradation of habitat quality on the breeding grounds due to urban development and/or changes in forest management; 2) loss and/or degradation of habitat on the wintering grounds; 3) large -scale changes in the availability of flying-insect prey due to unknown causes; 4) high rates of mortality during migration and/or on the wintering grounds); 5) high rates of nest predation from increasing numbers of avian predators; and 6) changes in forest structure due to white-tailed deer over-browsing[12].

We observed olive-sided flycatchers repeatedly in the large-toothed aspen (*Populus grandidentata*) stands. Prime habitat includes open spaces with isolated forest stands. The species profile[13] mentions that "open areas may be forest clearings, forest edges located near natural openings (such as rivers or swamps) or human-made openings (such as logged areas)". During migration, olive-sided flycatchers increase their use of riparian non-coniferous habitat types, which fits the habitat profile of the study area. However, they prefer mountainous regions[14]. The study area could nevertheless be used as a migratory stopover site. It was not listed in Québec's Breeding Bird Atlas. The threats to this species' survival are unclear but, habitat loss has been cited as the most probable cause.

We first observed wood thrushes on 13 May 2021 as part of our bird survey. The species profile[15] indicates that preferred breeding habitat includes "second-growth and mature deciduous and mixed forests", with a well-developed understory (saplings). Furthermore, while they prefer large forest mosaics, which can be found north of the

[12] Eastern Wood-pewee (*Contopus virens*) Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/1198-877. Accessed 21 July 2021.
[13] Olive-sided Flycatcher (*Contopus cooperi*) Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/999-683. Accessed 21 July 2021.
[14] Olive-sided Flycatcher, Guide to Boreal Birds, Boreal Songbird Initiative. Available from https://www.borealbirds.org/bird/olive-sided-flycatcher. Accessed 21 July 2021.
[15] Wood Thrush (Hylocichla mustelina). Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/1197-870. Accessed 21 July 2021.

study area, "they may also nest in small forest fragments", such as the study area. The Québec Breeding Bird Atlas lists it as a T nester. A T nester designates individual(s) heard or observed "producing other sounds associated with breeding… in suitable nesting habitat… during the species' breeding season." Once found across much of eastern North America, this bird has declined by 83% in 41 years. It requires mature, deep forest for habitat, and would no longer use the area if the forest were removed. Several threats have been identified as impeding the survival of this species, including habitat degradation and fragmentation due to development.

6.3.7 Mammals

We observed 14 species of mammals (Appendix 7), including four species at risk (Table 8). Of the 455 bat (order Chiroptera) passes recorded, 357 originated from four species at risk (two federally endangered and two susceptible at the provincial level, Table 8). Females of the endangered little brown myotis (*Myotis lucifugus*) and tri-coloured bat (*Perimyotis subflavus*) establish summer maternity colonies in large-diameter trees such as those found in the study area.

We also observed the American red squirrel (*Sciurus vulgaris*), big brown bat (*Eptesicus fuscus*), common muskrat (*Ondatra zibethicus*), common raccoon (*Procyon lotor*), Eastern chipmunk (*Tamias striatus*), Eastern gray squirrel (*Sciurus carolinensis*), North American beaver (*Castor Canadensis*), red fox (*Vulpes*) and white-tailed deer (*Odocoileus virginianus*) (Appendix 7). As we were not actively surveying for mammals except Chiropterans, many more species likely occupy the study area. North American river otters (*Lontra Canadensis*) were reported by residents consulted throughout the study period. Existing database searches revealed the potential presence of the Northern flying squirrel (*Glaucomys Volans*) within an 8km radius of the study area, but we did not observe this species.

Table 8. At-risk mammal fauna observed in the study area from April to July 2021.

Name	Scientific name	COSEWIC status[a]	SARA status[a]	Prov. status[b]	Date first observed
silver-haired bat	*Lasionycteris noctivagans*			susceptible	2021-06-28
red bat	*Lasiurus borealis*			susceptible	2021-06-28
little brown myotis	*Myotis lucifugus*	endangered	endangered	susceptible	2021-06-28
tri-coloured bat	*Perimyotis subflavus*	endangered	endangered		2021-06-28

[a]Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed 16 July 2021.
[b]Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.

6.3.7.1 Information on species at risk

We detected the presence of four species at risk: the federally endangered little brown myotis (*Myotis lucifugus*) and tri-coloured bat (*Perimyotis subflavus*), and the provincially susceptible silver-haired bat (*Lasionycteris noctivagans*) and red bat (*Lasiurus borealis*). The highest number of passes were recorded for the little brown myotis.

Females of the endangered little brown myotis and tri-coloured bat establish summer maternity colonies in large-diameter trees such as those found in the study area. We observed several large-diameter trees (white pine (*Pinus strobus*), hemlock (*Tsuga Canadensis*), willow (*Salix +fragilis*), tamarack (*Larix laricina*) and large-toothed aspen (*Populus grandidentata*)) in the study area. Foraging occurs over water, along waterways, forest edges, and in gaps in the forest[16]. The popularity of waterfront development along the Ottawa River has resulted in the destruction of large-diameter trees suitable for maternity sites along the water.

Canada represents half of both species' range globally. Populations in the eastern part of this range have been devastated by White-nose Syndrome (WNS), a fungal disease caused by an introduced pathogen. To date, this disease has caused an overall 94% decline of hibernating Myotis bats in Nova Scotia, New Brunswick, Ontario, and Québec.

The destruction of roosts and the loss of feeding habitat is considered a high-level threat in areas infected by WNS, according to the recovery program for the little brown myotis and the tri-coloured bat[17]. Surveys during the 2021 breeding period (June to July) are recommended to confirm the presence of roosts in the forest.

7 Discussion

7.1 Species richness of the study area

The study area is characterized by extensive wetlands (Figure 4), which houses a diverse flora and fauna. We observed and positively identified 354 species of flora and fauna, including a total of 29 species at risk. Among the species at risk, we identified 13 plant species, three insect species, three turtle species, six bird species, and four bat species. We found the wetland extent and size, especially of the eastern block, to be greater than the previously delineated area by the development plans submitted to Hudson in

[16] Little brown myotis (*Myotis lucifugus*) Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/1173-848. Accessed 21 July 2021.
[17] Tricoloured bat (*Perimyotis subflavus*) Species at Risk Profile. Available from https://species-registry.canada.ca/index-en.html#/species/1174-850. Accessed 21 July 2021.

2020 by Nicanco Holdings (9370-2413 Quebec Inc). In fact, our delineation is close to the one reported in the *zone d'intervention spéciale* (ZIS) plans created in 2019 by the *Ministère des Affaires des municipales et de l'Habitation* (MAMH, Figure 2). We therefore estimate that more backfill of wetlands will be required to build the development than described by the plans. The wetlands and forests slated for destruction in this development plan are a vital resource for many species: otters, muskrats, beavers, birds, turtles, frogs, insects, bats, and plants need both the water and the surrounding forest to survive. Removing the forest upon which these species rely will result in the reduction and potential loss of these species and contribute to the overall decline in biodiversity in the area and nationally.

At the provincial level, development in the study area must be approved by the MELCC under article 22 of the Loi sur la qualité de l'environnement (L.C. 1999, ch.33). At the federal level, the extensive backfill proposed by this development plan necessitates obtaining a Department of Fisheries and Oceans permit because four federally at-risk fish species are potentially present. A priority recommendation would be to conduct fish surveys to determine the presence of these species, and to encourage the Town to insist on a federal survey.

According to the Stratégie québécoise de l'eau 2018-2030, habitats such as wetlands are essential to the purification of water and the benefit of human populations (MELCC 2021). In a study of the Viviry River, AMEC (AMEC 2014) recommended carrying out water management in Hudson in accordance with Quebec policy, paying special attention to protecting banks and to preserving wetlands. Climate change predictions for this region warn of an increase in severe weather events, with 100-year-floods occurring every six years by 2050 (MELCC 2021, USGCRP 2017). Retaining this wetland can help protect current Hudson residents, as well as those downstream, from catastrophic flooding. Development increases the risks to current residents, and to the governments charged with the costs incurred protecting buildings on a floodplain.

Draining water from wetlands and soggy areas disrupts ecosystems and can cause problems for homeowners (Lipske 1998). Furthermore, building on a wetland in a floodplain could change the hydrological regime of the area (USGCRP 2018). Following the creation of the ZIS by MAMH in 2019 (MAMH 2019), any disruption to the wetland, including backfilling, ground preparation work, or draining for residential development, may influence its ability to absorb water, resulting in greater overflows of water during periods of flooding (Beacon Environmental 2012). Buffer zones are areas surrounding wetlands that protect the wetland from human activity over the long term. They filter out pollutants and give species the space and resources to survive. To preserve the long term integrity of a wetland ecosystem, most studies recommend a minimum of 100 metres (Beacon Environmental 2012).

The study area is further characterized by a high diversity of botanical species, especially given its size and history of use. It is rich in tree species (49 species), including three at risk, and one from a remnant population (black walnut). The presence of a species (toothed bittercress), so rare it is not even listed within the province, along with the susceptible and vulnerable herbaceous species indicates the area's value for biodiversity conservation. This forest is not interchangeable with an upland forest. It is unique and contains species that are scarcely found elsewhere in Quebec. It also contains ash individuals that may be resistant to the emerald ash borer, large trees potentially used as nest sites for at-risk birds and roosts for at-risk bats. This would require further specialised studies.

This diverse forested wetland provides suitable habitat for many animals from insects to mammals. We found this to be true for migratory and non-migratory birds, including six species at risk, despite its heavy use by citizens for recreational purposes. These wetlands are breeding grounds for insects, which are the preferred food source for many avian species, particularly during the spring brood-rearing periods, and for insectivorous species, which have been in sharp decline since the 1970's (NACBI 2019). The site shows potential to be designated as a Migratory Bird Sanctuary (MBS). Four criteria are used to determine whether a site can be considered an MBS (Government of Canada 2017), three of which may apply to the area of interest:

1. It supports populations that are concentrated, for any part of the year, to meet one or several essential needs; as such, the area figures prominently in the requirement for the management of regional populations of migratory birds.
2. The area is vulnerable to area-specific threats. This development will affect a significant portion of the bird population currently using the area. Such key habitat sites could include areas for nesting, moulting, wintering or staging.
3. It supports populations that occupy habitats of restricted geographical area and that are vulnerable to human disturbance. Areas that support threatened, endangered, or rare species are examples.

The Chiropteran order was the only mammalian order that was specifically surveyed. The presence of three endangered or susceptible bat species in numbers likely to have maternity roosts in the large-diameter trees in the area indicates the need to assess the forest for presence of bat roosts used for nesting. Overall, due to their at-risk status and the tendency of bat species to maintain interannual reproductive site fidelity (Brigham 2007), the area of interest is ecologically valuable for this taxon. While many terrestrial mammals could be passively observed in the area, many more elusive species, in

particular rodents, would need targeted surveys to confirm their presence. No inventories have been conducted in past studies. Many rodent species likely to be found in the area are currently at risk.

7.1.1 Socio-ecological value of study area

The social, ecological, and environmental value of the area is indisputable. Anyone who has walked a boardwalk on a developed beach backed by houses can recognize that Sandy Beach is different, and that such a development would impact these values. The COVID-19 pandemic has highlighted the inherent value of having access to green and natural spaces. For children in particular, green spaces are important for developing a sense of identity and for gaining social skills and independence.

These spaces also offer ecosystem services such as water filtration, carbon fixation, food and medicinal plants, and flood resilience (Mexia et al 2018). The rise in temperature due to climate change resulting in recent heat waves, magnifies the importance of natural areas' ability to mitigate the urban heat island effect (Aram et al. 2019). The INSPQ has labelled natural spaces as important for citizens' health. Following Canada's adoption of the 2015 UN Sustainable Development Goals, federal and provincial laws have been enacted to help develop a global partnership of sustainable development whereby human lives and the environment are protected. At the provincial level, the Sustainable Development Act (ch. D-8.1.1) aims to ensure sustainable development by guaranteeing good quality of life and social equity, environmental protection, and economic efficiency.

The promotion of residential developments in towns have been lauded as a source of income necessary to ameliorate infrastructure costs and quality of life. However, accounting for the long-term impacts of residential developments on the environment, human well-being, and the economy is frequently neglected (Pejchar et al. 2015). Tax revenue from residential developments can quickly be exceeded by infrastructure costs and elevated payments to other levels of government (Trent 2021).

Ecosystem services, such as flood mitigation, water filtration, carbon storage, and recreation provided by the study area assessed in this report to the town and its citizens, are long-lasting and that have historically been under-valued or excluded entirely from economic analysis and decision-making processes. A recent study examining the economic value of ecosystem services of l'Anse-à-l'Orme, a natural area in Pierrefonds-West and now part the Grand Parc de l'Ouest, found that the 180-hectare area provided services that were worth more than $285,000 each year (Gestion Environnement MM 2015). According to the Town of Hudson's By-law 525, Hudson benefits from "a natural environment of exceptional quality," citing the Ottawa River

and forest cover. By-law 525 also lists the preservation of natural elements, "particularly the forests, lakes, bodies of water, and the wetlands found within the Town's borders" as a goal. The study area here clearly fits that description.

7.2 Conclusion and recommendations

The study area is a vital resource for the flora, fauna, and human population of this region and beyond. It is unique to the area, and its loss will affect species well beyond the boundaries of the site itself. The existing backfill plans (Figure 2) of the wetlands will have negative consequences for many at-risk species. Wetlands slated to be filled include some of the richest biota of the study area. At-risk plants would be removed, birds would lose feeding perches and nests, bats would lose roosts and potential maternity trees, fish and amphibians would be impacted by reduced dissolved oxygen in the water and turtles would suffer from the loss of habitat and traffic mortality from increased human presence. Of the 29 species at risk documented in our study, the government lists only the map turtle within an eight-km radius of the study area, implying that few surveys exist of the site. The 28 currently unlisted species at risk we observed should be registered with the CDPNQ. The database tracks populations of animal and plant species to inform biodiversity conservation efforts at the provincial level. The province's current knowledge of the site is therefore insufficient, and development permits granted on that basis do not reflect the value of the site.

We therefore recommend the following:

1. *Wetlands*. As the value of vernal pools has often gone unrecognized, we recommend additional vernal pool surveys earlier in the spring of 2022, to observe species that may have already reproduced and vanished from the water column.
2. *Flora*. We recommended additional botanical surveys to be conducted in mid to late summer to acquire a complete inventory. The site should be a candidate for classification as an Exceptional Forest Ecosystem (EFE) (MFFP 2016-2019). EFEs are generally smaller forested areas that fall into one of three categories: rare forests, which are either naturally rare or have become rare due to human activity; old-growth forests, which have not been disturbed by human activity and which are made up of extremely old trees; and shelter forests, which house either a threatened or vulnerable species. Québec's Sustainable Forest Development Act stipulates that all forest development activities are prohibited in an EFE.
3. *Fauna*. The presence of one federally endangered, one critically imperilled, and one vulnerable insect species in a single morning's survey indicates the potential presence of many more species at risk. A more extensive survey should be conducted, perhaps involving the Montreal Insectarium, or inviting entomologists for a Bioblitz. Fish and snake surveys should be conducted in 2022 given the observation

by the CDPNQ of three at-risk snake species and four fish species. Turtle nesting sites in the area are currently vulnerable to human destruction as well as predation, and protection should be considered. A breeding bird survey is recommended to confirm the presence of the wood thrush, among other birds at risk.

4. Finally, because of the study area's ecological significance, we recommend that the town of Hudson take the findings of this study into account and consider revisiting its plan to develop the study area.

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Appendix *1. Flora observed (April-July 2021)* in the study area. Note that no plants were listed under SARA.

Name	Scientific name	COSEWIC status	Prov. status	Date observed
balsam fir*	*Abies balsamea*			2021-04-04
boxelder maple	*Acer negundo*			2021-05-03
striped maple*	*Acer pensylvanicum*			2021-06-05
red maple*	*Acer rubrum Linnaeus*			2021-05-03
silver maple*	*Acer saccharinum*			2021-04-04
sugar maple*	*Acer saccharum*			2021-04-04
mountain maple*	*Acer spicatum*			2021-06-11
white baneberry*	*Actaea pachypoda*			2021-06-28
red baneberry*	*Actaea rubra*			2021-06-05
Northern maidenhair fern*	*Adiantum pedatum*		*vulnérable à la récolte*	2021-05-13
white snakeroot	*Ageratina altissima*			2021-07-22
garlic mustard*	*Alliaria petiolata*			2021-05-03
giant ragweed	*Ambrosia trifida*			2021-06-05
common serviceberry	*Amelanchier arborea*			2021-06-11
American hog-peanut*	*Amphicarpaea bracteata*			2021-06-25
Canada anemone*	*Anemonastrum canadense*			2021-06-05
tall anemone	*Anemone virginiana*			2021-07-01
cow parsley*	*Anthriscus sylvestris*			2021-06-11
American groundnut*	*Apios americana*			2021-06-11
spreading dogbane	*Apocynum androsaemifolium*			2021-07-12
hemp dogbane	*Apocynum cannabinum*			2021-06-28
wild sarsaparilla*	*Aralia nudicaulis*			2021-05-03
American spikenard*	*Aralia racemosa*			2021-07-02

Name	Scientific name	COSEWIC status	Prov. status	Date observed
greater burdock*	*Arctium lappa*			2021-05-03
jack-in-the-pulpit*	*Arisaema triphyllum*			2021-05-03
common mugwort*	*Artemisia vulgaris*			2021-06-25
Canadian wild ginger*	*Asarum canadense*		*vulnérable à la récolte*	2021-06-01
swamp milkweed*	*Asclepias incarnata*			2021-06-11
common milkweed*	*Asclepias syriaca*			2021-06-25
Canadian milkvetch*	*Astragalus canadensis*			2021-06-25
common lady fern*	*Athyrium filix-femina*			2021-05-13
bitter wintercress*	*Barbarea vulgaris*			2021-06-25
common barberry	*Berberis vulgaris*			2021-07-12
yellow birch*	*Betula alleghaniensis*			2021-04-04
paper birch*	*Betula papyrifera*			2021-04-04
grey birch*	*Betula populifolia*			2021-04-04
moonwort species (*Botrychium*)	*Botrychium oneidensis*			2021-07-22
flowering-rush	*Butomus umbellatus*			2021-06-28
yellow marsh marigold*	*Caltha palustris*			2021-05-03
two-leaved toothwort*	*Cardamine diphylla*		*vulnérable à la récolte*	2021-04-04
toothed bittercress	*Cardamine dentata*			2021-06-04
northeastern sedge	*Carex cryptolepis*			2021-05-28
oak sedge	*Carex pensylvanica*			2021-04-13
American hornbeam	*Carpinus caroliniana*			2021-06-01
bitternut hickory*	*Carya cordiformis*			2021-06-01
giant blue cohosh*	*Caulophyllum giganteum*			2021-04-04

Name	Scientific name	COSEWIC status	Prov. status	Date observed
blue cohosh*	*Caulophyllum thalictroides*			2021-04-04
Eastern buttonbush	*Cephalanthus occidentalis*			2021-07-22
white turtlehead*	*Chelone glabra*			2021-09-13
common pipsissewa*	*Chimaphila umbellata*			2021-04-04
spotted water-hemlock	*Cicuta maculata var. maculata*			2021-07-22
broadleaf enchanter's nightshade*	*Circaea canadensis*			2021-06-25
field thistle	*Cirsium discolor*			2021-07-01
Carolina spring-beauty*	*Claytonia caroliniana*			2021-05-13
virgin's-bower*	*Clematis virginiana*			2021-07-12
bluebead lily*	*Clintonia borealis*			2021-05-13
alternate-leaved dogwood	*Cornus alternifolia*			2021-04-04
round-leaved dogwood*	*Cornus rugosa*			2021-04-04
red-osier dogwood*	*Cornus sericea*			2021-04-04
beaked hazelnut	*Corylus cornuta*			2021-05-28
common dodder	*Cuscuta gronovii*			2021-07-22
Northern bush-honeysuckle*	*Diervilla lonicera*			2021-04-04
wild cucumber	*Echinicystic lobata*			2021-06-11
common waterweed	*Elodea canadensis*			2021-06-25
purple-veined willowherb	*Epilobium coloratum*			2021-09-13
common scouring-rush*	*Equisetum hyemale subsp. affine*			2021-04-04
dwarf scouring-rush	*Equisetum scirpoides*			2021-04-04
variegated scouring-rush	*Equisetum variegatum*			2021-04-05
annual fleabane	*Erigeron annuus*			2021-06-28

Name	Scientific name	COSEWIC status	Prov. status	Date observed
yellow trout lily*	*Erythronium americanum*			2021-04-04
grass-leaved goldenrod*	*Euthamia graminifolia*			2021-07-12
spotted joe-pye weed*	*Eutrochium maculatum*			2021-06-11
American beech*	*Fagus grandifolia*			2021-04-04
woodland strawberry	*Fragaria vesca*			2021-06-11
wild strawberry	*Fragaria virginiana*			2021-07-01
glossy buckthorn*	*Frangula alnus*			2021-04-04
white ash*	*Fraxinus americana*			2021-04-04
black ash*	*Fraxinus nigra*	threatened		2021-06-01
red ash*	*Fraxinus pennsylvanica*			2021-06-01
Eastern teaberry	*Gaultheria procumbens*			2021-04-19
herb-Robert	*Geranium robertianum*			2021-06-28
white avens	*Geum canadense*			2021-06-11
common oak fern	*Gymnocarpium dryopteris*			2021-04-19
sharp-lobed hepatica*	*Hepatica acutiloba*			2021-04-15
dame's rocket*	*Hesperis matronalis*			2021-07-02
shining firmoss	*Huperzia lucidula*			2021-06-11
European frog-bit	*Hydrocharis morsus-ranae*			2021-07-01
common jewelweed*	*Impatiens capensis*			2021-05-03
Northern blue flag*	*Iris versicolor*			2021-06-11
yellow iris	*Iris pseudacorus*			2021-04-21
black walnut	*Juglans nigra*			2021-07-22
wood nettle*	*Laportea canadensis*			2021-06-01
common nipplewort	*Lapsana communis*			2021-06-11
tamarack*	*Larix laricina*			2021-05-03

Name	Scientific name	COSEWIC status	Prov. status	Date observed
rice cutgrass*	*Leersia oryzoides*			2021-06-01
common duckweed*	*Lemna minor*			2021-06-11
Indian tobacco	*Lobelia inflata*			2021-07-12
Canada fly-honeysuckle	*Lonicera canadensis*			2021-06-05
morrow's honeysuckle*	*Lonicera morrowii*			2021-05-03
bird's-foot trefoil*	*Lotus corniculatus*			2021-07-05
European water-horehound	*Lycopus europaeus*			2021-06-11
Northern starflower	*Lysimachia borealis*			2021-05-13
fringed loosestrife*	*Lysimachia ciliata*			2021-07-02
creeping jenny*	*Lysimachia nummularia*			2021-07-02
tufted loosestrife*	*Lysimachia thyrsiflora*			2021-06-11
swamp yellow-loosestrife/candle	*Lysimachia terrestris*			2021-06-28
purple loosestrife*	*Lythrum salicaria*			2021-06-11
Canada mayflower*	*Maianthemum canadense*			2021-06-11
false solomon's seal*	*Maianthemum racemosum*			2021-05-28
common apple tree	*Malus pumila*			2021-07-05
ostrich fern*	*Matteuccia struthiopteris var. pensylvanica*		*vulnérable à la récolte*	2021-06-01
Indian cucumber-root	*Medeola virginiana*			2021-05-13
square-stemmed monkeyflower	*Mimulus ringens var. ringens*			2021-07-01
two-leaved miterwort*	*Mitella diphylla*		*susceptible*	2021-05-13
Indian pipe	*Monotropa uniflora*			2021-06-11
water forget-me-not*	*Myosotis scorpioides*			2021-06-01
sweet gale	*Myrica gale*			2021-09-13

Name	Scientific name	COSEWIC status	Prov. status	Date observed
white rattlesnakeroot*	*Nabalus albus*			2021-06-28
three-leaved rattlesnakeroot	*Nabalus trifoliolatus*			2021-07-01
variegated pond-lily	*Nuphar variegata*			2021-06-11
American white waterlily*	*Nymphaea odorata*			2021-07-12
common evening-primrose*	*Oenothera biennis*			2021-06-25
sensitive fern*	*Onoclea sensibilis*			2021-06-01
hairy sweet cicely*	*Osmorhiza claytonii*			2021-06-11
cinnamon fern	*Osmunda cinnamomea*			2021-06-01
royal fern*	*Osmunda regalis var. spectabilis*			2021-06-01
Eastern hop-hornbeam*	*Ostrya virginiana*			2021-04-04
slender yellow wood-sorrel*	*Oxalis dillenii*			2021-07-12
dwarf ginseng	*Panax trifolius*			2021-05-13
Virginia creeper*	*Parthenocissus quinquefolia*			2021-06-01
wild parsnip*	*Pastinaca sativa*			2021-07-05
European reed*	*Phragmites australis australis*			2021-06-11
white spruce	*Picea glauca*			2021-04-04
clearweed	*Pilea pumila*			2021-06-05
Eastern white pine*	*Pinus strobus*			2021-04-04
hairy solomon's-seal*	*Polygonatum pubescens*			2021-06-11
rock polypody*	*Polypodium virginianum*			2021_06-11
pickerelweed	*Pontederia cordata*			2021-07-01
balsam poplar	*Populus balsamifera*			2021-04-04
Eastern cottonwood	*Populus deltoides*			2021-04-04
large-toothed aspen	*Populus grandidentata*			2021-04-04

Name	Scientific name	COSEWIC status	Prov. status	Date observed
trembling aspen*	*Populus tremuloides*			2021-05-13
Illinois pondweed	*Potamogeton illinoensis*			2021-06-25
common silverweed	*Potentilla anserine subsp. Anserina*			2021-06-28
rough cinquefoil	*Potentilla norvegica*			2021-06-28
bird cherry	*Prunus pensylvanica*			2021-06-01
black cherry*	*Prunus serotina*			2021-04-04
common bracken*	*Pteridium aquilinum*			2021-06-11
Shinleaf*	*Pyrola elliptica*			2021-06-11
Eastern white oak	*Quercus alba*			2021-06-01
swamp white oak*	*Quercus bicolor*		*susceptible*	2021-04-04
Northern red oak*	*Quercus rubra*			2021-04-04
kidney-leaved buttercup	*Ranunculus abortivus*			2021-05-13
meadow buttercup*	*Ranunculus acris*			2021-06-11
Yellow water buttercup	*Ranunculus flabellaris*		*susceptible*	2021-06-11
cursed buttercup	*Ranunculus sceleratus*			2021-09-13
japanese knotweed*	*Reynoutria japonica*			2021-06-11
European buckthorn*	*Rhamnus cathartica*			2021-05-03
staghorn sumac*	*Rhus typhina*			2021-06-11
prickly gooseberry*	*Ribes cynosbati*			2021-06-11
swamp red currant	*Ribes triste*			2021-07-01
European gooseberry	*Ribes uva-crispa*			2021-06-01
multi-flora rose	*Rosa multiflora*			2021-06-25
raspberry*	*Rubus idaeus*			2021-05-13
black raspberry*	*Rubus occidentalis*			2021-05-03

Name	Scientific name	COSEWIC status	Prov. status	Date observed
purple-flowering raspberry*	*Rubus odoratus*			2021-04-19
dwarf raspberry*	*Rubus pubescens*			2021-05-13
broadleaf arrowhead*	*Sagittaria latifolia*			2021-06-28
hybrid white willow	*Salix ×fragilis*			2021-05-03
pussy willow	*Salix discolor*			2021-07-12
sandbar willow*	*Salix interior*			2021-06-28
black willow	*Salix nigra*			2021-07-12
red elderberry*	*Sambucus racemosa*			2021-05-29
American bulrush	*Schoenoplectus americanus*			2021-06-28
soft-stemmed bulrush*	*Schoenoplectus tabernaemontani*			2021-06-28
bladder campion*	*Silene vulgaris*			2021-0705
narrow-leaved blue-eyed-grass	*Sisyrinchium angustifolium*		*susceptible*	2021-07-12
herbaceous carrionflower	*Smilax herbacea*			2021-07-12
perennial sow thistle*	*Sonchus arvensis*			2021-07-12
white meadowsweet*	*Spiraea alba*			2021-07-12
marsh hedge-nettle	*Stachys palustris*			2021-06-28
clasping-leaved twisted-stalk	*Streptopus amplexifolius*			2021-05-03
calico aster	*Symphyotrichum lateriflorum*			2021-07-22
New England aster*	*Symphyotrichum novae-angliae*			2021-07-12
common comfrey*	*Symphytum officinale*			2021-05-13
Canadian yew*	*Taxus canadensis*			2021-04-04
Canada germander*	*Teucrium canadense*			2021-07-12
Eastern white cedar*	*Thuja occidentalis*			2021-04-04

Name	Scientific name	COSEWIC status	Prov. status	Date observed
basswood*	*Tilia americana*			2021-04-04
poison ivy*	*Toxicodendron radicans*			2021-06-11
meadow goatsbeard	*Tragopogon pratensis*			2021-07-01
red trillium*	*Trillium erectum*		*vulnérable à la récolte*	2021-04-04
white trillium*	*Trillium grandiflorum*		*vulnérable à la récolte*	2021-04-04
Eastern hemlock*	*Tsuga canadensis*			2021-04-04
coltsfoot*	*Tussilago farfara*			2021-04-04
narrow-leaved cattail	*Typha angustifolia*			2021-07-01
broadleaf cattail*	*Typha latifolia*			2021-07-02
American elm*	*Ulmus americana*			2021-04-04
slippery elm	*Ulmus rubra*			2021-06-01
rock elm	*Ulmus thomasii*		*menacé*	2021-07-12
stinging nettle*	*Urtica dioica*			2021-06-11
large-flowered bellwort*	*Uvularia grandiflora*		*vulnérable à la récolte*	2021-05-13
sessile-leaved bellwort	*Uvularia sessilifolia*			2021-04-19
blueberry	*Vaccinium spp*			2021-06-01
common valerian*	*Valeriana officinalis*			2021-06-25
common mullein	*Verbascum thapsus*			2021-07-02
blue vervain	*Verbena hastata*			2021-07-22
mapleleaf viburnum	*Viburnum acerifolium*			2021-07-02
hobblebush, alder-leaved viburnum	*Viburnum lantanoides*			2021-05-03
nannyberry	*Viburnum lentago*			2021-05-21

Name	Scientific name	COSEWIC status	Prov. status	Date observed
tufted vetch*	*Vicia cracca*			2021-06-25
downy yellow violet	*Viola pubescens*			2021-05-13
riverbank grape*	*Vitis riparia*			2021-06-05

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ).

Sources:

1. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed 14 July 2021.
2. Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
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5. Native Plant Turst. 2021. Go Botany. Framingham, Massachusetts, USA.
6. Flora of North America (FNA). 1993+. Flora of North America. Flora of North America North of Mexico. Available from http://beta.floranorthamerica.org. Accessed on 7 July 2021.

Appendix 2. Insect species observed (April-July 2021) in the study area.

Name	Scientific name	COSEWIC status	SARA status	Wild Species status	Date observed
black-and-gold flat millipede	*Apheloria virginiensis*				2021-05-27
powdered dancer*	*Argia moesta*				2021-07-05
common Eastern bumblebee*	*Bombus impatiens*				2021-06-25
half-black bumble bee	*Bombus vagans*				2021-07-12
ebony jewelwing	*Calopteryx maculata*				2021-06-01
spring azure	*Celastrina ladon*				2021-07-05
awl fly	*Coenomyia ferruginea*				2021-06-01
clouded sulphur	*Colias philodice*				2021-07-05
longlegged fly spp.	*Condylostylus patibulatus*				2021-06-25
dobson fly larvae	*Corydalus cornutus*				2021-05-13
monarch	*Danaus plexippus*	Endangered	Special Concern		2021-06-28
phantom midges	*Diptera Chaoboridae*				2021-06-27
non-biting midges	*Diptera Chironomidae*				2021-06-27
rat-tail maggot fly	*Diptera Syrphidae (Eristalini)*				2021-06-27
diving beetles	*Dysticidae larvae*				2021-06-27
silver-spotted skipper	*Epargyreus clarus*				2021-06-11
orange-legged drone Fly	*Eristalis flavipes*				2021-07-02
Flower longhorn spp.	*Etorofus subhamatus*				2021-07-12
fraternal potter wasp	*Eumenes fraternus*			critically imperilled	2021-07-12
Dion skipper	*Euphyes dion*			vulnerable	2021-07-05
whirligig beetles	*Family Gyrinidae*				2021-06-27
druid flies	*Family Clusiidae*				2021-07-02

Name	Scientific name	COSEWIC status	SARA status	Wild Species status	Date observed
firefly beetles	*Family Lampyridae*				2021-06-01
leafcutter, mortar, and resin bees	*Genus Megachile*				2021-06-25
pond spreadwings	*Genus Lestes*				2021-07-05
ground crab spiders	*Genus Xysticus*				2021-04-13
grapeleaf skeletonizer moth	*Harrisina americana*				2021-06-25
Northern pearly-eye	*Lethe anthedon*				2021-06-25
twelve-spotted skimmer	*Libellula pulchella*				2021-07-12
gray spring moth	*Lomographa glomeraria*				2021-04-13
Hobomok skipper	*Lon hobomok*				2021-06-01
long-tailed giant ichneumonid wasp	*Megarhyssa macrurus*				2021-07-05
American carrion beetle	*Necrophila americana*				2021-07-22
mourning cloak	*Nymphalis antiopa*				2021-07-12
Compton tortoiseshell	*Nymphalis l-album*				2021-04-13
Canadian petrophila	*Petrophila canadensis*				2021-06-25
common whitetail	*Plathemis lydia*				2021-06-11
stag beetle	*Platycerus depressus*				2021-06-27
great spangled fritillary	*Speyeria cybele*				2021-07-05
large crane fly	*Tipula metacomet*				2021-07-22
pale green assassin bug	*Zelus luridus*				2021-07-02

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ).

Sources:

1. M. Buck, S. A. Marshall and D. K. Cheung. 2008. Identification Atlas of the Vespidae (Hymenoptera, Aculeata) of the northeastern Nearctic region. https://cjai.biologicalsurvey.ca/bmc_05/key_eumeninae.html. Accessed on 25 July 2021.
2. C. E. S. C. Council. Wild Species 2015: The General Status of Species in Canada. Available from: https://www.wildspecies.ca/home. Accessed 25 July 2021.
3. The Crane flies (Diptera: *Tilulidae*) of Pennsylvania. Available from https://www.invertebratezoology.org/cranefly/idkeys.htm. Accessed on 25 July 2021.
4. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm (SARA). Accessed on 16 July 2021.
5. iNaturalist. Available from https://www.inaturalist.org. Accessed on 16 July 2021.

Appendix 3. Molluscs and Annalida potentially present and observed (April-July 2021) in the study area.

Name	Scientific name	COSEWIC status	SARA status	Provincial status	Date observed
spike-lip crater	*Appalachina sayana*				
Western dusky slug	*Arion subfuscus*				2021-07-02
Eastern elliptio*	*Elliptio complanata*				2021-07-12
spike*	*Eurynia dilatata*			Susceptible	
river mussels*	*Family Unionidae*				
amber snails*	*Family Succineidae*				
arion slugs*	*Genus Arion*				
amber snails*	*Genus Succinea*				
melantho snails	*Genus Lymnaea*				2021-06-03
smooth turtle leech	*Genus Placobdella*				2021-06-28
Eastern lampmussel*	*Lampsilis radiata*				
fatmucket*	*Lampsilis siliquoidea*				
black sandshell*	*Ligumia recta*				
hickorynut	*Obovaria olivaria*	Endangered	Endangered		
marsh ramshorn*	*Planorbella trivolvis*				
pink heelsplitter*	*Potamilus alatus*				
pink heelsplitter*	*Potamilus alatus*				
fragile papershell*	*Potamilus fragilis*				

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ).

Sources:

1. iNaturalist. Available from https://www.inaturalist.org. Accessed on 16 July 2021.
2. Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
3. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm (SARA). Accessed on 16 July 2021.

Appendix 4. Potentially present and observed (April-July 2021) fish fauna in the study area.

Name	Scientific name	COSEWIC status	SARA status	Provincial status	Fisherman observed
lake sturgeon*	*Acipenser fulvescens*	threatened	no status	susceptible	
rock bass	*Ambloplites rupestris*				
brown bullhead*	*Ameiurus nebulosus*				
Eastern sand darter	*Ammocrypta pellucida*	threatened	threatened		
American eel	*Anguilla rostrata*	threatened		susceptible	
freshwater drum	*Aplodinotus grunnien*				
white sucker*	*Catostomus commersoni*				
spring cisco	*Coregonus sp.*	endangered	endangered		
spoonhead sculpin*	*Cottus ricei*	not at risk			
brook stickleback	*Culea inconstans*				
common/European carp*	*Cyprinus carpio*				
redfin pickerel	*Esox americanus americanus*	not at risk			
grass pickerel	*Esox americanus vermiculatus*	special concern	special concern		
Northern pike*	*Esox lucius*				2021-07-05
muskellunge*	*Esox masquinongy*				x
chain pickerel	*Esox niger*	not at risk			
johnny darter*	*Etheostoma nigrum*				
tessellated darter	*Etheostoma olmstedi*	not at risk			
tessellated darter	*Etheostoma olmstedi*	not at risk			
cutlip minnow	*Exoglossum maxillingua*	special concern	special concern		
banded killfish	*Fundulus diaphanus*	not at risk			
mooneye*	*Hiodon tergisus*				
Eastern silvery minnow	*Hybognathus regius*	not at risk			
Northern brook lamprey	*Ichthyomyzon fossor*	special concern	special concern		
silver lamprey	*Ichthyomyzon unicuspis*	special concern	special concern		

Name	Scientific name	COSEWIC status	SARA status	Provincial status	Fisherman observed
channel catfish*	*Ictalurus punctatus*				
brook silverside	*Labidesthes sicculus*	not at risk			
longnose gar*	*Lepisosteus osseus*				
pumpkinseed	*Lepomis gibbosus*				
bluegill sunfish*	*Lepomis macrochirus*				x
Northern sunfish	*Lepomis peltastes*	special concern	special concern	susceptible	
American burbot	*Lota lota*				
smallmouth bass	*Micropterus dolomieu*				
largemouth bass*	*Micropterus salmoides*				
striped bass	*Morone saxatilis*	extinct	endangered		
river redhorse*	*Moxostoma carinatum*	special concern	special concern		
copper redhorse*	*Moxostoma hubbsi*	endangered	endangered		
common mullet	*Moxostoma macrolepidotum*				
greater redhorse*	*Moxostoma valenciennesi*				
deepwater sculpin	*Myoxocephalus thompsonii*	special concern	special concern		
golden shiner	*Notemigonus crysoleucas*				
emerald shiner	*Notropis ahterinoides*				
bridle shiner	*Notropis bifrenatus*	special concern	special concern		
blackchin shiner	*Notropis heterodon*	not at risk			
spottail shiner	*Notropis hudsonius*				
rosyface shiner	*Notropis rubellus*	not at risk			
sand shiner	*Notropis stramineus*				
margined madtom	*Noturus insignis*	data deficient	threatened		
catfish	*order Siluriformes*				x
American smelt	*Osmerus mordax*				
yellow perch	*Perca flavescens*				
logperch	*Percina caprodes*				

Name	Scientific name	COSEWIC status	SARA status	Provincial status	Fisherman observed
channel darter*	*Percina copelandi*	special concern	special concern		
finescale dance	*Phoxinus neogaeus*				
bluntnose minnow	*Pimephales notatus*	not at risk			
black crappie	*Pomoxis nigromaculatus*				
amu-darya trout	*Salmo trutta*				x
pike perch	*Sander canadensis*				
fallfish	*Semotilus coporalis*				
American chub	*Semotilus corporalis*	threatened	no status	susceptible	
sauger	*Stizostedion canadense*				
walleye *	*Stizostedion vitreum/ Sander vitreus*				x
central mudminnow	*Umbra limi*				

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ).

Sources:

1. iNaturalist. Available from https://www.inaturalist.org. Accessed on 16 July 2021.
2. Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
3. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm (SARA). Accessed on 16 July 2021.

Appendix 5. Herpetofauna potentially present and observed (April-July 2021) in the study area.

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Date observed
blue-spotted salamander*	*Ambystoma laterale*				2021-06-11
American toad*	*Anaxyrus americanus*				2021-05-13
Eastern spiny softshell turtle*	*Apalone spinifera*	endangered	threatened	menacée	
snapping turtle+nests*	*Chelydra serpentina*	special concern	special concern		2120-07-12
painted turtle (nests)	*Chrysemys picta*	special concern			2120-07-12
ringneck snake*	*Diadophis punctatus*	candidate		susceptible	
Northern two-lined salamander	*Eurycea bislineata*				2120-07-12
Northern map turtle*	*Graptemys geographica*	special concern	special concern	vulnérable	2021-07-02 & 2120-07-12
four-toed salamander*	*Hemidactylium scutatum*			susceptible	
gray treefrog	*Hyla versicolor*				2021-04-19
Eastern milksnake*	*Lampropeltis triangulum*	special concern	special concern	susceptible	
American bullfrog*	*Lithobates catesbeianus*				2021-06-01

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Date observed
green frog*	*Lithobates clamitans*				2021-05-13
pickerel frog**	*Lithobates palustris*			susceptible	
Northern leopard frog*	*Lithobates pipiens*				2021-04-19
wood frog*	*Lithobates sylvaticus*				2021-04-19
Northern watersnake*	*Nerodia sipedon*			susceptible	
Eastern red-backed salamander*	*Plethodon cinereus*				2021-05-13
spring peeper*	*Pseudacris crucifer*				2021-04-19
garter snake*	*Thamnophis sirtalis*				

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ).

Sources:

1. iNaturalist. Available from https://www.inaturalist.org. Accessed on 16 July 2021.
2. Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
3. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm (SARA). Accessed on 16 July 2021.
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Appendix 6. Avifauna potentially present and observed (April-July 2021) in the study area.

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
alder flycatcher*	*Empidonax alnorum*				R	T	
American bittern*	*Botaurus lentiginosus*				M	H	
American black duck*	*Anas rupripes*				R	H	
American Coot*	*Fulica americana*				R		
American crow*	*Corvus brachyrhynchos*				R	C	2021-05-03
American goldfinch*	*Spinus tristis*				M	C	2021-05-03
American kestrel*	*Falco sparverius*				M		
American redstart*	*Setophaga ruticilla*				M	T	2021-05-21
American robin*	*Turdus migratorius*				M	AT	2021-05-03
American tree sparrow*	*Spizelloides arborea*				R		
American Wigeon*	*Mareca americana*				R	H	
bald eagle*	*Haliaeetus leucocephalus*	not at risk		vulnérable	M		2021-07-02
Baltimore oriole*	*Icterus galbula*				M	NO	2021-05-13
bank swallow*	*Riparia*	threatened	threatened		M		
barn swallow*	*Hirundo rustica*	threatened	threatened		M	JE	
barred owl*	*Strix varia*				R	P	
bay-breasted warbler*	*Dendroica castanea*				M		2021-05-21
belted kingfisher*	*Ceryle alcyon*				R	T	2021-05-13

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
black scoter*	*Melanitta americana*				M		
black-and-white warbler*	*Mniotilta varia*				M	T	2021-05-13
black-bellied plover*	*Pluvialis squatarola*				M		
blackburnian warbler*	*Dendroica fusca*				M	T	2021-05-21
black-capped chickadee*	*Poecile atricapillus*				R	AT	2021-05-03
black-crowned night-heron*	*Nycticorax nycticorax*				R		
blackpoll warbler*	*Setophaga striata*				M		
black-throated blue warbler*	*Dendroica caerulescens*				M	T	2021-05-03
black-throated green warbler*	*Dendroica virens*				M	T	2021-05-21
blue jay*	*Cyanocitta cristata*				R	T	2021-05-03
blue-headed vireo*	*Vireo solitarius*				M	C	
blue-winged teal*	*Spatula discors*				M		
bohemian waxwing*	*Bombycilla garrulus*				M		
Bonaparte's gull*	*Chroicocephalus philadelphia*				M		
brant*	*Branta bernicla*				M		
broad-winged hawk*	*Buteo platypterus*				M	H	
brown creeper*	*Certhia americana*				R	S	

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
brown thrasher*	*Toxostoma rufum*				M	AT	2021-05-03
brown-headed cowbird*	*Molothrus ater*				M	JE	
bufflehead*	*Bucephala albeola*				R		
Canada goose*	*Branta canadensis*				M	JE	2021-05-03
Cape May warbler*	*Dendroica tigrina*				M		2021-05-21
Carolina wren*	*Thryothorus ludovicianus*				R		
Caspian tern*	*Hydroprogne caspia*			menacée	M		
cedar waxwing*	*Bombycilla cedrorum*				M	T	2021-06-01
chestnut-sided warbler*	*Dendroica pensylvanica*				M	AT	
chimney swift*	*Chaetura pelagica*	threatened	threatened	susceptible	M		
chipping sparrow*	*Spizella passerina*				M	AT	2021-05-03
common goldeneye*	*Bucephala clangula*				R		
common grackle*	*Quiscalus quiscula*				M	AT	2021-05-03
common loon*	*Gavia immer*	not at risk			M		
common merganser*	*Mergus merganser*				R		
common nighthawk*	*Chordeiles minor*	special concern	threatened	susceptible	M		
common raven*	*Corvus corax*				R	AT	2021-05-03
common Redpoll*	*Acanthis flammea*				R		
common tern*	*Sterna hirundo*	not at risk			M		2021-07-05

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
common yellowthroat*	*Geothlypis trichas*				M	AT	2021-05-21
cooper's hawk*	*Accipiter cooperii*	not at risk			M	AT	
dark-eyed junco*	*Junco hyemalis*				R		
double-crested cormorant*	*Phalacrocorax auritus*	not at risk			M		
downy woodpecker*	*Picoides pubescens*				R	JE	2021-05-03
Eastern bluebird*	*Sialia sialis*	not at risk			M	NJ	
Eastern kingbird*	*Tyrannus*				M	C	
Eastern meadowlark*	*Sturnella magna*	threatened	threatened		M	JE	
Eastern phoebe*	*Sayornis phoebe*				M	JE	2021-05-03
Eastern Towhee						‡	2021-07-05
Eastern wood pewee*	*Contopus virens*	special concern	special concern		M	T	2021-05-21
European starling*	*Strunus vulgaris*				R	AT	2021-05-21
evening grosbeak*	*Coccothraustes vespertinus*	special concern	special concern		R		
fox sparrow*	*Passerella iliaca*				M		
golden-crowned kinglet*	*Regulus satrapa*				R	H	
great black-backed gull*	*Larus marinus*				R		
great blue heron*	*Ardea herodias*				M	H	
great crested flycatcher*	*Myiarchus crinitus*				M	JE	2021-05-13
great egret*	*Ardea alba*				M		

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
greater scaup*	*Aythya marila*				M		
greater yellowlegs*	*Tringa melanoleuca*				M		
green heron*	*Butorides virescens*				R	JE	
green-winged teal*	*Anas crecca*				R		
grey catbird*	*Dumetella carolinensis*				M	AT	2021-07-02
hairy woodpecker*	*Picoides villosus*				R	JE	2021-05-13
hermit thrush*	*Catharus guttatus*				M	JE	2021-05-21
herring gull*	*Larus argentatus*				R		
hoary redpoll*	*Acanthis hornemanni*				O		
hooded merganser*	*Lophodytes cucullatus*				M	H	
house finch*	*Carpodacus mexicanus*				R	H	
house sparrow*	*Passer domesticus*				R	NJ	
house wren*	*Troglodytes aedon*				M	AT	2021-05-13
killdeer*	*Charadrius vociferus*				M	V	
least bittern*	*Ixobrychus exilis*	threatened	threatened	vulnérable	M		
least flycatcher*	*Empidonax minimus*				M	S	
lesser scaup*	*Aythya affinis*				R		
Lincoln's sparrow*	*Melospiza lincolnii*				R		
loggerhead shrike*	*Lanius ludovicianus*	endangered	no status	vulnérable	M		
long-tailed duck*	*Clangula hyemalis*				M		

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
magnolia warbler*	*Dendroica magnolia*				M	H	2021-05-21
mallard duck*	*Anas platyrhynchos*				R	JE	2021-05-21
marsh wren*	*Cistothorus palustris*				M		2021-05-21
merlin*	*Falco columbarius*					H	
mourning dove*	*Zenaida macroura*				R	T	2021-05-21
mourning warbler	*Oporornis philadelphia*				M	JE	
Nashville warbler*	*Oreothlypis ruficapilla*				R	JE	
Northern cardinal*	*Cardinalis cardinalis*				R	T	2021-05-03
Northern flicker*	*Colaptes auratus*				R		2021-05-03
Northern goshawk	*Accipiter gentilis*	not at risk	threatened		R		
Northern harrier*	*Circus cyaneus*	not at risk			M	H	
Northern mockingbird	*Mimus polyglottos*				M		
Northern parula*	*Setophaga americana*				R		
Northern pintail*	*Anas acuta*				R		
Northern saw-whet owl	*Aegolius acadicus*				R		
Northern shoveler*	*Spatula clypeata*				R	JE	
Northern waterthrush*	*Seiurus noveboracensis*				M	S	
olive-sided flycatcher*	*Contopus cooperi*	special concern	threatened	susceptible	M		2021-05-21
orange-crowned warbler*	*Leiothlypis celata*				M		

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
osprey*	*Pandion haliaetus*				M	NJ	
ovenbird*	*Seiurus aurocapillus*				M	T	2021-05-21
palm warbler*	*Setophaga palmarum*				M		2021-05-13
peregrine falcon*	*Falco peregrinus anatum/tundrius*	not at risk	special concern	vulnérable	R		
Philadelphia vireo*	*Vireo philadelphicus*				M		
pied-billed grebe*	*Podilymbus podiceps*				M		
pileated woodpecker*	*Dryocopus pileatus*				R	T	2021-05-21
pine grosbeak*	*Pinicola enucleator*				R		
pine siskin*	*Spinus pinus*				R		
pine warbler*	*Dendroica pinus*				M	T	2021-05-03
purple finch*	*Carpodacus pupureus*				M	C	2021-05-13
purple martin*	*Progne subis*				M		
red-breasted merganser*	*Mergus serrator*				M		
red-breasted nuthatch*	*Sitta canadensis*				R	JE	
red-eyed vireo*	*Vireo olivaceus*				M	CN	2021-05-21
red-headed woodpecker*	*Melanerpes erythrocephalus*	endangered	threatened	menacée	R		
red-necked grebe*	*Podiceps grisegena*				M		
red-shouldered hawk*	*Buteo lineatus*	not at risk	special concern		M	T	2021-05-03

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
red-tailed hawk*	*Buteo jamaicensis*	not at risk			M	JE	
red-winged blackbird*	*Agelaius phoeniceus*				R	AT	2021-05-03
ring-billed gull*	*Larus delawarensis*				M		2021-05-13
ring-necked duck*	*Aythya collaris*				M		
rock pigeon*	*Columba livia*				R	T	
rose-breasted grosbeak*	*Pheucticus ludovicianus*				M	FE	2021-05-13
rough-legged hawk*	*Buteo lagopus*				R		
ruby-crowned kinglet*	*Regulus calendula*				M		2021-05-03
ruby-throated hummingbird*	*Archilochus colubris*				M	T	2021-06-11
ruffed grouse*	*Bonasa umbellus*				R	S	
rusty-headed blackbird*	*Euphagus carolinus*	special concern	special concern	susceptible	R		
Savannah sparrow*	*Passerculus sandwichensis*				M	T	
scarlet tanager*	*Piranga olivacea*				M	T	2021-05-21
sedge wren*	*Cistothorus platensis*			susceptible	M		
semipalmated Plover*	*Charadrius semipalmatus*						
sharp-shinned hawk*	*Accipiter striatus*	not at risk			R	H	
short-eared owl*	*Asio flammeus*	special concern	special concern	susceptible	M		2021-04-04

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
snow bunting*	*Plectrophenax nivalis*				R		
snow goose*	*Anser caerulescens*				M		
solitary sandpiper*	*Tringa solitaria*				M		2021-05-21
song sparrow*	*Melospiza melodia*				R	AT	2021-05-03
spotted sandpiper*	*Actitis macularius*				M	A	
surf scoter*	*Melanitta perspicillata*				M		
Swainson's thrush*	*Catharus ustulatus*				M		
Swamp* sparrow	*Melospiza georgiana*				M	AT	2021-05-03
Tennessee warbler*	*Leiothlypis peregrina*				M		2021-05-21
tree swallow*	*Tachicineta bicolor*				M	NO	
tufted titmouse*	*Baeolophus bicolor*				M		
turkey vulture*	*Cathartes aura*				M	T	2021-05-03
veery*	*Catharus fuscescens*				M	AT	2021-05-21
vesper sparrow*	*Pooecetes gramineus*	endangered	endangered		M		
Virginia rail*	*Rallus limicola*				M	S	
warbling vireo*	*Vireo gilvus*				M	T	2021-05-13
white-breasted nuthatch*	*Sitta carolinensis*				R	C	2021-05-03
white-crowned sparrow*	*Zonotrichia leucophrys*				M		2021-05-13
white-throated sparrow*	*Zonotrichia albicollis*				M	JE	2021-05-03

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Migratory status	Breeding Evidence Code	Date observed
white-winged scoter*	*Melanitta deglandi*				M		
wild turkey*	*Meleagris gallopavo*				R	H	
Wilson's warbler*	*Cardellina pusilla*				M		
winter wren*	*Troglodytes hiemalis*				R	S	2021-05-13
wood duck*	*Aix sponsa*				M	JE	2021-05-13
wood thrush*	*Hylocichla mustelina*	threatened	threatened		M	T	2021-05-13
yellow warbler*	*Setophaga petechia*				R		2021-05-13
yellow-bellied sapsucker*	*Sphyrapicus varius*				M	NJ	2021-05-03
yellow-rumped warbler*	*Dendroica coronata*				M	T	2021-05-03

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ) and/or eBird.

Sources:

1. eBird available from https://ebird.org/home. Accessed on 15 July 2021.
2. Québec Breeding Bird Atlas. Available from https://www.atlas-oiseaux.qc.ca/index_en.jsp. Accessed on 16 July 2021.
3. Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
4. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm (SARA). Accessed on 16 July 2021.

Appendix 7. Mammal species observed (April-July2021) in the study area.

Name	Scientific name	COSEWIC status	SARA status	Prov. status	Date first observed
North American beaver*	*Castor canadensis*				2021-04-04
big brown bat	*Eptesicus fuscus*				2021-06-28
silver-haired bat	*Lasionycteris noctivagans*			susceptible	2021-06-28
red bat	*Lasiurus borealis*			susceptible	2021-06-28
American river otter	*Lontra canadensis*				Don McCracken sighting
little brown myotis	*Myotis lucifugus*	endangered	endangered	susceptible	2021-06-28
white-tailed deer*	*Odocoileus virginianus*				2021-07-12
common muskrat	*Ondatra zibethicus*				2021-07-22
tri-coloured bat	*Perimyotis subflavus*	endangered	endangered		2021-06-28
common raccoon*	*Procyon lotor*				2021-07-12
Eastern grey squirrel*	*Sciurus carolinensis*				2021-04-04
Eastern chipmunk*	*Tamias striatus*				2021-05-27
American red squirrel*	*Tamiasciurus hudsonicus*				2021-05-27
red fox	*Vulpes vulpes*				2021-04-19

*Indicates that the species was also listed in iNaturalist and/or Centre de données sur le patrimoine naturel du Québec (CDPNQ).

Sources:

1. BatWatch. Available from: https://batwatch.ca/.
2. iNaturalist. Available from https://www.inaturalist.org. [Accessed 16 July 2021].
3. Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), Ministère des Forêts, de la Faune et des Parcs (MFFP). Available from Centre de données sur le patrimoine naturel du Québec (CDPNQ), https://cdpnq.gouv.qc.ca/produits.htm#. Accessed 14 July 2021.
4. Government of Canada. Species at Risk Public Registry. Available from https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm (SARA). Accessed on 16 July 2021.