Item 8.2

Item for the Information of the Regional Watershed Alliance

TO: Chair and Members of the Regional Watershed Alliance
Wednesday, November 10, 2021 Meeting

FROM: Sameer Dhalla, Director, Development and Engineering Services

RE: **TRCA's HABITAT CONNECTIVITY AND ROAD ECOLOGY INITIATIVES**
Bridging the gap between science, policy, and practice

KEY ISSUE

To inform the Regional Watershed Alliance regarding the results of TRCA's habitat connectivity, wildlife movement, and road ecology applied research initiatives and their applications in various TRCA operations, including land use and infrastructure planning processes.

RECOMMENDATION

WHEREAS Toronto and Region Conservation Authority (TRCA) staff has completed several applied research and monitoring initiatives since 2015 to advance the local scientific knowledge of habitat connectivity, wildlife movement, impacts of road networks, and effectiveness of mitigation measures;

AND WHEREAS the completed initiatives have informed various watershed planning, restoration, ecosystem and land management, climate adaptation, and land use and infrastructure planning processes, including implementation of TRCA's *Crossings Guideline for Valley and Stream Corridors* (2015);

AND WHEREAS TRCA staff has collaborated with several researchers from academic institutions and partner municipalities to complete these initiatives and use them to inform decision making;

IT IS RECOMMENDED THAT the staff report and presentation on TRCA's habitat connectivity, wildlife movement, and road ecology initiatives be received;

AND FURTHER THAT the Regional Watershed Alliance members advise how they wish to be engaged about progress made on these projects and their applications.

BACKGROUND

Road networks are an important part of modern society. They allow for people and goods movements, enabling important social and economic activities. However, roads can also have impacts on ecological systems that are essential for overall ecosystem health and community well-being. For example, the location and design of roads can negatively influence ecosystems by (i) reducing habitat connectivity (increasing fragmentation) thereby restricting access by wildlife to necessary resources and (ii) by increasing road mortality. These impacts can lead to substantial degradation of habitat quality and cumulative negative impacts on long-term population persistence of wildlife unless these effects are mitigated.

In TRCA's watersheds, more than one third of the natural cover that provides habitat and connectivity corridor function is located within valley and stream corridors. Road crossings at these locations can have substantial impacts on these functions and appropriate management and mitigation measures can have substantial benefit to the overall ecosystem and biodiversity

of the Greater Toronto Area bio region. Recognizing this, TRCA's Crossings Guideline for Valley and Stream Corridors (the Guideline) developed in 2015 outlines guidance on addressing the adverse impacts of road crossings on natural heritage functions and highlights the need for regional and field level data to inform the infrastructure planning process. Though the Guideline focuses on the valley and stream corridors, the principles of habitat, connectivity, road ecology and mitigation measures can be applied more broadly to the entire landscape as well.

The importance of habitat connectivity is strongly underscored in the Provincial Policy Statement (2020) as well as in our partner municipalities Official Plans. Likewise, TRCA's Living City Policies, Terrestrial Natural Heritage System Strategy (2007), updated Natural Heritage System (2021-draft), Integrated Restoration Prioritization planning (2016), and various watershed plans including Carruthers Creek Watershed Plan (2020) and Etobicoke Creek Watershed Plan (in progress) highlight the importance of this work. These documents recognize how critical habitat connectivity is in achieving the broader goals and objectives related to natural heritage, biodiversity, and watershed health and reference the information provided by TRCA's habitat connectivity and road ecology initiatives.

RATIONALE

Recognizing the importance of habitat connectivity and wildlife movement in achieving the natural heritage goals of TRCA's and its municipal partners, TRCA staff has undertaken a series of applied research and monitoring initiatives, with support from our municipal partners. This has been accomplished in collaboration with various researchers and practitioners from academic institutions, partner municipalities, and non-profit organizations. These initiatives are intended to advance our understanding of habitat connectivity priorities and wildlife movement across our watersheds, evaluate the extent of impacts of road network on connectivity, facilitate implementation of appropriate mitigation, and monitor their effectiveness over the long term to achieve natural heritage objectives.

Broadly, TRCA's habitat connectivity and road ecology initiatives can be classified into four focus areas including:

i. **Identifying strategic habitat connectivity areas** across TRCA's watersheds using ecological models to inform proactive planning
ii. **Identifying hotspots for road mortality** and wildlife movement on select road segments using field surveys to inform road planning and design
iii. **identifying priority crossing structures** (bridges and culverts) on the road for mitigation and/or replacement using models and field data to improve habitat connectivity for fish and wildlife
iv. **Pilot studies at two select sites to understand species specific details** on movement pattern and identify specific needs for enhancing habitat and connectivity

The following section will describe each of the four focal areas in more detail.

(i) **Identifying strategic habitat connectivity areas**

- Preliminary assessment tool for assessing natural heritage functions within valley and stream corridors in TRCA's Crossings Guideline for Valley and Stream Corridors (TRCA 2015; Page 47) (Figure 1a in Attachment 1). It provides a watershed scale assessment of terrestrial and aquatic natural heritage functions within valley corridors. This contains a high-level mapping tool that was developed using desktop analysis of existing data to highlight valley and stream corridors that are predicted to be of high, medium, or low natural heritage/ecological function priority in the consideration of siting and design of crossings within TRCA's jurisdiction.

- Priority areas for regional connectivity among TRCA's high quality habitat patches across TRCA jurisdiction (TRCA 2015) (Figure 1b in Attachment 1). High regional connectivity areas in the map reflects areas that are critical for connecting all high-quality habitat across TRCA's watersheds for terrestrial wildlife. Regional connectivity is necessary for wildlife as corridors allow wildlife to move among habitat patches to establish new or expanded home ranges, if necessary. These movements, also called dispersal movements, often occur over larger geographic space, longer time scales, and may be infrequent but are critical for long-term population persistence. Maintaining connectivity helps wildlife to adapt to the changing conditions in their habitat including those related to land use and climate change.
- Priority areas for local connectivity among forest habitat patches and forests and wetland habitat patches across TRCA's jurisdiction (TRCA 2015) (Figure 1c and 1d in Attachment 1) reflect areas that are important for wildlife moving in search of food, a mate, and appropriate seasonal refuge. These often occur within species' home ranges and over shorter time scales. When roads cross these local connectivity priority areas, they are likely to create barriers and/or result in road mortality due to vehicular traffic. This results in wildlife population decline and eventual extirpation unless appropriate mitigation actions are undertaken.
- Priority stream reaches important for fish habitat and stream connectivity were identified for parts of TRCA's jurisdiction where barrier data was available (TRCA 2015) and updated more recently for Etobicoke Creek watershed as part of the work completed for the Etobicoke Creek Watershed Plan (TRCA 2021) (Figure 1e in Attachment 1). This work uses a modelling approach that calculates Dendritic Connectivity Index (DCI) based on the stream reach length and barrier data. DCI summarizes the overall connectivity for fish passage in the entire stream network. It ranks stream reaches into very high, high, moderate, and low priority for improving habitat connectivity for fish passage. Very high and high indicates stream reaches that are highly fragmented.
- Priority Reach Contributing Areas (RCA) for improving fish habitat and aquatic barrier removal (Etobicoke and Mimico Creek) (Figure 1f in Attachment 1) were assessed based on the amount of impervious area within the 125-ha drainage line RCA, also called Directly Connected Impervious Surface Cover/Area (DCIA; TRCA 2019). The higher quality RCA contains high amount of pervious surface, which is assumed to have lower level of impacts on instream habitat. Removing barriers in-stream within these priority RCAs will contribute to improving the higher quality fish habitat by increasing its connectivity.

(ii) Identifying hotspots for road mortality and wildlife movement on select road segments

TRCA continues to study the impacts of roads on habitat and wildlife movement at both the jurisdiction-scale and site-scale to help plan mitigation measures through various planning processes (e.g. watershed planning, development and infrastructure planning). As part of our road ecology initiative, TRCA completed a two-year field study (2018-2019) that included collecting road ecology data at six sites in Peel and York Region that were identified as habitat connectivity priority areas through TRCA's Crossings Guideline for Valley and Stream Corridors (TRCA 2015). The broader goal of this work is to help

- estimate potential impacts of roads on habitat connectivity and wildlife movement,
- recommend appropriate mitigation measures, and
- monitor long-term effectiveness of the implemented mitigation through a before-after study.

This work demonstrates the benefits of integration of habitat connectivity models and desktop analysis (described in previous section) with site level field survey data on wildlife-vehicle collision (WVC) to inform the road planning and design process. The six study sites in Peel and York Region include The Gore Road, Mountainview Road, Airport Road, Goreway Drive, Teston Road and Stouffville Road (Figure 2 in Attachment 1). These sites represent select high and medium priority crossings for habitat connectivity in the natural heritage section of TRCA's Crossings Guideline for Valley and Stream Corridors (TRCA 2015) that were also identified in the regional transportation master plans as undergoing construction within the next 10 years.

Table 1 shows the results of the road ecology surveys showing WVCs at all six sites. It shows that there is significant road mortality occurring at these sites and mitigation is necessary to protect local populations of wildlife. Overall, 8,778 WVCs were documented in this study in 2018 and 2019.

Table 1: Summary of four road ecology survey sites with the number of road mortality

Site	Total area surveyed (sq. m)	Total number of surveys	Total number of road mortality
the Gore Road	48,005	79	2,664
Airport Road (between Mayfield and Healey)	7,000	76	265
Mountainview Road (between Old Baseline and The Grange)	16,162	80	2,542
Goreway Drive (between Queen St East and Castlemore)	13,060	77	1,095
Stouffville Road (between Bayview Ave and Leslie St)	8,857	56	340
Teston Road	12,642	76	1,872

Figure 3 in Attachment 1 showcases the distribution of different taxonomic groups in these six sites combined. Frogs and toads accounted for a disproportionately large number of WVCs representing 89% of all WVCs. Species-specific data also suggested that populations of two species at risk, Jefferson salamander (*Ambystoma jeffersonianum*) and common snapping turtle (*Chelydra serpentina serpentina*), along with 23 other fauna species of regional concern in the jurisdiction (ranked L1-L3) are being negatively affected through WVC-related injuries and mortality.

Altogether, using the WVC data collected in 2018 and 2019, we estimate that over 1.16 million WVCs occur in a single season (April 5-November 5) along major roads in the rural area of the jurisdiction. This number is staggering and highlights the importance of avoiding the negative effects of roads through proper planning to avoid natural features prior to construction and mitigating impacts during/post-construction if avoiding natural features is not possible.

Figure 4 in Attachment 1 showcases the same data being used to identify hotspots for WVCs at the study sites. The hotspot maps indicate the approximate location where mitigation measure like wildlife passage may be located. Further field assessment during

infrastructure planning and design phases should be undertaken to guide specific mitigation measures. These detailed site assessments can also help determine whether additional best management practices, such as wildlife fencing should be applied.

(iii) Identifying priority crossing structures (bridges and culverts) on the road for mitigation

Implementing mitigation measures to improve habitat connectivity, facilitate wildlife movement, and reduce WVCs can be often very challenging given the resources required to understand the ecological needs and to locate, plan, and design mitigation measures. By undertaking the identification of priority road crossings, TRCA has highlighted the opportunity for our municipal partners to address appropriate wildlife crossings as they undertake major roadworks, which can help our partners be more strategic and efficient in allocating resources for maximum benefit.

Habitat connectivity priorities for terrestrial wildlife were combined with terrestrial wildlife passability of existing crossing structures assessed at the field level to identify the priority road crossing structures for mitigation and/or replacement to improve wildlife passage. This analysis was completed only in those areas where all the required data are available (Caledon for wildlife passage). The identification of crossing priorities for the Caledon area can be expanded jurisdiction wide to inform where crossings can provide the greatest benefit to terrestrial wildlife.

Results of the prioritization class for all 388 structures in Caledon are shown in Table 2 and Figure 5 in Attachment 1.

Table 2: Summary of the priority road crossings for mitigation and/or replacement for improving terrestrial habitat connectivity in Caledon

Priority Road Crossings for Mitigation and/or Replacement	***Number of Crossings***	***Notes***
Very High	8	Road crossing structures that are in all priority areas for habitat connectivity and are completely unpassable for all wildlife
High	25	Road crossing structures that are in at least one of the priority areas for habitat connectivity and are completely unpassable for all wildlife
Moderate	107	Road crossing structures that are in all priority areas for habitat connectivity and are partially passable for some wildlife
Moderate Low	74	Road crossing structures that are at least one of the priority areas for habitat connectivity and are partially passable for some wildlife
Low	167	Assumed completely passable or not within the predicted high priority areas for terrestrial habitat connectivity
Unclassified	7	Passability information was inconclusive due to lack of sufficient data
Total	***388***	

(iv) Pilot studies at two select sites to understand species specific details on movement pattern

Stouffville Road

Stouffville Road between Bayview Avenue and Leslie Street (Figure 6 in Attachment 1) in the City of Richmond Hill is nestled within an urbanizing setting with conservation lands (Oak Ridges Corridor Conservation Reserve) and rural parcels of land to its north and private low-density residential areas to its south. This section of Stouffville Road intersects a highly functioning habitat mosaic with more than 101 species of flora, 55 terrestrial fauna (including 37 TRCA's regional and urban Species of Concern), and 4 fishes in its immediate vicinity (within 1 km buffer) including the federally and provincially listed endangered species Jefferson Salamander.

Habitat connectivity models identified this as the high priority area for both regional and local connectivity (as described in section i) and road ecology survey data (described in section ii above) indicates that this section of Stouffville Road is a hotspot for road mortality and thus a priority for wildlife movement and connectivity management for TRCA species of concern including Jefferson Salamanders (JESA).

As such, TRCA has been conducting an in-depth study to expand our understanding to identify where and when the JESA populations are using habitat and moving to and from to inform specific mitigation measures. This includes studies to understand where JESA overwinter to inform broader habitat and connectivity management using cutting edge technologies like laser-triggered camera traps (Figure 6a in Attachment 1), pitfall traps and pit tags (Figure 6b in Attachment 1), ground penetrating radar (Figure 6c in Attachment 1) and eDNA testing. This project is being competed in close collaboration with various partners including University of Guelph, NRSI, York Region, and City of Richmond Hill.

The data generated have provided proactive information to York Region to assist in the detailed design phase of this road project, and to help streamline the planning process and make efficient use of the available resources. York Region staff has engaged TRCA staff in initial discussions to provide preliminary input as the Region advances forward in the detailed design process, as well as to put in place other mitigation measures such as seasonal (spring and fall) road closures in 2021 (Figure 6d in Attachment 1).

Heart Lake Road

Heart Lake Rd in the City of Brampton bisects a series of provincially significant wetlands where there was very high road mortality for turtles in particular. Most turtle species in the province are listed as species at risk. Turtles are one of the most vulnerable group of wildlife in TRCA jurisdiction in terms of road ecology. Female turtles frequently nest on the gravel edges of roads and as such are injured and killed by vehicles. If they do nest successfully, often their hatchlings are killed when they emerge from the roadside nest. Given that turtles have delayed sexual maturity, the loss of females from populations is a significant concern for local populations.

Multi-year volunteer monitoring has indicated that turtle road mortality is substantial in this location. Further studies have revealed that TRCA and York University documented a significant male sex bias in Midland painted turtles at this location of 21:4. This indicates

that the road may be a strong factor in in sex-specific road mortality where nesting females are more vulnerable to collisions.

Based on the road mortality data and concerns around the impacts to the turtle population the City of Brampton has installed three mitigation structures along the road and TRCA partnered to a create turtle nesting structure to discourage turtles from crossing the road (Figure 7 in Attachment 1).

TRCA has partnered with the City to monitor the three installed ecopassages: one wildlife tunnel (2 m closed foot box culvert) and 2 ACO tunnels (Figure 8a and b in Attachment 1) to evaluate its effectiveness in improving habitat connectivity for turtle populations as well as other species. The laser triggered cameras have been installed at these ecopassages during peak migration movement season to document the number and type of species using the structures (Figure 8c in Attachment 1). Lastly, TRCA, in partnership with York University, has also pit tagged the turtle population to understand the turtle movement pattern across this wetland complex to inform road mitigation measure as well as land management (Figure 8d in Attachment 1).

Relationship to Building the Living City, the TRCA 2013-2022 Strategic Plan

This report supports the following strategies set forth in the TRCA 2013-2022 Strategic Plan:
Strategy 3 – Rethink greenspace to maximize its value
Strategy 4 – Create complete communities that integrate nature and the built environment
Strategy 8 – Gather and share the best sustainability knowledge
Strategy 12 – Facilitate a region-wide approach to sustainability

FINANCIAL DETAILS
This work is funded through capital funding from the Regional Municipalities of Peel, York, Durham, and Toronto. In addition, staff successfully secured additional funding through other sources such as research granting organizations (Canadian Water Network, Mitacs Inc.) and Habitat Stewardship Program for Species at Risk to supplement the municipal capital funds.

DETAILS OF WORK TO BE DONE
TRCA will continue to support our municipal partners, research partners, and TRCA's own operations by advancing the science, policy, and practice of incorporating road ecology principles to improve habitat connectivity and wildlife movement within our watersheds. TRCA will continue work with our partners to share the data, knowledge, and expertise to plan and design mitigation measures as requested. TRCA will continue towards completing detailed review of projects and share the knowledge gathered more fully with our partners to improve habitat connectivity and road ecology outcomes in TRCA's jurisdiction.

The RWA can provide guidance and facilitate this by:

- Identifying opportunities (including funding) to expand road ecology projects
- Identifying priority work in your organization and/or community
- Advocating as an organizational and/or community champion
- Joining us in the field so that we can share our knowledge and experience

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Attachment 1: Figures