2016

Road Ecology Study and Mitigation

Provincially Significant Wetland – Area "C"

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Acknowledgements

Toronto and Region Conservation Authority (TRCA), City of Brampton (CoB), Ontario Road Ecology Group (OREG), and York University (YU) again express sincere thanks to the dedicated volunteers and project partners who continue to participate in this road ecology and turtle population study.

With the help of citizen science volunteers, data continues to be collected at the designated Provincially Significant Wetlands along Heart Lake Road (HLR) to gain further knowledge on effects of roads to wildlife and fragmented habitat. These efforts assist in protecting wildlife and their habitat in this sensitive wetland.

The continued input of equipment, time, expertise and valuable feedback from project partner's has been critical to this projects ongoing success.

Introduction

Toronto and Region Conservation Authority (TRCA) in partnership with City of Brampton (CoB), Ontario Road Ecology Group (OREG), York University and local volunteers has been leading a series of studies examining the wildlife fatalities along a stretch of HLR between Sandalwood Parkway (43°45'09.3"N 79°48'11.2"W) and Mayfield Road in Brampton, Ontario (43°45'09.2"N, 79°48'10.6"W). The study known as Heart Lake Road Ecology Volunteer Monitoring Project (HLREMP) was initiated to better understand which species were being impacted by interactions with vehicles, how many interactions were occurring, and to suggest mitigation measures to protect local biodiversity.

From data collected in 2011, hotspot wildlife fatality areas were identified and it was decided to conduct Phase II. In 2012, TRCA and City of Brampton staff met to locate existing culverts and assess the area to begin examining mitigation options. The study area (SA) was redefined to focus data collection in areas with high levels of Wildlife Vehicle Collisions (WVCs). Phase II began in 2013 and site boundaries redefined to extend along Heart Lake Road from Sandalwood Parkway to Countryside Drive. Data was collected by participants and a report of findings is available online at: http://www.trca.on.ca/dotAsset/187823.pdf

In 2014, protocols were developed for a turtle population study undertaken by TRCA staff and experts in wildlife handling and care. This study was implemented as part of the component of wildlife fatality mitigation science. This portion of the study was put in place to gather demographic baseline information on in situ turtle population, before and after the proposed mitigation measures are applied. TRCA and partners agreed that it would be important to try to gain additional information on the turtle population prior to installation of any mitigation measures. A report on this study is available online at: http://www.trca.on.ca/dotAsset/201845.pdf

In 2015, the study continued resulting in findings of a significant male bias population supporting the theory that female turtles are at higher risk of fatalities related to nesting in gravel along roads. Report findings can be found at: http://www.trca.on.ca/dotAsset/215754.pdf

TRCA, CoB and its partners moved forward in 2016 to implement a dedicated wildlife passage under Heart Lake Road just south of Countryside Drive and installed Animex directional wildlife fencing to help guide wildlife to passage.

The following report outlines efforts of this study and mitigation during 2016.

Road Ecology in the Broader Context

Ontario's turtle populations are at risk. The federal and provincial government designates seven out of the eight native turtle species as Species at Risk (SAR). Government, conservationists and the public are making strides in the protection of turtle and other herpetofauna (i.e. reptile and amphibian) populations. Paramount in efforts to protect these species is mitigating threats of roads and traffic.

Road ecology is the study of interactions between roads and the environment. Applying road ecology principles and practices is of increasing importance, as rural lands and wildlife habitats are decreasing due to development to accommodate an increasing human population.

Mitigation infrastructure that protects biodiversity and SAR from the threats of roads has become more common across Ontario. Agencies such as Parks Canada, Ontario Parks, the Ministry of Transportation of Ontario (MTO) and municipalities are seeking solutions to improve habitat connectivity and allow wildlife safe passage across the landscape (Figures 1 to 7).

Conservation Authorities (CAs) across Ontario are actively protecting local biodiversity and SAR herpetofauna through road ecology planning policy and research and mitigation projects (Table I). These projects have advanced conservation goals by contributing data; researching, implementing and monitoring a suite of mitigation measures (e.g. crossing signs, road closures, dedicated wildlife culverts and fencing); and educating the public thereby generating an invested community that endorses conservation initiatives.

Table I. Examples of road ecology work accomplished by Conservation Authorities across Ontario.

Conservation Authority (CA)	Accomplishments
Conservation Halton	• Planning policy updates (e.g. development of a Natural Heritage System with an emphasis on maintaining connectivity. • Town of Oakville Road Ecology Strategy • Data collection on how existing culverts and bridges relate to wildlife crossing. • King Road, Burlington, road closure for seasonal salamander migration • Wildlife culvert and fencing, Milton
Ganaraska CA	• Turtle crossing signs
Hamilton CA	• Collects wildlife/vehicle collision data • Erects barrier fencing to keep turtles off the road • Turtle crossing signs • Potential speed reductions at hotspots • Working with Royal Botanical Gardens to relocate the Dundas Community Garden away from prime turtle nesting habitat • Improve water quality in important turtle habitat (e.g. Cootes Paradise)
Lake Simcoe Region CA	• Wildlife Passage Day workshop (2014) • Mapping potential road mortality hotspots for amphibians and reptiles in the Lake Simcoe watershed (2015) • Wildlife Safe Passage Pilot Project (2015)
Raisin Region CA	• Monitoring and pre-mitigation assessment (Gunson and Schueler 2014)
South Nation CA	• Totally Turtles program (raises public awareness, builds nesting habitat, installs crossing signs and fencing)

Figure 1 - Bruce Peninsula National Park ecopassage (Credit: Parks Canada)

Figure 2 - Bruce Peninsula National Park grated ecopassage (Credit: Parks Canada)

Figure 3 - Ontario Parks SAR snake road mitigation (Credit: Ontario Parks)

Figure 4 - MTO dedicated wildlife overpass Hwy #69 (Credit: MTO)

Figure 5 - Wildlife passage/fence Terry Fox Dr, City of Ottawa (Credit: Dillon Consulting Ltd)

Figure 6 - Turtle exclusion fence City of Kingston (Credit: Mandy Karch)

Figure 7 - Remote camera data, snapping turtle under road (Credit: Lake Simcoe Region CA)

TRCA has taken the lead on road ecology initiatives in its jurisdiction. Some of these initiatives include; 'Brake for Snakes' signs (Figure 8) and speed bumps at Tommy Thompson Park (TTP) intended to slow cyclists and encourage visitors to watch for snakes at TTP; basking habitat creation at King's Mill Park in the Humber River Watershed and developing planning policies such as *The Crossings Guidelines for Valley and Stream Corridors.* These methods assist in working towards protecting sensitive ecosystems and wildlife within urban settings.

Figure 8 - Example of TRCA snake mitigation

TRCA recognizes the value of public partnerships. Citizen science-led ecological monitoring has long played an important role in TRCA data collection (e.g. Terrestrial Volunteer Monitoring Program established 2002). In the field of road ecology, Citizen Science is crucial to collecting robust datasets and garnering public support. Vast road networks in Ontario necessitate public participation in documenting and submitting wildlife/road interaction sightings.

The value of Citizen Scientists has been exemplified through HLREMP with the following results:

- **2011** Total time spent collecting field data - 420 hours.
  Actual time spent monitoring represents approximately 10% of the total available time for monitoring based on 12 daylight hours
- **2013** Total time spent collecting field data - 202 hours.
  Actual time spent monitoring represents approximately 9.5% of total available time based on 12 daylight hours.
- **2014** Total time spent collecting field data - 41.12 hours.
  Actual time spent monitoring represents approximately 2.9% of total available time based on 12 daylight hours.

This data and overwhelming public awareness and support to mitigate the site caught city official's attention and brought awareness to this issue. Since that first year, dataset and project goals have grown. In 2012, partners (TRCA, OREG, and COB) explored mitigation options for the site.

Committed biologists, project managers, engineers and traffic services personnel collaborated and supported Phase II of HLREMP from 2013 to 2015. Phase II engaged citizen scientist volunteers from 2011, along with new participants to focus survey efforts within hotspots identified in Phase I.

In addition, a mock culvert and wildlife directional fencing study was launched in 2011. This study could not successfully be carried out due to unusually high wetland water levels that submerged mitigation materials. Although unsuccessful that year, it allowed partners to strengthen their focus and lessons were learned in respect to installation methods and materials used.

In 2014 and 2015, a population study of turtles within this wetland complex bisected by Heart Lake Road was conducted to ascertain additional information to help form a mitigation strategy. Signage at both north and south locations where wetlands commence and traffic calming devices were installed along Heart Lake Road to alert motorists they had entered a significant natural area inhabited by wildlife.

Contributions of the road ecology work conducted on Heart Lake Road (Table II) has fostered new partnerships, engaged members of the public, students from all levels of education and generated new data points for a growing dataset. This has laid the foundation of the 2016 Heart Lake Road Mitigation Study.

The purpose of this report is to present the results of the wildlife/road interaction data collected in 2016 at the designated Heart Lake Road hotspots and discuss the preliminary findings of the implemented mitigation strategy.

Table II. Summary of HLREMP timeline and accomplishments leading up to 2016.

Year	Project	Partnerships	Results
2010	TRCA staff and local residents report fatalities of turtles to OREG	TRCA, OREG, COB	Turtle Crossing Signs
2011	HLREMP Phase I	TRCA, OREG, COB, Brampton Environmental and Planning Committee (BEPAC), Public	Wildlife/Road Interaction Dataset Identified and prioritized hotspots
2012	HLREMP Phase II initiated	TRCA, OREG, COB, BEPAC, ACO Wildlife Systems Ltd.	Located existing corrugated steel pipe culverts Refined study area to focus on hotspots identified in Phase I
2013	HLREMP Phase II	TRCA, OREG, COB, Toronto Zoo, Public	Augmented Wildlife/Road Interaction Dataset Mock Culvert and Wildlife Directional Fencing Study Nesting beach habitat creation for turtles Nest protectors implemented
2014	Turtle Population Study: Provincially Significant Wetland – Area 'C' (HLREMP)	TRCA, OREG, COB, selected expert volunteers from partner institutions	Added to baseline dataset of local turtle population presence prior to mitigation installation
2015	Road Ecology and Turtle Population Study	TRCA, OREG, COB, Public	Added to baseline dataset of local turtle population presence prior to mitigation installation Significant Natural Area signage

Mitigation Efforts at Heart Lake Road, 2016

Culmination of data and information over six years resulted in a multi-level approach comprised of wildlife area/crossing signs, traffic calming measures, nesting habitat creation, fencing and a newly installed dedicated wildlife concrete box culvert selected to promote safe passage of herpetofauna including SAR.

The 2016 Heart Lake Road Mitigation study includes a follow up monitoring and maintenance plan to ensure long-term goals for protecting wildlife populations. This mitigation strategy is reliant upon productive partnerships among government and non-government agencies, a supportive community and dedicated citizen scientists.

Following results of road ecology monitoring efforts and identification of herpetofauna road mortality hot-spots, CoB with advice from TRCA approved a series of measures designed to curb incidences of WVCs.

Measures contemplated were:

i.	Pavement markings (optical speed bars)	Approved
ii.	Warning signage	Approved
iii.	Dedicated wildlife passage at identified hot spots	Approved
iv.	Installation of drift fencing to curb wildlife access to road	Approved
v.	Seasonal road closures	
	a) 24 hr/day	Rejected
	b) From 9:00 p.m. to 7:00 a.m.	Rejected

1. Traffic, Speed Limits and Signage

Speeding and traffic volumes are an issue on Heart Lake Road. CoB Public Works Department provided in-kind traffic data collection at the study area (SA) between June 7 and June 13, 2013, Vehicle volume totals are listed below:

- **Weekday:** (Friday June 7th and Monday June 10th to Thursday June 13, 2013)
  Average Daily Traffic was 5,435 vehicles/day
- **Weekend:** (Saturday June 8th and Sunday June 9, 2013)
  Average Daily Traffic was 7,073 vehicles/day
- **Speed:** 85% of vehicles were travelling at an estimated rate of speed of 78.1 km/hr or <
  (posted speed limit; 60 km/hr)

New signs were installed to raise awareness and alert public to potential small wildlife on roads (Figure 9 and 10). An enhanced seasonal, motion activated (sensitive to approaching vehicles) wildlife crossing sign (Figure 11) equipped with solar-powered amber flashing lights was chosen to help influence motorists' behaviour (i.e. proceed cautiously and watch for wildlife on the road). Use of this type of temporary passive sign with flashing lights has been shown to reduce motorist speed in some cases (Hedlund et al. 2003 in a study of deer crossing signage) but signage should not be used as a substitute for more permanent and effective mitigation (i.e. dedicated wildlife culvert and exclusion fencing) where deemed necessary.

In an effort to modify motorist behaviour to reduce speed, CoB also installed/painted Optical Speed Bars (OSB) on Heart Lake Road (Figure 12). These transverse stripes are spaced at gradually decreasing distances and cause a visual effect intended to reduce drivers' speed as they react to the spacing of painted lines (McGee and Hanscom 2006).

The expectation is that the OSB will encourage slower driving speeds that facilitate motorists to watch for and react to wildlife on the road thereby contributing to the overall goal of preventing WVCs.

Figure 9 - Sign installed north and south of wetland

Figure 10 - CoB staff install wildlife crossing sign

Figure 11 - CoB Solar powered flashing sign

Figure 12 - CoB install optical speed bars to slow traffic

2. Dedicated Wildlife Passage and Direction Fencing

Ecopassage's are intended to safely attract and allow wildlife to cross roads. Wildlife passages combined with directional fencing (Figure 14) are intended to safely attract, direct and allow wildlife to move between habitats.

i. Wildlife Passage

Wildlife passage design details including construction materials, placement, entry features, lighting, moisture levels and length, all interplay to determine if target wildlife species will successfully enter and pass through. Installation of large tunnels (e.g. oversized concrete box culvert (Figure 13) that maintain good airflow and natural light throughout or smaller tunnels specifically designed for reptiles and amphibians that enhance ambient light and moisture conditions through a grated slot system that lies flush with the road surface are recommended (Clevenger and Huijser 2011). A drawback of the grated slot system (Figure 2) is that wildlife may be exposed to pollution and road runoff (Kintsch and Cramer 2011). Concrete or polymer concrete culverts should be chosen over corrugated steel structures that are cold and may repel herpetofauna due to the un-favourable micro-climate created inside the passage. Following a lengthy investigation process and consultation with project partners, COB and TRCA opted to install a concrete box culvert of suitable dimensions for herpetofauna and mammals of the area. Installation of the culvert commenced on April 18, 2016, when CoB closed Heart Lake Road (Figure 15) to redirect traffic during installation of the passage and was completed on April 20th, 2016 (Figure 16 to 18).

Figure 13 - Oversize culvert as wildlife passage

Figure 14 - Passage and wildlife directional fencing

Figure 15 - CoB road closed sign

Figure 16 - CoB digs trench at Heart Lake Road to install passage

Figure 17 - Oversize concrete culvert sections craned to site

Figure 18 - Oversized concrete culvert sections at site

A 10 cm layer of natural soil mixture composed of composted leaves and wood chips was blown into the passage (Figure 19) and extended beyond the passage entrance (Figure 20) to provide suitable substrate for wildlife. This soil layer was laid down to enhance the natural texture of the ecopassage and to encourage movement of amphibians and reptiles that might be otherwise subject to desiccation travelling over a concrete surface (Mazerolle & Desrochers, 2005).

Figure 19 - Soil/mulch substrate being "blown" into passage

Figure 20 - Soil/mulch substrate extending beyond passage entrance

This dedicated wildlife culvert was installed to cross HLR, approximately 100 metres south of Countryside Dr. This location was chosen as it coincided with an identified herpetofauna mortality hotspot #3 (Figure 21).

Hotspot locations #1 and #2 (Figure 21) were deemed unsuitable for the installation of a wildlife culvert by the COB following a geotechnical investigation performed by Engtec Consulting. Given the inability to install other wildlife culverts at these hotspots, project partners decided not to install exclusionary fencing at these locations.

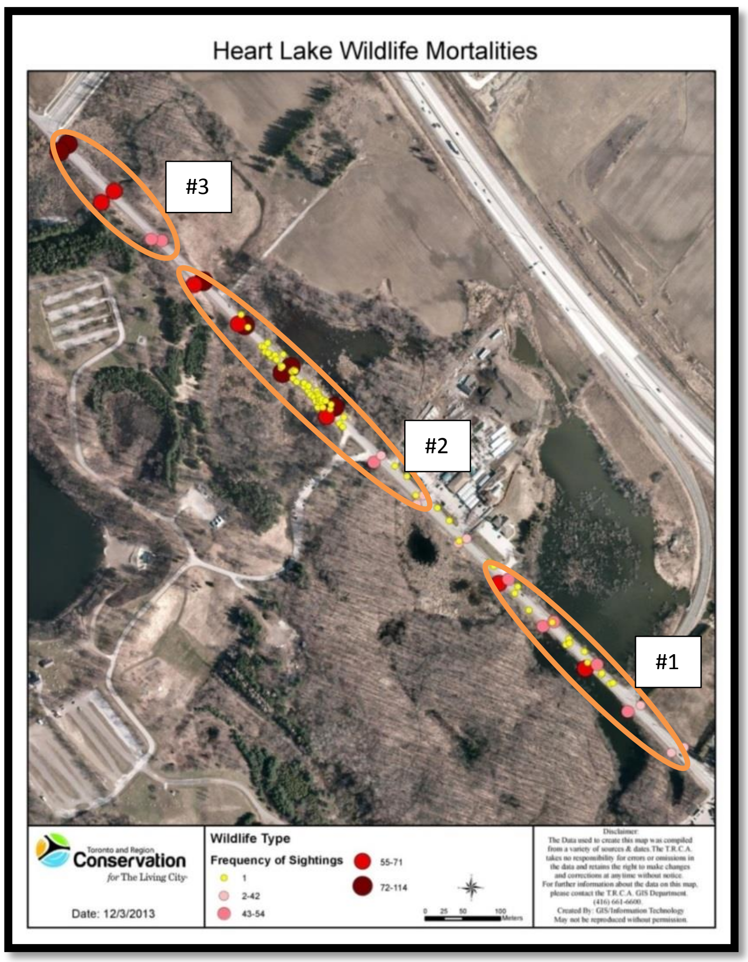

Figure 21 - Hotspots identified from data collection

ii. Wildlife Directional Fencing

Fencing is required to keep animals from accessing roads and reduce or eliminate mortality caused by wildlife/vehicle collisions (Cunnington et al. 2014). Fencing is also beneficial to guide animals to suitable, safe passageways.

Maintaining fence integrity is critical. Any structural failure (e.g. holes, gaps, slack walls, overgrown vegetation) may compromise effectiveness of a mitigation strategy (Baxter-Gilbert et al. 2015). Proper installation of a permanent fence design is paramount to improve mitigation functionality and cost efficiencies over time.

Design details of exclusion and directional fencing are specific to the landscape and target species. To deter climbing species (e.g. snapping turtles) from going over fencing structures, it is recommended to add an overhanging lip extending away from the road (Figure 22 and 23).

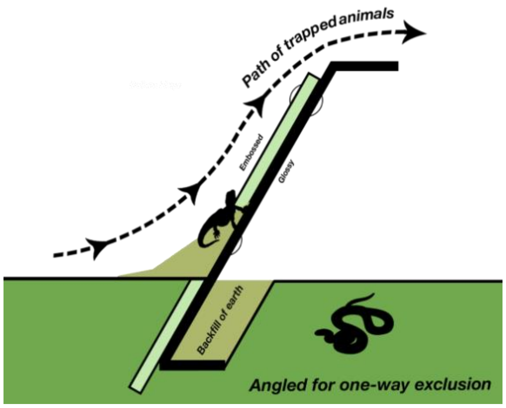

Figure 22 - Animex wildlife fencing cross section (Credit: Animex)

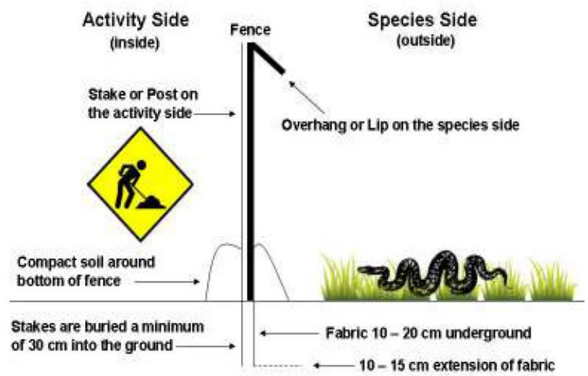

Figure 23 - MNRF Best management practices exclusion fencing with flexible lip (Credit MNRF 2013)

Fencing design, construction materials and installation methods are changing and improving as studies, monitoring and report successes and failures of in situ projects are conducted (Baxter-Gilbert et al. 2015, Ashpole et al. 2016).

TRCA investigated various styles and gauges of specialized directional fencing from multiple suppliers including ACO Wildlife, Herpetosure and Animex. Field tests were carried out and TRCA selected Animex one-way exclusionary fencing. TRCA designed the fencing system using Animex fencing which is secured on 45 centimeters high, galvanized steel farm fencing and round posts.

CoB contracted for the farm fence posts to be installed from June 6th to 16th, 2016, and suffered delays due to improper site preparation (lack of grubbing, leveling, trenching and mowing). Following the installation of the fence posts, TRCA staff worked with Animex reps to install the fencing.

Animex wildlife fencing attaches to the round wooden posts and farm fence (Figure 24) and has a smooth interior face (facing the wetland) to discourage climbers (e.g. snakes). There is a 15 cm lip angled back into the wetland to prevent any climbing fauna to gain purchase and breach the fence. However, the outside face of the fence and the lip has a textured grid, which facilitates returning back into the wetlands in the event an animal accesses the road moving from fragmented wetlands. TRCA also augmented the poles with steel T-bars to reinforce where sections were joined (Figure 25 to 27). Fencing was also banked with mulch (Figure 28 and 29) to seal gaps, allow animals on the road to access the wetlands and allow water to filter through during storm events. Banking the edge with mulch also provided support from snow plowing and potential strain from snow/ice weight.

Figure 24 - Wood poles and farm fence installation

Figure 25 - Installation of steel T-bars for reinforcement

Figure 26 - TRCA staff install Animex fencing to poles

Figure 27 - TRCA staff install Animex fencing

Figure 28 - Animex fencing banked with mulch

Figure 29 - Animex fencing banked with mulch leading to passage

This specialized fencing was completed on June 16, 2016, on both sides of HLR., south of Countryside Drive. Total length of directional fencing is approximately 190 m on the east side and 140 m on the west side, to reduce herpetofauna accessing the road in these two bisected wetlands. Fencing terminal edges curl around the wetland to re-direct fauna back into the wetland toward the wildlife passage.

iii. Turtle Nesting Beaches

The number of eggs laid by an adult female turtle varies and less than 1% of those eggs will reach sexual maturity. An adult female is a vital part of species continuation and a loss of 1% to 2% percent each year in an area will lead to extirpation in a very short period of time. Roads put turtles at a higher risk of mortality as they migrate to feeding, breeding and hibernation habitats. Turtle eggs are dependent upon specific conditions to incubate. The exposed, sandy-gravel conditions located on the shoulder of roads provide an ideal location for the turtle to lay her eggs putting her, as well as hatchlings, at risk of WVCs, leading to reduced populations and number of eggs laid each year (KTTC, 2011). Success of the nest is impacted by soils becoming compacted by cars and routine roadside grading maintenance practices negatively affecting emerging hatchlings that disperse to find suitable habitat.

Creating safe, alternative habitat by installing turtle nesting beaches may reduce the number of turtles crossing roads and encourage nesting away from gravel shoulders. Nesting beaches have shown to be successful at attracting nesting female turtles (Figure 32) incubating eggs, and producing viable hatchlings. Based on these findings, creating artificial nest mounds has been recognized as a valuable conservation tool, and may be especially effective at sites with low nesting habitat availability (Paterson et al. 2013).

Figure 30 - TRCA installation of turtle on nesting beach

Figure 31 - TRCA installed turtle nesting beach on east side of Heart Lk Rd

Nesting mounds were designed and installed by the TRCA (Figure 30 and 31) on both sides of the mitigated areas on May 11 to 13, 2016, in time for the turtle-nesting season peaking in June. The mounds were positioned close to the road but inside the wildlife fencing and act as an alternative to roadside nesting.

Figure 32 - Blanding's turtle on artificial nest beach in Algonquin Provincial Park (Photo Credit: James Paterson)

Post Mitigation Monitoring

Once mitigation is in place, monitoring is critical to ascertain if the strategy is functioning as intended. As a developing field, road ecology depends on monitoring to validate or inform adjustments to ensure mitigation dollars are effectively and efficiently spent. Any mitigation project should budget and/or make arrangements for post-installation monitoring. Methods could be remote (e.g. cameras, track boards, etc.) or on-the-ground surveys including wildlife/road interaction data collection conducted by trained officials, university students or members of the public. Van der Grift et al. (2013) suggest a nine step process to develop an effective monitoring plan of wildlife mitigation measures.

1. Maintaining Mitigation

Evaluating mitigation infrastructure and addressing maintenance needs is an important part of a mitigation strategy. Culverts may need to be cleaned out, or have bottom substrate levels replenished. Vegetation growth must be cut down around fencing to deter wildlife breaching the fence. Checking fence integrity ensures that wildlife won't get caught in decomposing vegetation or simply pass through and access the road.

2. Routine Maintenance Schedules

Roads require routine maintenance such as mowing, grading, ice control, etc. These practices may be altered in mitigation areas to help support conservation goals. For example, mowers and brush cutters used for shoulder maintenance may kill wildlife nesting, resting or hiding in grassy shoulders. Frequency of mowing, timing and mower blade height for different types of roadside vegetation may all be adjusted to help avoid accidental deaths caused by this routine maintenance practice. Road shoulder grading also poses a threat for nesting females and their nests and hatchlings. Heavy machinery may kill nesting turtles and compacted road soils may cause nests to fail (i.e. not hatch). Working with COB, safer maintenance practices and schedules may be determined to augment mitigation efforts.

3. Public Awareness

Effective road ecology projects require funding. Some projects use funds from a combination of public, private sector and fundraising sources. Typically, government or municipal funds (i.e. public tax dollars) constitute a portion of a project. Raising public awareness, engaging local residents and organizations and garnering support for local road mitigation projects facilitates the ease and pace with which projects may proceed. Seeking media outlets (e.g. local newspaper, television station, social media, public events, etc.) and hosting a presentation of a project, is advantageous and serves to assist in more awareness of road ecology, ultimately moving this initiative forward. Road ecology on Heart Lake Road has been and continues to be well promoted (Table III).

Other aspects of raising awareness may include ensuring local residents, community groups and businesses are aware about legislation (e.g. Endangered Species Act (2007) that mandates protection of SAR from primary threats such as roads. Once there is an understanding that mitigation is required, corporate compliance follows and opportunities for sponsorship of a road ecology project may even be explored.

Table III – Public awareness of Road Ecology at Heart Lake Road

Source	Title	Date
Brampton Guardian	Corpse counters needed	March 22, 2011
Brampton Guardian	Residents wildlife about survey	April 16, 2011
Brampton Guardian	Friends of wetlands	May 17, 2011
Creel Time e-newsletter	Heart Lake Road Wildlife Monitoring Heart Lake Road Wildlife Monitoring - Update	May, 2011 January, 2012
Brampton Guardian	Motorists kill 90 turtles on Heart Lake Road in 25 weeks	February 9, 2012
Royal Ontario Museum Blogs	Ontario Road Ecology Group – Protecting biodiversity from the threats of roads	June 6, 2013
	TRCA Family Fishing Day Event	July, 2013
	Evergreen Brick Works, Stewardship Event	August, 2013
Brampton Guardian	Thousands dying on Heart Lake Road every year	October 8, 2013
YouTube	Heart Lake Road Ecology Project www.youtube.com/watch?v=E186zpcX45s	January 16, 2015
TRCA News	Dedicated Wildlife Culverts Installed on Heart Lake Road	August 4, 2016

Materials and Methods

1. Site Description

The wetlands bordering Heart Lake Road represent a 99 hectare designated Provincially Significantly Wetland complex scoring in the top 10 most important evaluated wetlands in Ontario, out of nearly 1,500 evaluated wetlands (Appendix A - Evaluated Wetlands Spreadsheet).

There are a variety of amphibians, reptiles, mammals and birds within the wetlands, most of these are common but some species are of special concern for local or provincial extirpation (Appendix B - Fauna Species list Heart Lake).

Road mortality is an important issue at HLR, as the road bisects this wetland complex. Extensive research conducted by TRCA has documented many WVCs and identified three mortality hotspots.

2. Road Ecology Monitoring

i. 2011-2014

TRCA engaged in a community-led citizen science monitoring effort along HLR. This effort to document WVCs led to a series of reports and presentations to COB council that culminated in the adoption of mitigation measures discussed in this current report.

ii. 2016 Survey methods

In 2016, TRCA developed a citizen-science based road-ecology monitoring program that was implemented at various sites around the GTA including HLR. Staff trained volunteers to record WVC incidents, upload data to a mobile tablet and subsequently into a central database. Monitoring took place between 9:00 a.m. and 12:00 p.m., on various days at each site. Along HLR, the monitoring days were Tuesdays and Saturdays. Volunteers monitored HLR. between Countryside Dr. and the south entrance to HLCA, a distance of approximately 650 metres on each side of the road.

Volunteers were taught to identify and catalogue (using an electronic tablet) fauna encountered, while monitoring the SA. Fauna encountered was categorized by species with accompanying photographic references. Location was recorded using a built-in GPS function in the tablet.

iii. BACI methodology

Before After Control Impact (BACI) study design involves pre and post monitoring of the site that will be remediated (hotspot #3), as well as a control site nearby that receives no mitigation. As only one of the three hotspots along HLR was receiving mitigation, we were able to add a control location (hotspot #2). Both hotspot #2 and #3 have been monitored for many years. Hotspot #1 was not monitored in 2016 due to limited staff and volunteer time.

iv. Safety Protocol

Staff and volunteers adhered to strict safety protocols following guidance from the Ministry of Transportation (Book 7). Although security protocols were viewed as excessively restrictive and time consuming by most volunteers and staff at the onset, participants did adhere to protocols and managed to integrate it into the monitoring routine. Teams of three or four people conducted monitoring during daylight hours and only in dry conditions (Appendix C - Road Safety Protocol). Because of delays implementing the new safety protocols, monitoring did not begin until late May, in effect missing the spring freshets (spring thaw) and most of the early season movement.

v. Stream Crossing Model

Citizen scientist monitoring efforts at HLR and other locations were being integrated into a larger stream-crossing model. Using twenty or so locations in the Greater Toronto Area, staff and volunteers were recording WVCs to validate this model.

3. Other Survey Methods Used in 2016

i. Visual surveys for nesting turtles

TRCA staff and volunteers also monitored the SA for evidence of turtle nests. Nest sites were recorded as part of the road ecology monitoring protocol. No artificial protection, such as wire cages was used to cover the nests. In the past, nest cages had proven ineffective due to a combination of poor installation and/or determined predators.

ii. Visual inspection of turtle nesting beaches

TRCA staff and volunteer citizen scientists visually monitored nesting structures for any signs of nesting activity. Inspection of turtle beaches occurred during regular road ecology monitoring days.

iii. Camera-trapping at ecopassage entrances

TRCA staff installed four wildlife cameras, two at each end of the wildlife passage, setting cameras to take photos with both motion capture and on a timer. Cameras were inside a locked security box secured on a RAM mount and screwed into a block of wood that was epoxied to the culvert. The lock-box was tethered to an aircraft cable anchored into the ground.

Shortly after installation two of the four cameras were stolen (cable cut and broken RAM mounts). The remaining two cameras were removed to prevent additional theft/vandalism. Consequently there is limited wildlife camera monitoring within the passage.

Results

1. Road Ecology Volunteer Efforts

There were a total of fourteen volunteers working in groups of three or four along HLR. Monitoring began on May 21st, 2016, and ended on Oct 29th 2016, and took place twice a week on Tuesday and Saturday. The Heart Lake team of volunteers managed to monitor thirty-one mornings out of a possible forty-seven. Inclement weather during the monitoring period of all sites was not a major factor with minimal cancellations at all sites and none at HLR. On average, each monitoring session required approximately two or more hours to set up safety equipment, monitor the road and shoulder, record incidents and re-store safety equipment in an equipment box located on site.

Doodle polls (Figure 33) were used to manage the timetables and Track-it-Forward (Figure 34) used to manage volunteer hours and awards.

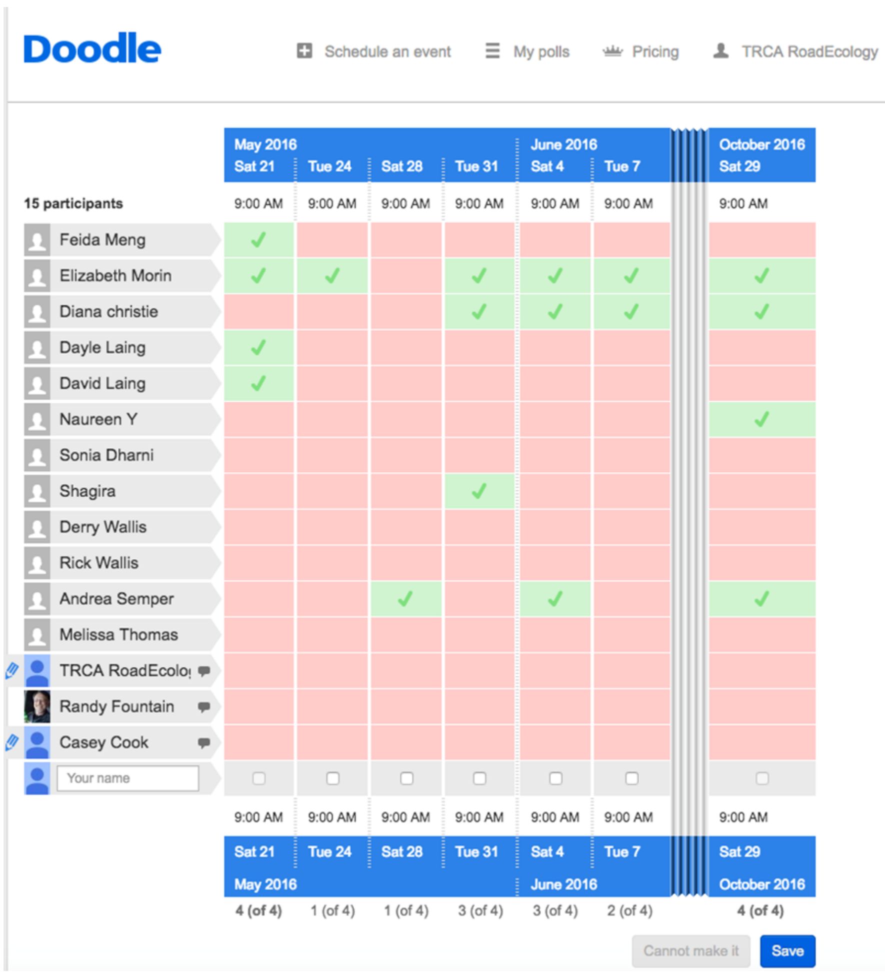

Figure 33 - Doodle poll schedule for citizen scientist participants

Citizen Scientist- Gold (45 hours)

Volunteer	Email	Hours	Action
Dilys Bowman	dilys.bowman@gmail.com	65.5	award
Elizabeth Morin	lisyir@yahoo.com	64.5	award
Randy Fountain	r_fountain@hotmail.com	60	award
Diana Christie	dianachristie@sympatico.ca	51	award
Natalie Helferty	nhelferty@rogers.com	48	award
Marco Prosdocimo	marcoprosdocimo@outlook.com	48	award
Bob Noble	bob_noble@rogers.com	46	award

Citizen Scientist- Silver (30 hours)

Volunteer	Email	Hours	Action
Andrea Semper	asemper@alumni.yorku.ca	44	award
Emily Dutton	emily.m.dutton@gmail.com	40	award
Daniel Lie	danionlie@hotmail.com	32	award

Citizen Scientist- Bronze (15 hours)

Volunteer	Email	Hours	Action
Mamta Patel	mamta01@hotmail.com	27.5	award
Hill Huang	hill.huang@hotmail.com	17	award

Working on it

Volunteer	Email	Hours
Rick Wallis	rwallc623@rogers.com	14
Adrienne Camilleri	adriennecami@rogers.com	13
Shagira Bonduki	sbonduki_04@hotmail.com	12.5
Naureen Yousufali	naureen.y@gmail.com	12
Nick Wong	szeyuwong@hotmail.com	11
Tejinder Sidhu	tejinder.sidhu@outlook.com	10
Rebecca Sookram	rebecca.sookram@hotmail.com	10
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Figure 34 -Track-it-Forward chart of citizen scientist's contributions

2. Wildlife-Vehicle Collisions

In 2016, a total of 263 WVCs were recorded along the monitored stretch of HLR, including 28 turtles indicated in the map below (Figure 35). General road mortality was clumped along the identified unmitigated hot spot #2 near the wetland. This 2016 survey adds another year of data to a growing body of evidence that HLR is, and continues to have, high mortality rates for all herpetofauna.

The level of road mortality evidenced at HLR is unsustainable for species with longer life spans and species with slow reproducing rates such as turtles. It is unclear if levels of frog mortalities caused by road traffic have any long-term effect on population demographics.

Figure 35 - Map of WVCs along Heart Lake Road 2016

Table IV – Record of wildlife fatalities along Heart Lake Road

Wildlife Type	Number	Species
Bird	15	AMGO(7), AMRO(2), AMRS (1), BAOR (1), RWBL (1), UNKN (4)
Frog	167	GRFR(17), LEFR(28), TGTF (11), UNKN(111)
Mammal	24	EACH(1), GRSQ(3), MEVO(1), MJMO(1), MUSK(1), RACC(3), RESQ (2), STSK (3), VIOP (1), UNKN (7), WTDE (1)
Turtle	28	MPTU (14), UNKN (14)
Snake	6	EAGA (4), UNKN (2)
UNKN	21	
TOTAL	263	

Volunteers also discovered turtle nests, but these occurrences usually happened after the nest had been predated. Other nests were not identified, as only a few shells remnants were available to determine type of turtle.

3. Effectiveness of the exclusionary fencing

Of the 263 incidents recorded in 2016, only 18 incidents were recorded within the limits of the mitigated area or immediately outside, (8 frogs, 2 turtles, 5 mammals, 1 bird and 2 unknown).

i. Frogs:

Six of the eight frog casualties were discovered before the exclusionary fencing was in place, therefore only two dead frogs were discovered post fencing, one inside and the other very near the edge of the mitigated area.

ii. Turtles:

The two turtle incidents recorded were one predated nest and one piece of turtle shell. The turtle nest discovered on June 28th, was located on the shoulder north of the mitigated area and had been predated. It was just outside limits of the exclusion zone.

The second incident, a small piece of turtle plastron was discovered near the north edge of the mitigated area in October and could have been dragged by a vehicle from further away as no additional pieces of turtle shell/structure were found in the immediate area.

iii. Snakes:

Only one eastern garter snake casualty was discovered Oct 8th, in the vicinity of the mitigation fencing just outside fence limits.

iv. Others:

Other casualties discovered post-mitigation were; a fledgling bird; a red squirrel, raccoon and chipmunk. The exclusionary fencing is not designed to restrict movements of these animals. The two unknowns had no discernable body parts left to identify and are unlikely to be turtles or larger fauna.

4. Weather

Weather did play a role with respect to conditions on site as 2016 was the sixth driest summer for Toronto on record with 113 mm of rain for June, July and August combined, and the second hottest with 36 days above 30 degrees Celsius. Overall, 2016 is set to be the driest year in the last 25 years according to data from weatherstats.ca (Figure 36).

These conditions had an adverse effect on PSWs and wildlife within them. This wetland complex is thought to be surface fed and as a consequence of the unusually dry summer, water levels were at their lowest since 2005, (from historical photos of Google Earth). The wetland that received mitigation had no water level by the end of June (Appendix D - Heart Lake Wetlands Photographs). The control wetland (hotspot # 2) had also dried up by late July and by August, was being overtaken by grasses and phragmites. Turtles could no longer be seen basking in either wetland and a turtle rescue effort by TRCA staff in late July netted six juvenile turtles; four midland painted and two snapping, that were relocated to Heart Lake within HLCA.

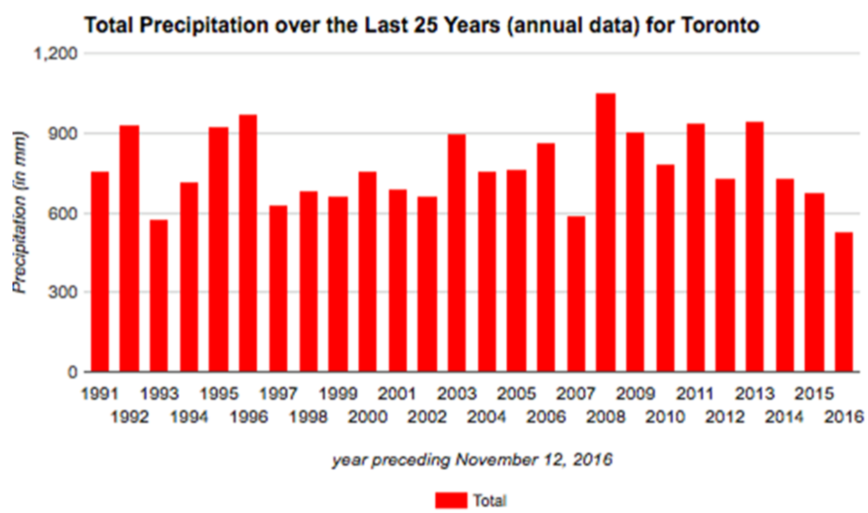

Figure 36 - Precipitation for 2016 (Credit: Weather Stats Canada)

Discussion and lessons learned

- What went right: Passage and fencing design
- What went wrong: Stolen culvert monitoring equipment, delayed fence installation, poor fence maintenance
- Variables (weather): Exceptionally dry summer

What could be improved

i. Traffic calming measures

Peripheral optical speed bars were implemented along HLR, north of Sandalwood Parkway and south of Countryside Dr. The impetus for peripheral pavement markings was to reduce average speeds of vehicles along HLR. Research elsewhere into the effectiveness of optical speed bars has been mixed and at best can be considered marginal in its effectiveness, with multiple studies showing a decrease in speeds between 0 km/hr and 5 km/hr.

At this time it is unclear if pavement markings have had any effect on average speeds of vehicles using HLR, as no post mitigation study with a traffic counter has been conducted. The pre-mitigation average speed along HLR was 78.1 km/hr, with an average number of vehicles of 5,435 on weekdays and 7,073 on weekends. Studies have shown that when roads have a large volume of cars they become nearly impassable to herpetofauna (Aresco, 2005; Gibbs & Shriver, 2005).

Current assumption is that as housing developments around HLR continue to increase, there will be increased traffic volume.

ii. Signage

Wildlife crossing signs were installed at a few locations along HLR, along with seasonal motion activated flashing lights. These types of signage have a very poor record of reducing WVCs and have been abandoned by many jurisdictions in the USA 6-9. In Minnesota, where 35,000 deer-vehicle crashes occur annually resulting in multiple human fatalities, the Minnesota Department of Transport (MnDoT) has abandoned this type of signage. Somewhat effective signage is flashing signs activated by wildlife being on the road. At this time, there is no evidence that signage implemented along HLR is effective, as no monitoring pre-post signage was in effect in 2016.

iii. Dedicated Wildlife Culvert

Long-term studies of dedicated herpetofauna wildlife culverts remain scarce. There is evidence that reptiles and amphibians use passages but effects on population numbers and demographics is almost non-existent (Lesbarrères & Fahrig, 2012). On their own, culverts and other eco-passages represent only half a solution and are generally ineffective (Baxter-Gilbert, Riley, Lesbarrères, & Litzgus, 2015). Another integral part of a wildlife passage solution is directional fencing specialized to the particular class of animal targeted (McCollister & Van Manen, 2010; Pagnucco, Paszkowski, & Scrimgeour, 2012).

iv. Exclusionary Fencing

Directional fencing has proven to be very effective in keeping herpetofauna from roads (Aresco, 2005; Dodd Jr, Barichivich, & Smith, 2004). However fencing on its own can lead to habitat fragmentation and long-term instability and lack of resilience within fenced populations (Jaeger & Fahrig, 2004). Fencing solutions are usually paired with wildlife passages. Based on the very limited number of turtles, frogs and snakes that were found post mitigation fencing completion, it would seem that fencing is restricting access to the road for targeted species and not diverting movement to fencing edges.

Without effective monitoring of the dedicated wildlife culvert and directional fencing, it is difficult to say how many animals have used the culvert versus how many animals have been dissuaded from crossing altogether. The small number of incidents at fencing edges may be from animals following the fencing, escaping the 180-degree turn-back and finding their way to the road. With so few of these incidents, these animals may have found themselves on the road approaching the mitigated section from either south or north of the mitigation.

v. Turtle Nesting Mounds

No nesting or exploratory nesting activity was detected during the 2016 season. With 2016 being one of the driest on record and the wetlands associated with the mitigation become devoid of water in early June, the site conditions provided unsuitable habitat for turtles. One turtle nest (volunteers could not identify the species) was discovered predated on June 28th, along the road shoulder. The nest was found just outside the mitigation area and its location was within 15 meters of the artificial nesting mounds. Both snapping and painted turtles are known to have high nest fidelity (Bombard & Brooks, 1980; Rowe, Coeval, & Dugan, 2005) and it is not surprising that turtles may continue to attempt to nest by the roadside until they are aware of nearby nest beaches.

Take-up of the new artificial nesting mounds might take time, allowing for chance discovery or actively moving gravid turtles to the mounds to encourage nesting (Paterson, Steinberg, & Litzgus, 2013).

Protection of identified nesting sites is recommended by using wire-cages (Riley & Litzgus, 2013) and has been in practice by TRCA staff and volunteers during this study. Sweeping the surface of the sand on top of nesting sites does not reduce predation (Geller, 2015).

vi. Maintenance regime

Success of any exclusionary fencing system depends on keeping the system in working fashion (Baxter-Gilbert et al., 2015). Breaches in fences can occur due to material stress, weather, vegetation overgrowth, debris, etc. A regular maintenance schedule is crucial to ensuring proper functioning of fences. The dedicated wildlife culvert needs to be kept clear of debris at entrances and a regular inspection of substrate is recommended to keep the culvert appealing to wildlife.

vii. Expanding exclusionary fencing and nesting structures mitigation to other hotspots

Given the success of the exclusionary fencing installed, it is recommended to extend the treatment further south to encompass hotspot #2, where the majority of WVCs were observed in 2016. Although no monitoring was done south of HLCA entrances, casual observation noted multiple WVCs from Sandalwood Pkwy to HLCA which is hotspot #1. Fencing should also be considered for areas surrounding hotspot #1 and hotspot #2.

Although no evidence was recorded of nesting beaches being used in 2016, partners are confident of their placement and utility. If exclusionary fencing is contemplated for the two other hotspot locations, then alternative nesting grounds should be provided.

As a consequence of the borehole report and the recommendations against cutting the road and installing a dedicated wildlife culvert in other hotspot locations, it is recommended exploring the possibility of using a small tunnel-boring machine to connect both sides of HLR. The Ontario Ministry of Transportation is currently using such machinery to repair 1.8m diameter corrugated steel pipe

(CSP) that spans 215m under Highway #11 (http://dailycommercialnews.com/Projects/News/2016/3/Tunnel-boring-machine-used-in-culvert-repair-1014295W/). Costs for the tunnel-boring machine might be prohibitive leading to recommendations for CoB to consideration an ACO tunnel, suitable for roads close to water, such as at HLR. This tunnel system does not require a deep cut in the road and may be better suited to local conditions (http://www.aco-wildlife.com/solutions/main-road-tunnel-crossings/).

viii. Other wetland improvements

The drought of 2016 and resulting drying out of the main wetlands along HLR has caused some deep consternation among the volunteers and TRCA staff. Measures to keep water in the wetlands could be envisaged. Major dredging of deep channels would keep water in the wetlands longer during drought and offer overwintering habitat for turtles in future years of drought.

The dry conditions have also been favorable to the spread of common reed (*Phragmites australis*) in the wetlands. Common reed is notoriously difficult to control and therefore it is best addressed early on to avoid encroachment of native vegetation.

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Appendix A

Evaluated Wetlands Spreadsheet

EVALUATED WETLAND NAME	EVALUATED WETLAND SIZE	EVALUATED WETLAND TYPE	BIOLOGICAL COMPONENT SCORE	SOCIAL COMPONENT SCORE	HYDROLOGICAL COMPONENT SCORE	SPECIAL FEATURES SCORE	OVERALL WETLAND SCORE
Luther Marsh	4031.6	Evaluated Wetland Complex	193	212	219	250	874
Nappan Island Complex		Evaluated Wetland Complex	233	192	191	250	866
Cranberry Oil Well Bog Wetland Complex	372.57	Evaluated Wetland Complex	187	195	222	250	854
Little Cataraqui Creek Complex	320.7	Evaluated Wetland Complex	161	224	219	250	854
South Dorchester Swamp (UT 23)		Evaluated Wetland Complex	185	181	236	250	852
Snelgrove Brook		Evaluated Wetland Complex	196	177	229	250	852
Heart Lake Wetland Complex	99	Evaluated Wetland Complex	174	183	243	250	850

Appendix B

TRCA Fauna Species List – Heart Lake

Fauna Scores and Ranks, December, 2013.

Common Name	Scientific Name	Code	LO	PTn	PTt	AS	PIS	StD	HD	+	TS	L-Rank
Survey Species: species for which the TRCA protocol effectively surveys.												
Birds												
American redstart	*Setophaga ruticilla*	AMRE	0	3	2	3	1	4	2	0	15	L3
brown creeper	*Certhia americana*	BRCR	1	2	2	3	2	4	2	0	16	L3
common merganser	*Mergus merganser*	COME	5	3	2	3	2	2	2	0	19	L3
great blue heron	*Ardea herodias*	GBHE	3	2	2	3	1	4	2	0	17	L3
mourning warbler	*Geothlypis philadelphia*	MOWA	1	4	3	2	2	4	2	0	18	L3
pileated woodpecker	*Dryocopus pileatus*	PIWO	0	2	2	4	1	3	3	0	15	L3
Virginia rail	*Rallus limicola*	VIRA	1	2	2	2	3	4	3	0	17	L3
wild turkey	*Meleagris gallopavo*	WITU	0	1	0	4	3	3	4	0	15	L3
wood thrush	*Hylocichla mustelina*	WOTH	0	4	2	3	2	4	2	0	17	L3
yellow-billed cuckoo	*Coccyzus americanus*	YBCU	0	4	2	3	1	3	3	0	16	L3
belted kingfisher	*Ceryle alcyon*	BEKI	0	3	2	2	1	2	2	0	12	L4
blue-grey gnatcatcher	*Polioptila caerulea*	BGGN	0	1	1	3	1	3	1	0	10	L4
common yellowthroat	*Geothlypis trichas*	COYE	0	3	2	1	2	4	1	0	13	L4
Cooper's hawk	*Accipiter cooperii*	COHA	0	2	2	4	1	2	3	0	13	L4
eastern bluebird	*Sialia sialis*	EABL	2	1	1	2	1	2	2	0	11	L4
eastern wood-pewee	*Contopus virens*	EAWP	0	4	2	2	1	3	1	0	13	L4
great-crested flycatcher	*Myiarchus crinitus*	GCFL	0	2	2	3	1	2	2	0	12	L4
green heron	*Butorides virescens*	GRHE	0	3	2	2	1	4	2	0	14	L4
grey catbird	*Dumetella carolinensis*	GRCA	0	3	2	1	1	3	1	0	11	L4
hairy woodpecker	*Picoides villosus*	HAWO	0	2	2	3	1	2	2	0	12	L4
indigo bunting	*Passerina cyanea*	INBU	0	3	2	1	1	4	2	0	13	L4
northern flicker	*Colaptes auratus*	NOFL	0	4	2	1	1	3	2	0	13	L4
northern rough-winged swallow	*Stelgidopteryx serripennis*	NRWS	0	3	2	1	1	2	3	0	12	L4
pine warbler	*Setophaga pinus*	PIWA	0	1	2	4	1	3	3	0	14	L4
red-breasted nuthatch	*Sitta canadensis*	RBNU	0	1	2	3	1	2	1	0	10	L4
red-eyed vireo	*Vireo olivaceus*	REVI	0	1	2	2	1	3	1	0	10	L4
rose-breasted grosbeak	*Pheucticus ludovicianus*	RBGR	0	3	2	3	1	3	2	0	14	L4
ruby-throated hummingbird	*Archilochus colubris*	RTHU	0	2	2	1	1	2	2	0	10	L4
swamp sparrow	*Melospiza georgiana*	SWSP	0	1	2	1	2	5	1	1	13	L4
white-breasted nuthatch	*Sitta carolinensis*	WBNU	0	2	2	3	1	2	2	0	12	L4
wood duck	*Aix sponsa*	WODU	0	2	1	3	2	4	2	0	14	L4
American Crow	*Corvus brachyrhynchos*	AMCR	0	1	2	1	1	0	0	0	5	L5
American goldfinch	*Carduelis tristis*	AMGO	0	3	2	1	1	1	0	0	8	L5
American robin	*Turdus migratorius*	AMRO	0	1	2	1	1	1	0	0	6	L5
Baltimore oriole	*Icterus galbula*	BAOR	0	4	2	1	1	1	0	0	9	L5
black-capped chickadee	*Parus atricapillus*	BCCH	0	1	2	1	1	1	0	0	6	L5
blue jay	*Cyanocitta cristata*	BLJA	0	3	2	1	1	1	0	0	8	L5
brown-headed cowbird	*Molothrus ater*	BHCO	0	3	2	1	1	1	0	0	8	L5
Canada goose	*Branta canadensis*	CANG	0	0	2	1	2	0	1	0	6	L5
cedar waxwing	*Bombycilla cedrorum*	CEDW	0	1	2	1	1	1	0	0	6	L5
chipping sparrow	*Spizella passerina*	CHSP	0	3	2	1	1	2	0	0	9	L5
common grackle	*Quiscalus quiscula*	COGR	0	4	2	1	1	1	0	0	9	L5
downy woodpecker	*Picoides pubescens*	DOWO	0	1	2	1	1	1	1	0	7	L5
eastern phoebe	*Sayornis phoebe*	EAPH	0	1	2	1	1	1	2	0	8	L5
house wren	*Troglodytes aedon*	HOWR	0	1	2	1	2	1	1	0	8	L5
mallard	*Anas platyrhynchos*	MALL	0	1	2	1	2	1	0	0	7	L5
mourning dove	*Zenaida macroura*	MODO	0	3	2	1	1	0	0	0	7	L5
northern cardinal	*Cardinalis cardinalis*	NOCA	0	1	2	1	1	2	1	0	8	L5
red-tailed hawk	*Buteo jamaicensis*	RTHA	0	2	2	2	1	1	1	0	9	L5
red-winged blackbird	*Agelaius phoeniceus*	RWBL	0	3	2	1	1	2	0	0	9	L5
song sparrow	*Melospiza melodia*	SOSP	0	3	2	1	1	2	0	0	9	L5
warbling vireo	*Vireo gilvus*	WAVI	0	1	2	1	1	2	1	0	8	L5
yellow warbler	*Setophaga petechia*	YWAR	0	3	2	1	1	2	0	0	9	L5
European starling	*Sturnus vulgaris*	EUST		4								L+
house sparrow	*Passer domesticus*	HOSP		4								L+
trumpeter swan	*Cygnus buccinator*	TRUS										L+
Herpetofauna												
grey treefrog	*Hyla versicolor*	TGTF	1	3	2	3	4	5	2	1	21	L2
spring peeper	*Pseudacris crucifer crucifer*	SPPE	1	2	2	3	4	5	3	1	21	L2
wood frog	*Lithobates sylvatica*	WOFR	0	2	2	3	4	5	3	1	20	L2
eastern red-backed salamander	*Plethodon cinereus*	RBSA	0	2	2	1	4	4	3	0	16	L3
northern leopard frog	*Lithobates pipiens*	LEFR	0	3	2	1	4	5	2	1	18	L3
American toad	*Anaxyrus americanus*	AMTO	0	3	2	1	4	4	0	0	14	L4
green frog	*Lithobates clamitans*	GRFR	0	2	2	1	3	4	1	0	13	L4
Incidental Species: species that are reported on as incidental to the TRCA protocol.												

Appendix C

Road Safety Protocol

This document includes the following:

1. **Volunteer Safety Protocol**
2. **Volunteer Injury Reporting Process**
3. **Volunteer Road Ecology Monitoring – Safe Work Procedure**
4. **Volunteer Road Ecology Monitoring Safe Work Procedures Competency Sign Off**
5. **Competency Checklist (to be completed by Supervisor at Field Training Session)**

1. Volunteer Safety Protocol

All volunteers must:

1. In case of emergency call 911.
2. In the case of an injury, follow the Volunteer Injury reporting process.
3. Attend one Field Training Session.
4. Sign “Volunteer Waiver” and submit to Project Coordinator.
5. Complete all mandatory AODA and TRCA orientation training online, review summary of TRCA’s Harassment, Health and Safety, E-Communication Policies and Code of Conduct. Sign “Volunteer Intake Form” and submit to Project Coordinator.
6. Sign “Volunteer Letter of Offer” and submit to Project Coordinator.
7. Check in with Project Coordinator at the start and end of each shift using an agreed upon method (email, text message)

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   cell: 647-221-1929

8. Not conduct surveys in rain, thunder or high winds, where weather conditions inhibit safety while on or near the roads.
9. Do a safe road assessment and follow the procedure to properly place two “Road Works” signs on the side of the roadway prior to the commencement of work. One at either extent of the study site and on the side of the road of oncoming traffic. When the work is done the signs must be dismantled and stored.
10. Work in groups of 3 and comply with the roles assigned as outlined in the “Safe Work Procedure”.
11. Adhere to the “Safe Work Procedure” for Volunteer Road Ecology Monitoring.
12. Walk the shoulder of the road, facing on-coming traffic.

13. Wear Personal Protective Equipment that consists CSA approved safety boots, Class 2 high visibility safety vest, Type 1 hard hat, CSA approved eye protection. If carrying a backpack, the safety vest is to be worn over the backpack.

14. Park vehicles at designated locations as indicated on site fact sheets.

15. Carry a copy of the Road Occupancy Permit for your site at all times while on site.

16. Only remove wildlife (dead or alive) when there is a sufficient gap in traffic to do so as you are not authorized to stop or direct traffic.

17. Carry a charged cell phone (minimum 1 per group).

18. Not eat during surveys. Use the hand sanitizer at the end of the survey and before eating.

19. Avoid all visual and auditory distractions throughout shift such as wearing ear buds, texting, phone calls, etc. Adhere to duties as assigned.

20. Wear Nitrile Gloves. TRCA will supply.

21. Be prepared for the conditions with:
    a. Sunscreen
    b. Bug spray
    c. Extra clothing layers
    d. Extra drinking water

2. Volunteer Injury Reporting Process for the Volunteer:

1. Call 911 if necessary
2. Contact Project Coordinator

   Marc Dupuis-Desormeaux

   trcaroadecology@gmail.com

   cell: 647-221-1929

   Record information as outlined in the Visitor / Volunteer Injury Form in folder. Injury forms will be in the box on site.

3. Take photos of injury and scene.

3. Volunteer Road Ecology Monitoring – Safe Work Procedure

Background Information

This project involves collecting road/ wildlife interaction data from the roadside. This work necessitates compliance with Ontario Traffic Manuals - Book 7 and municipal requirements for road side works.

Equipment

All personal protective equipment must be inspected before use, to ensure it is in safe working condition. All equipment must be worn and used as per the manufacturer's recommendations and without modification.

Personal Protective Equipment Requirements:

1. CSA approved safety boot.
2. CSA approved eye protection
3. Type 1 hard hat
4. High visibility class 2 safety vest
5. Nitrile gloves
6. Hand sanitizer
7. First aid kit including tick removal kit
8. Working cell phone (1 amongst group of 3)
9. 2 'men at work' road signs
10. 5 28" pylons

Procedure

Volunteers must be given detailed instruction from a properly trained and competent person on all procedures and safe practices. No monitoring will take place without the presence of at least 3 volunteers. Roles and responsibilities shall be designated at the beginning of each shift. At any time volunteers are to communicate any potential hazards or concerns to the volunteer coordinator.

1. **Pre-monitoring set-up**
    a. Park vehicles at designated parking area identified on site fact sheets.
    b. Observe weather conditions. Refrain from monitoring if there is rain, thunder and/or high winds or where weather conditions inhibit safety while

on or near the roads.

c. Contact volunteer coordinator to indicate that monitoring is about to commence (via text or email).

d. Review all personal protective equipment and ensure that you have all items on the **Personal Protective Equipment Requirements list. Inspect all equipment to ensure that it is in good working order**

e. Review "Conditions that Affect Traffic Control Requirements" in the site fact sheet for the site being monitored and note any changes to conditions. If conditions have changed record on a new sheet and submit to Project Coordinator. Take special note of Emergency road repair, broken down vehicles, obstructions to traffic flow.

f. Observe site and identify emergency escape route.

g. Identify roles for the shift: Volunteer A, Volunteer B, Volunteer C

Role	Responsibility
A (Spotter and safety set up)	- Observes oncoming traffic in both directions at all times. - Observes oncoming traffic (work side) during removal. - Gives the 'All Clear to A for removal - Communicates potential hazards to team. - Shifts safety set-up as required. - Activates 911 if necessary.
B (Data Collection)	- Collects data - Observes for wildlife on roadway - Communicates potential hazards to team
C (Support)	- Observes for wildlife on shoulder - Observes oncoming traffic (opposite work side) during removal - Gives the 'All Clear' to A for removal - Assists with data collection at roadside - Communicates potential hazards to team

2. At work procedure

a. Set up 'men at work' roadside signs at designated locations identified in site fact sheets (set up will need to be moved once for each monitoring session

b. Walk on shoulder facing on-coming traffic, following the route identified in the site fact sheets.
c. When stopped to record data ensure that you are within a pylon set up as depicted in figure 1 below
d. Volunteer B (Data Collector) to only remove wildlife (dead or alive) when there is a sufficient gap in traffic to do so and when given the 'all clear' by volunteer A (Spotter and safety set up) and volunteer C (support). Volunteers are not authorized to stop or direct traffic.

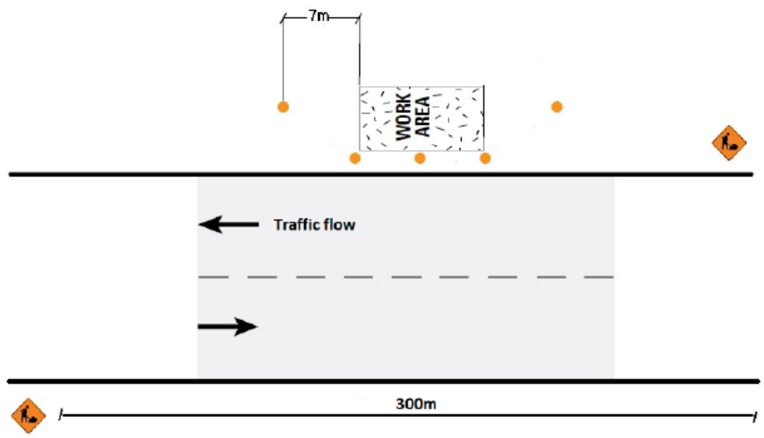

Figure 1: Work Area Set Up

3. Close out procedure

a. When the work is done the signs must be put back inside the storage box stored onsite. Contact volunteer coordinator to inform that the shift is complete (via text or email).
b. Upload data at secure wifi location.
c. Record volunteer hours worked at http://www.trackitforward.com/site/trca

Important Contact Information:
Volunteer Coordinator
Marc Dupuis-Desormeaux
trcaroadecology@gmail.com
Cell: 647-221-1929

4. Volunteer Road Ecology Monitoring Safe Work Procedures - Competency Sign Off

I have reviewed the "Volunteer Road Ecology Monitoring Safe Work Procedures" document and have demonstrated the following tasks to a competent supervisor.

- ☐ Pre-monitoring Procedure (Assigning roles and responsibilities, setting up signs, etc.)
- ☐ At Work Procedure (assessing traffic flows, traffic judgement, etc.)
- ☐ Close-out Procedure (Shift completion)

Name	Signature	Date

Competent Supervisor Name:

Competent Supervisor

Signature:

5. Competency Checklist

(to be completed by Supervisor at Field Training Session)

Competency Checklist *Volunteer Name:___*

- □ Has gone through Safe Work procedures with supervisor and demonstrates a sound understanding of the outlined principles
- □ Demonstrates knowledge of required PPE
- □ Able to identify hazards during pre-monitoring and at work procedure
- □ Demonstrates knowledge of doing Pre-monitoring Procedure (Assigning roles and responsibilities, setting up signs, etc.)
- □ Demonstrates knowledge of doing At Work Procedure (assessing traffic flows, traffic judgement, etc.)
- □ Demonstrates knowledge of doing Close-out Procedure (Shift completion)

Supervisors Name: _____ Supervisors Signature: _____

Appendix D

Heart Lake Wetlands indicating water levels.

Figure 37 - East wetland, HLR north of HLCA. Image 1 – Nov 2011, Image 2 – Jun 2013

Figure 38 - East wetland, HLR north of HLCA. Image 1 - Sep 2015, Image 2 - Jul 2016.

Figure 39 - East wetland, HLR north of HLCA Jul 2016.

Figure 40 - West wetland, Heart Lake Road north of HLCA. Image 1 - Nov 2011, Image 2 – Jun 2013.

Figure 41 - West wetland, Heart Lake Road north of HLCA. Image 1 – Sep 2015, Image 2 - Aug 2016.