

Green infrastructure design for municipal roads

Southern Ontario has the greatest density of roads, vehicles, and wildlife species in Canada. In some regions, for example the Niagara Peninsula, there's no point further than 1.5 km from a road. As traffic volumes and road expansions have increased in line with municipal and provincial demands, and roads weave through more and more natural areas, wildlife and motorists have found themselves competing dangerously for travel rights. Statistics from the Ontario Ministry of Transportation for 2005 reveal that roughly six percent of all motor vehicle collisions involve wildlife – about 14,000 crashes per year. Many of these accidents – especially with Northern Ontario's large free-roaming wildlife species like moose – result in fatality or injury to both motorist and animal.

Science of Road Ecology

To mitigate these wildlife-vehicle collisions, more commonly called road-kill, the science of road ecology has evolved over the past 30 years. Road ecology is the science of understanding the interactions between roads and the surrounding wildlife, air, vegetation, soil, and water – the environment. When road ecology is applied to transportation projects, the



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result is green infrastructure design: land-use planning and development that integrates the natural environment in the decision-making process.

Road ecologists and wildlife managers have been working with transportation planners and engineers to implement a variety of road mitigation crossing structures so animals can cross without endangering

themselves or motorists. These wildlife crossing structures – typically an overpass or an underpass – are typically designed for multi-species usage, although certain species sometimes prefer certain designs. Mesh fencing is often used to lead or funnel animals to the appropriate tunnel for safe passage beneath or over the road. The animals then integrate this passage into their daily movements from one side of the road to the other.

Such projects are important not only for motorists' safety, but because competition for space across the landscape has reached a point where road-kill has become a noticeable threat to some of Ontario



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species' long-term survival. For instance, populations of the Blanding's turtle, once widespread, are now scattered and depleted, with road-kill listed as a significant cause for their decline. Many other turtle and snake species in Southern Ontario are similarly under threat. Wildlife transportation mitigation developments are underway across Canada in hopes of reversing these trends.

Successful Mitigation Projects

The largest mitigation project in Canada is in Banff National Park, where 21 wildlife underpasses and two overpasses were built along the Trans-Canada Highway in the late 1990s, and several more are now under construction in the Lake Louise area. The structures were intended for large ungulates such as elk and deer, but monitoring has demonstrated that most wildlife species, including large carnivores such as grizzly bears and wolves, have also integrated the safe passages into their movement. As a result, the Ontario Ministry of Transportation is currently in the detail-design phase of building a large wildlife overpass and underpass on the Highway 69 twinning project early in the next decade. This project, just south of Sudbury, will target animals such as elk, deer, and moose.

On a local, but equally important scale, several municipalities in Ontario's densely populated Greater Golden Horseshoe region have taken the initiative to integrate routine road upgrades or road extensions with wildlife crossing structures for amphibians such as frogs and toads, and reptiles such as turtles and snakes. For example a metal tunnel with concrete fencing was built for smaller animals on the Bayview extension project in York Region in 2002. Halton Region plans to build a specialized crossing structure within the Neyagawa Boulevard extension. The Region of Waterloo has integrated a wildlife crossing structure beneath Blair Road, using a metal culvert with 10 metres of fencing either side.

Many townships, cities, and counties have erected over 600 turtle-crossing signs on municipal roads across the province, alerting drivers to watch for and avoid collisions with turtles. The benefits of signs, rather than crossing structures, include cost-savings, their less permanent nature, and their use as a stewardship or awareness tool for motorists. However, it is not known if and how much road-kill is reduced, if the signs encourage poaching, and if renegade motorists deliberately run over turtles in these locations. Further, road experts caution that motorists will become desensitized to over-use of the signs, ignoring what they represent.

Landscape-Level Strategy Required

While these excellent examples of green infrastructure design occur locally, road ecologists also look at the landscape level to determine road mitigation priorities. When a landscape is inundated with roads (as in Southern Ontario), there is a pressing need to prioritize areas for mitigation that will greatly reduce road mortality, while reconnecting natural habitats. The Ontario Road Ecology Group at the Toronto Zoo is currently establishing such a landscape-level strategy, using geospatial maps, spatial analysis, and data to pinpoint where road-kill hotspots are likely to occur; for example, where a road bisects a species' favourable natural habitat.

This strategy is a first step to locating where mitigation measures should go. However, pre-mitigation monitoring data, such as road-kill locations, will greatly improve mitigation planning on a road-by-road basis. Road-kill locations can be analyzed to determine the spatial and temporal distribution, and intensity of road-kill along the road. This information can be used to determine whether wildlife crossing measures are necessary, how many signs or structures and associated fencing are required, and where mitigation is most effective along a road. These analyses can save valu-

able municipal dollars with cost-effective, informed mitigation planning.

Road ecology and its application to practical on-the-ground mitigation solutions is an adaptive science. More research is continually needed, especially to examine crossing structure design to document what works best, such as a metal or concrete box culvert, for a particular species to pass through. Lessons learned from each mitigation scenario must be documented for integration into ongoing and new road projects – an adaptive management approach. These lessons will be gained from monitoring new mitigation measures after implementation for at least two to three years. Several years of data is required because wildlife movement patterns fluctuate annually, especially when the landscape has been altered by transportation infrastructure.

Measuring Success

Performance measures for monitoring include determining how much road-kill is still occurring along the road, and whether wildlife is using the structures to cross the road. Wildlife passage can be assessed through video and/or digital camera technologies that will take pictures of animals as they cross through a structure. Successful wildlife passage suggests that the landscape has been partially reconnected, and some wildlife species can still access resources on the other side of the road.

Road ecologists and transportation planners are playing catch up to permeate decades of expansive road construction for wildlife movement – an incredibly ambitious task. Furthermore, channels for funding mitigation design, construction, and monitoring for municipal roads are still being created. With the advent of geospatial technologies, road ecology, and our increased capacity to share knowledge, the tools exist for government, science, and consulting practitioners to work together integrating responsible green transportation solutions within the municipal road network. [MW](#)