Title
Under the Boardwalk – Case History – St. John's Sideroad at the McKenzie Wetland, Aurora, Ontario, Canada

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Abstract: St. John's Sideroad, is a major east-west arterial under the jurisdiction of the Regional Municipality of York (York Region). It is located in the Town of Aurora, Ontario, Canada and lies within the watershed of the East Holland, Lake Simcoe basin. This unique project involved the widening and reconstruction of a two-kilometre section of St. John's Sideroad between Yonge Street and Bayview Avenue.

As a result of increased traffic volumes due to highly active residential development in the area, the existing two-lane rural road section could not meet the needs of the growing population (figure 1). In response to the proposed development growth in the Town, the Class Environmental Assessment study undertaken for the project identified that additional roadway capacity was needed, and recommended that this section of roadway be widened to a four-lane urban cross-section.

Figure 1. St. John's Sideroad prior to construction looking west across the McKenzie Wetland.

This project presented significant environmental challenges as St. John's Sideroad runs through the McKenzie Wetland (also known as Aurora Wetland or McKenzie Marsh), an area designated as a Provincially Significant Wetland and an important environmental feature to the local community. The McKenzie Wetland is a permanent home to numerous fish and wildlife species. Recognizing a significant opportunity to both protect and enhance the wetland and its functions along with the roadway, York Region implemented a number of key design elements to limit intrusion in the marsh and restore many of the impaired functions of the wetland.

While achieving the transportation objectives, project design emphasized improvements to:

- Wetland area, function and attributes
- Fish and wildlife habitat and function
- Water quality and circulation

Other technical innovations associated with the project included:

- Timber boardwalks, viewing areas, education and interpretive signage.
- Unique streetscaping elements including landscaping and decorative lighting.
- Bike paths throughout the length of the project, which linked the Town's existing bicycle trail network to the McKenzie Wetland and its boardwalk.
- Widening the roadway to a fully illuminated four lane urban cross-section with curb and gutter, storm sewers, sidewalks on both sides and traffic signals at major intersections.
- Railway safety improvements that included profile revisions and new gates and signals at an existing at-grade commuter railway crossing.
- Extension of the East Holland River Culvert, a triple-cell culvert, with construction being staged to maintain stream flows without using dam-and-pump or flow bypass methods.
- Tunnel construction of the East Holland Sanitary Trunk Sewer using a tunnel boring machine with a connection to the Aurora Pumping Station.

This $20 million project presented several challenges that in turn provided opportunities to develop unique design approaches. This project complimented the surroundings by being sensitive to both the natural environment, while enhancing the communities enjoyment of the area (figure 2).

Figure 2. Aerial view of the St. John's Sideroad project post construction, looking eastward.

Environmental Considerations

In 1973, as part of a habitat improvement program, the McKenzie family, in conjunction with Environment Canada, created the McKenzie Wetland by installing a simple stop-log dam structure on a small tributary of Tannery Creek. The resulting flooded area quickly became a permanent and highly productive wetland habitat teeming with wildlife.

St. John's Sideroad had already been in place long before the wetland was created. Today the McKenzie Wetland is a 10 ha wetland complex that has been designated as a Provincially Significant Wetland by the Ministry of Natural Resources (MNR). It is recognized as a significant ecological feature due to its diverse wildlife habitat functions and high aesthetic social and cultural value to the local community (figure 3).

Throughout the Class EA process, the potential effects of the road widening on the McKenzie Wetland were a key concern to York Region, the Town, the MNR, the Department of Fisheries and Oceans (DFO), the LSRCA and the general public. In light of this, one of the primary goals of the Class EA was to:

> *Ensure that any recommended road design incorporates natural environmental design features to avoid or mitigate the effects of the undertaking and, to the extent feasible, to make recommendations to enhance important wetland functions and attributes.*

To achieve this overall goal, the key attributes and functions of the wetland were described, and the existing and potential future loss of environmental function associated with the proposed road widening was identified. Design recommendations to mitigate these concerns were aimed at minimizing the loss of wetland, reducing the loss of wildlife (i.e. roadkills), managing stormwater runoff quality, and accommodating a pedestrian boardwalk within the right-of-way, which in turn minimizes the overall "footprint" of the road.

The ecological and hydrological functions of the McKenzie Wetland have been enhanced and the plants and animals it supports have been protected through this project. The wetland was protected by minimizing the width of the road through the marsh while re-connecting the north and south portions of the wetland through the provision of both wet and dry culverts under the road. A variety of other enhancements implemented through the project provided net benefits to the wetland and its inhabitants.

Figure 3. The McKenzie Wetland looking north from St. John's Sideroad.

Environmental Issues

Wetland Loss

The original profile of the section of St. John's Sideroad that bisected the wetland was only about 0.5m above the water level in the wetland. The road profile did not meet road design standards and therefore had to be raised 2.5m above the original profile. Using conventional embankments to raise the road by 2.5m and to widen it from 2 to 4 lanes would have significantly increased the road footprint with corresponding wetland loss. In order to reduce the footprint of the road, thereby reducing the loss of wetland and fish habitat, sheet pile vertical retaining walls were constructed (instead of conventional sloping embankments) for a distance of 300 m through the wetland. This resulted in a loss of wetland of only 0.22 ha, or just over 2% of the total area of the McKenzie Wetland.

Construction was carried out during the fall and winter to protect nesting and migrating wildlife and spawning fish during critical seasons. The use of sheet piles helped minimize the degree of disturbance to the natural environment by clearly separating the construction zone from the adjacent wetland.

Wildlife and Fish Habitat Loss

Two years of pre-construction monitoring provided irrefutable evidence that slow-moving animals inhabiting McKenzie Wetland such as turtles, frogs, aquatic mammals (e.g. muskrats) and fledgling waterfowl were susceptible to roadkill at certain times of the year. Of the greatest concern was the number of turtles that were being killed, a condition that had been reported by local residents for many years. Both Snapping Turtles and Painted Turtles are present and historically, the female turtles laid their eggs around the Wetland, as well as in nests excavated from the soft gravel that lined both shoulders of St. John's Sideroad.

Not surprising, this made adult females particularly susceptible to roadkill, as they crossed the road to lay eggs in the Spring. Turtles were again at risk during September and October, when the young hatched and the adults returned to favoured winter hibernation locations in the marsh. Frogs and toads often crossed the road in large numbers on warm wet nights in Spring and again in Fall. Ducks and geese that nest near the wetland would traverse the road when moving their broods from one side to the other which could also result in significant roadkill.

In order to reduce the incidence of roadkill, which was an almost daily occurrence during the non-winter months, the design team recognized the need to eliminate the ability for wildlife to gain access to the surface of the road. This could be achieved in two ways: by eliminating the habitat adjacent to the road or by maintaining (and in some locations even enhancing) the habitat but preventing access to the road surface. Accordingly, the decision was made to design the road cross-section through the wetland with vertical retaining walls on both sides in order to prevent animals that use crawling, hopping or walking as their means of locomotion from gaining access to the roadway.

This project provided for the protection of both wetland and upland habitats, while increasing the opportunity for the unobstructed movement of fish and wildlife through the variety of culverts placed under the road bed. These culverts provide and alternative means for animals to gain safe passage from one side of the road to the other while reducing the incidence of wildlife loss from roadkill. Three culverts (two wet and one dry) were incorporated into the design of the road through the marsh. The dry culvert, having a diameter of 1.2 m was installed with drift fencing at both ends and strategically situated on higher ground just east of the wetland (figure 4).

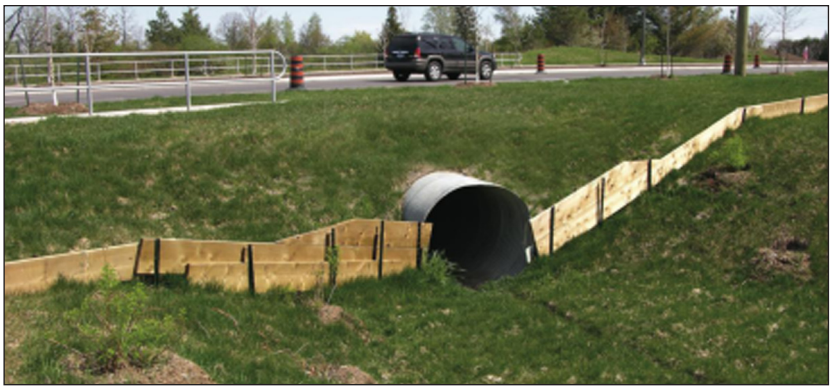

Figure 4. Dry culvert at McKenzie Wetland with drift fencing to direct wildlife movement.

The largest wet culvert is a 4 m-wide concrete box culvert, which replaced a 0.6 m diameter culvert that was too small and often plugged with sediment and debris. The larger culvert allowed fish and other wildlife to move back and forth from one side of the marsh to the other (figure 5). The new structure was deliberately oversized (i.e. it is considerably larger than required for hydrological purposes) so that it would facilitate improved fish and aquatic wildlife passage under the road. The design also included the installation of fish habitat friendly structures called 'root wads' which were placed in the open marsh to provide important cover for resident fish. Water quality improvements associated with the project also provided benefits to the fisheries resource.

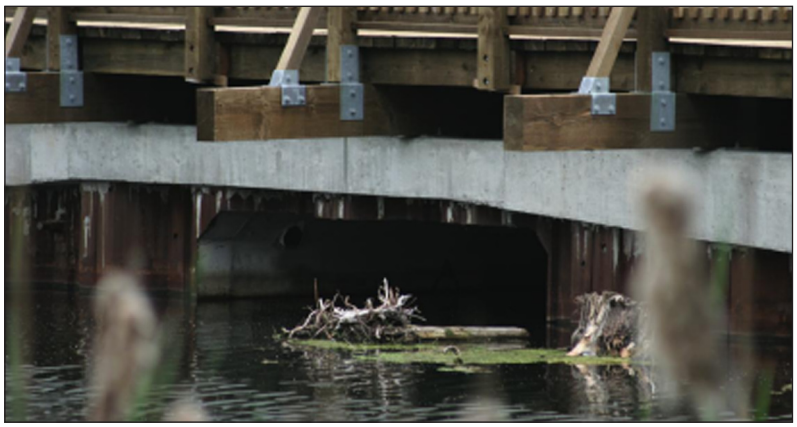

Figure 5. Wet culvert at McKenzie Wetland for fish, waterfowl, reptile and amphibian passage.

In addition, special consideration was also given to the design of several culverts that accommodate the flow from significant tributaries of the East Holland River under St. John's Sideroad to the east of the wetland. These culverts incorporated the installation of extensive aquatic habitat restoration and enhancement measures both upstream and downstream.

Water Quality and Quantity

Prior to its widening the existing surface of St. John's Sideroad was graded directly into the wetland and all road runoff was directed to the marsh with little opportunity for infiltration and no treatment. As a result, oil, grease and other contaminants that are commonly associated with roads entered directly into the wetland ecosystem. Prior to the improvements, the small diameter pipe culverts crossing the road were predominantly plugged, which prevented any circulation of water between the two water bodies.

Improvements to water quality and quantity were achieved through the installation of storm water management structures which included an integrated system of curbs and gutters, an oil grit separator and the use of infiltration swales (figure 6). Each of these storm water management components improves the quality of water before it enters the wetland. The system of culverts underneath the road not only improve wildlife and fish passage, but serve to re-connect the water flow from the north and south sides of the wetland and balance water levels. These improvements in water quality and connectivity are vital to sustaining a thriving wetland and its inhabitants.

Figure 6. Storm water outfall retrofit to promote infiltration.

Recreational Use

Wildlife viewing and walking in the non-winter months, and ice-skating in the winter have historically been the primary human activities associated with the McKenzie Wetland. The southern basin has been subjected to increasing human pressure from the adjacent residential development and Atkinson Park. The creation of a series of informal trails has resulted in trampling of the upland vegetation that fringes the wetland.

To accommodate these highly valued and traditional human uses of the area, while avoiding direct intrusion into the sensitive wetland ecosystem, a 3.6 m wide timber boardwalk has been constructed along the north side of the road through the wetland (figure 7). The boardwalk is used by both pedestrians and cyclists and has viewing outlooks that provide excellent vistas of the wetland. Interpretive signage mounted on pedestals has been placed in strategic locations along the length of the boardwalk to provide visitors with information about the features and functions of the wetland, its ecological significance, and how protection and enhancement of the McKenzie Marsh ecosystem has been incorporated into the design of the road. This boardwalk prevents human access to the wetland itself, provides a safe environment for walking and cycling away from vehicular traffic and has established a key east-west link in the Nokiida Trail System, linking it to the regional Holland River Trail System.

Decorative lighting has been installed to provide safe lighting levels along the boardwalk and incorporates special distribution to prevent light spillage into the wetland which could impact nocturnal wildlife.

Figure 7. Boardwalk, lighting and viewing platform at the McKenzie Wetland looking west.

Monitoring

Monitoring (prior to, during and post-construction) was an essential component of the environmental approvals process, with the following goals:

- To help ensure that public confidence in the process is maintained;
- To ensure that best management practices were implemented and enforced during construction;
- To direct post-construction changes that may need to be made to the project; and
- To provide information regarding the efficacy of mitigation so that lessons can be learned and wisely applied to future projects.

Pre-Construction Monitoring - Surveys to quantify the level of roadkills prior to construction of the road were carried out and those data are being compared to the results of post-construction surveys (which commenced in 2006) to measure the effectiveness of the design measures intended to prevent wildlife from gaining access to the roadway.

Construction Monitoring - To minimize the disturbance to the wetland and its inhabitants, construction of the four-lane road through the wetland commenced after July 1, effectively avoiding the sensitive fish spawning and bird nesting seasons.

Post-Construction Wildlife Monitoring - To complement the pre-construction field inventory and assessment, and further test the validity of the wildlife mitigation and enhancement aspects of the project, post construction wildlife monitoring was implemented. The following suite of field investigations were undertaken in 2006:

- Amphibian calling counts
- Breeding bird surveys
- Road kill surveys
- Wildlife passage at the dry culvert

The results of these surveys were compared to pre-construction data and will be compared with results of monitoring studies which will be repeated in 2007.

Amphibian calling counts

Monitoring was conducted using the Provincial Marsh Monitoring Program protocol. This targeted an early (mid April) and late (late May) survey by walking transects at dusk and recording calls of male amphibians. The survey recorded Gray Treefrogs (*Hyla versicolor*) and numerous Green Frogs (*Rana clamitans*). Unfortunately, the early monitoring did not occur in 2006. It is anticipated that species recorded in pre-construction assessments including Leopard Frogs (*Rana pipiens*) and American Toads (*Bufo americanus*) will be recorded in 2007.

Breeding bird surveys

Breeding bird surveys included walking through the wetland and also recording territiorial responses to pre-recorded calls played in the field. These survey consisted of two days of field work in June (early and late). The survey results indicate that the marsh continues to support a relatively low species richness, with most species recorded being habitat generalists and highly resilient species. These generalists include Red-winged Blackbirds, Song Sparrows, Yellow Warblers, Warbling Vireos and waterfowl such as the Canada goose and Mallard ducks.

Pre-construction inventory includes a variety of information from observations dating back to the 1970's, and including works done in the 1990's. Two factors have likely contributed to the general decline in the presence of more sensitive species including Pied-billed Grebes, the American Coot, Wood duck, Sora etc.. These factors include the overall increase in disturbance associated with urbanization in the area. Increased urbanization has resulted in higher direct and indirect stresses on the marsh and its community, associated with increased predation (pets and urban wildlife e.g. racoons) and higher public activity and traffic in the area. The second factor relates to water level management. The current water level management has maintained a large area of open water marsh. This limits the amount of emergent, wet meadow and upland habitat areas. This influence on habitat diversity may affect the variety of nesting and brooding habitat available to a wider variety of species. In subsequent years water level management may be regulated to help enhance certain habitat values associated with more sensitive species use of the marsh.

Road kill surveys

One of the major ecological concerns raised by the public during the consultation phase of the project was road kill of reptiles and amphibians. Pre-construction roadkill surveys were conducted in 2002 and 2003. In 2006 16 post construction field visits were made between May and October. Road killed species recorded in pre-construction monitoring included the Common Snapping Turtle (*Chelydra serpentine*) and Midland Painted Turtles (*Chrysemys picta*). Both adults, when searching for nesting sites in the Spring and migrating in the Fall, and young turtles emerging from nests in the Spring and early summer. Mortality of turtles declined from 20 (over 2 years) pre-construction to one specimen recovered in 2006.

The frequency of amphibian mortality was also significantly reduced following the project. Muskrat (*Ondatra zibethicus*) mortality declined from 13 pre-construction to zero recorded in 2006. Overall the reduction in the occurrence of road kill of all wildlife through the wetland area was significantly reduced.

Wildlife passage at the dry culvert

The project included the installation of a 1.2 m CSP culvert in a terrestrial location. The culvert was installed with permanent drift fencing at both ends. It was noted that the drift fencing was not functioning at 100% efficiency due to a gap in the fencing at the culvert interface. This situation was corrected following the 2006 survey. A Digital Game Camera (Model IR-3BU) was obtained from Leaf River Outdoor Products. The camera works with an infra-red sensor and motion detector, and set up to take pictures day or night and store them on a Compact Flash Card (512MB). At night an infra-red flash, invisible to animals, is used to illuminate the image while not disturbing the animals. The camera was in place from August 11th until October 10th, 2006 (60 days).

Figure 8. Rabbit at north entrance to dry culvert.

Images captured of animals using the culvert included primarily racoons (10 records), Eastern Cottontail rabbits (3 records), and a singled record of a Red fox. Animals recorded at the entrance to the culvert included groundhogs, Eastern Gray squirrels, domestic cats, American Robin and one inquisitive young boy who appeared to be inspecting the culvert.

Certainly the dry culvert is working for wildlife passage as indicated by a well worn trail leading to and from the culvert.. In 2007 it is hoped to deploy the camera earlier in the Spring to hopefully capture reptile and amphibian migration. In addition, it is suggested that vegetation be planted and or woody debris be placed along the drift fence at the culvert to provide cover for moving wildlife and deter predation.

Summary of Environmental Impacts

Table 1: Summary of environmental impacts, mitigation and net effects.

ISSUES	MITIGATION	NET EFFECTS
WETLAND AREA AND FUNCTION	road designed to minimize encroachment	- loss of 0.2 ha (0.5 acres) of wetland (2% of total area)
	plantings around south wetland	+ provide additional habitat for wildlife (nesting birds)
	manage water levels	+ more "natural" hydrologic cycles + increased wetland productivity
FISH HABITAT	road designed to minimize encroachment	- minor loss of 0.03 ha (0.1 acres) of open water
	oversized culvert	+ replaced habitat under road
	manage water levels in wetland	+ more wetland vegetation, more productive fish habitat
WILDLIFE	vertical retaining wall	+ reduced roadkills
	wet and dry culverts	+ improved wildlife movement
	alternative turtle nesting habitat	+ no turtle nesting habitat at roadside
SURFACE WATER RUNOFF	removal of gravel shoulders	+ reduction in direct discharge of road debris and contaminants
	urban road design (curb and gutter, catchbasins, oil grit separator and grassed swales)	+ water to be treated in oil grit separator and grassed swales
	retrofit of storm water pond to south	+ reduced sediment loading + overall improvement in water quality
HUMAN USE	boardwalk and trail (part of Nokiida Trail)	+ reduces uncontrolled access
	focus pedestrian access with plantings, controlled observation points	+ provides passive recreational opportunities
CONSTRUCTION AND POST-CONSTRUCTION MONITORING	minimum 2 year monitoring program	+ test impact predictions, identify corrective measures + contribute to understanding of road/wetland dynamics

+ = positive net effect - = negative net effect

Effective Community Relations

Context sensitive design and effective constructive engagement with stakeholders is vital to any successful project but is especially important when a project description includes a provincially significant wetland, high animal mortality rates, a substandard road, unsafe pedestrian conditions, development pressures for widening roadways and a community demanding active involvement. With this view, York Region undertook the project with a Context Sensitive Solution (CSS) approach as a guiding principle to build a functional infrastructure facility that fits with the adjacent social and environmental surroundings.

CSS is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist. CSS principles include the employment of early, continuous and meaningful involvement of the public and all stakeholders throughout the project development process.

Public Consultation

There was a conscious decision by York Region on this project to do more than just the minimum level of public consultation. In addition to the two mandatory Public Consultation Centres (PCCs) required for Class Environmental Assessment (EA) studies, three additional PCCs were held during the EA study for this project. The PCCs were facilitated by an independent facilitator in order to present the project to the public and solicit feedback. Two more PCCs were held during detailed design. These were not a compulsory public contact requirement, but it was advantageous to obtain the public's comments. Once the preliminary design for the McKenzie Wetland area was completed. A pre-construction public consultation centre was also not compulsory but was arranged after the construction contract was awarded, so that the project could be presented to the public one last time, with specific emphasis on the construction schedule and phasing, anticipated environmental issues and proposed mitigation measures, and the upcoming temporary road closure. The owner, consultant and contractor all participated in the PCC.

Meetings with Individual Stakeholders

The project team was aware of concerns of some members of the public, so proactive one-on-one consultation was arranged throughout the project, utilizing on-site meetings with politicians and local ratepayer groups. During one meeting, the proposed footprint was actually staked-out in the field so that the stakeholders could visualize the extent of the widening into the wetland. Kitchen-table forums were also useful in resolving those concerns in advance of the public meetings. In this way the public consultation centres were not 'bogged down' by the concerns of a few, and resulted in meetings being successfully managed and objectives met.

Through the constructive engagement approach, York Region was able to change public opinion from resistance to one of acceptance, praise and community pride at the outcome.

Graphical Renderings

Sometimes it is difficult for members of the community to visualize how the end result of the project might appear and this can lead to unintentional misconceptions by the public. Therefore photo imagery using computer generated renderings was useful in presenting how the proposed work would appear before construction occurred. Figure 9 presents a rendering that was created for the public consultation centres to present the project. The renderings were very useful in easing the concerns of the public towards this project. Also, design input by the community resulted in the project team modifying the cladding/facing of the sheet pile wall with wood planks instead of steel. This was done on the south side of the road that faces the adjacent residential development. Figure 10 is a post construction photograph, demonstrating the accuracy of the computer rendering.

Figure 9. Computer rendering of the proposed road improvements through the McKenzie Wetland.

Figure 10. Photograph looking northwards across the McKenzie Wetland to St. John's Sideroad.

Consultation with Town of Aurora

The Town of Aurora was a significant stakeholder for this project, since the project was located within the Town. The landscaping and streetscaping improvements would not have been done without a funding partnership with the Town. The Town contributed to the construction of the watermain, timber boardwalk, sidewalks, bike paths and streetlighting. Several meetings were arranged with the Town staff to obtain their input into the design alternatives and agreement to the final design. York Region used innovative ideas such as design workshops where questions such as "Imagine if money was no object, what would you like to see built?" were posed in order to 'brainstorm' solutions. This helped develop ideas that normally may not have been considered if funding was the only factor. The project team considered cost only after all ideas had been developed. Through those meetings, agreement was reached on various components of the project and the designs were developed in order to present to Town Council for approval. Examples include the selection of timber materials for the handrails and the idea to incorporate a cedar veneer to the face of the south sheet-pile wall to enhance the look when viewed from the residential development on the south side of the McKenzie Wetland area.

Consultation with Department of Fisheries and Oceans, Ministry of Natural Resources and Conservation Authority

Extensive consultation was undertaken with the federal Department of Fisheries and Oceans (DFO) and provincial Ministry of Natural Resources (MNR) throughout the project. Several meetings were also instrumental in creating open dialogue and achieving approval from the Lake Simcoe Region Conservation Authority (LSRCA). Early in the design, a site meeting was arranged to present the design concept, summarize the environmental issues, and obtain their initial agency comments. LSRCA's agreement in principle to the proposed design was obtained during this initial meeting, and laid out the foundation for the subsequent development of the road design.

Design Charette Workshop

In keeping with the Context Sensitive Solution approach, towards the end of the design phase there was discussion as to how a good project could be made even better. A design charette workshop was arranged that included the Town of Aurora, the project team and a landscape architect, where ideas that would enhance the design further at the McKenzie Wetland area could be brain-stormed. Out of that session came an agreement to contribute the additional funding necessary to improve the project further with the following features:

- Various renderings were produced to enable staff and the public to visualize the project goals and as an aid to help present it to council for approval.
- Eliminate guiderail on each side of the road and replace with armour-stone planter walls and metal bollards.
- Extensive plantings, which consisted of trees, shrubs and ground cover with irrigation system.
- Revise the boardwalk layout so that it is meandering, with lookout features for the enjoyment of the public.
- Use of decorative street furniture such as benches, metal bollards, trash receptacles, signage and special pavements such as impressed concrete.
- Incorporate ornamental lighting rather than traditional roadway lighting.

Ongoing Commitment to Education

York Region has an ongoing commitment to educate the public on how the region is managing and directing growth, transforming urban landscapes and protecting-/enhancing the natural environment and heritage features. Education is imparted through mobile workshops or guided tours and presentations at conferences such as the 2006 APWA Congress and Exposition in Kansas City, Kansas.City, Kansas.

Challenges and Technical Accomplishments

The St. John's Sideroad project presented various technical, environmental and financial challenges that had to be effectively managed for this project to achieve success. These challenges include unusual subsurface conditions and their effect on the retaining wall design, environmental constraints and opportunities, impacts to utilities and their relocation, project financing, and most importantly, how the project could be implemented to the satisfaction of the public and other stakeholders.

In the McKenzie wetland area, these challenges had to be implemented within a very limited area bounded by water on each side of the existing narrow road platform.

Soil Consolidation and Settlement Monitoring Prior to Permanent Works

Geotechnical investigations determined the presence of a deep underlying zone of sensitive silty clays and clayey silt materials. Under the existing road platform, this material was already pre-consolidated, but additional settlement was expected due to the raising of the road profile by 2.5m. For the proposed road widening, the amount of settlement under the proposed fills would be greater than under the existing road platform, since it had not been pre-consolidated. On this basis, the project team recommended that temporary asphalt be placed and that the settlement be monitored over a period of time before construction of the permanent works. Regular measurements were taken during construc-

tion to record the rate of settlement and establish when the majority of consolidation of the sensitive clay materials would be completed.

Wetland Constraints and Mitigation

The proposed design recommended vertical retaining walls at the McKenzie wetland in order to reduce the roadway footprint and prevent wildlife from accessing the roadway.

Sheet-pile retaining walls were selected over other retaining wall systems such as gravity or cantilever retaining walls for several reasons. First, due to the consolidation of the sensitive material underlying the road platform, it was necessary to select the lightest structure possible. Second, sheet-pile walls could be driven by equipment positioned on the existing road platform, and therefore disturbance to the wetland by equipment or by workers was avoided. Third, once the sheet-pile walls were driven, they immediately formed a barrier between the construction work zone and the wetland environment for the remainder of the project.

Subsurface Excavation 'In the Wet'

Within the wetland area itself, a surficial zone of peat material was sub-excavated after the pile-driving operation and replaced with clear stone backfill material wrapped in geotextile filter material. This excavation 'in the wet' avoided pumping large volumes of water out from behind the retaining wall, and eventually back into the wetland.

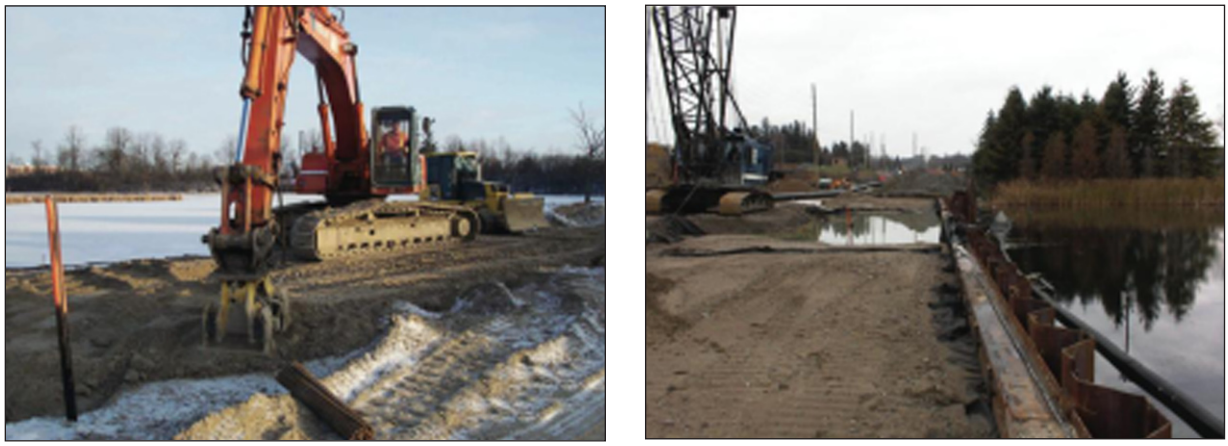

Figure 11. Road platform and the sheet-pile retaining wall under construction.

Utility Relocations

The project team expected the increase of road profile over the poor subsurface conditions to cause additional consolidation and corresponding significant settlement problems which could cause damage to existing and newly placed utilities and services.

Sanitary Trunk Sewer

An existing 1050 mm diameter sanitary trunk sewer was replaced with concrete pressure pipe having extra deep joints that could tolerate the anticipated joint movement as the pipe settled during the consolidation of the underlying materials. The replacement and the construction of connection chambers around the existing sewer at each end were carefully staged to avoid interruption of sewer flows.

Watermain

A new 500 mm diameter watermain was proposed within the McKenzie Wetland area, and it was also important that the watermain have the flexibility to tolerate the anticipated consolidation of the underlying material. High-density polyethylene pipe (HDPE) was selected, since it can be butt-fused together to eliminate joints. The watermain was also installed successfully by horizontal direction drilling (HDD) to avoid impacting the wetland.

Gas Main Relocation

A 300 mm diameter gas main on the north side of the road was in conflict with the proposed retaining wall. It was also considered that the vibrations caused by pile driving may also endanger the gas main at its original location. Therefore, prior to construction, the gas main was relocated further north - under the bed of the wetland using directional boring to avoid impacts to the wetland itself. During the construction of St. John's Sideroad, survey crews monitored vibrations on the gas main and took settlement readings throughout the pile-driving activities to ensure that the gas main was protected.

Hydro Pole and Bell Canada Relocations

Although Hydro power and Bell telephone relocations were arranged in advance of construction in most areas within the contract limits, it was not possible to do so at the McKenzie Wetland area, due to the future road fills and open water beyond the existing shoulders. This required that the relocations be included within the overall construction staging. To resolve this issue, the retaining walls on the south side were constructed, but not immediately backfilled to the design elevations. The construction contract was structured to accommodate a six week construction hiatus in order to allow Aurora Hydro to install poles. The poles had unique foundation details, designed to be temporarily supported within the existing peat material, and extra-deep embedment to account for the placement of future road fills. Once the overhead lines were transferred to the new poles on the south side, the poles on the north side were removed to permit pile driving for the north retaining wall. Bell relocations were scheduled during the settlement monitoring period, after the walls were backfilled to design grades.

Financial Considerations

Securing funding for infrastructure to support our growing communities is achieved annually through Council approval. This funding process for key infrastructure is not unusual in other municipalities. What is unusual and sometimes difficult, however, is securing funding for those little extras that often times are deemed not necessary, or too expensive in light of fiscal constraints that many public agencies face. However, these little extras very often transform routine projects into "WOW" projects. York Region was able to work cooperatively with the Town of Aurora staff and council to secure funding for several project features that could easily be considered as not required or extra to the project. Through the context sensitive solution approach, a number of features were added to the original scope of the project to make it better. These features included the meandering timber boardwalk/bicycle path, timber railings, interpretive signs, decorative lighting, landscaping and street furniture (metal bollards, flags, trash receptacles and benches).

Public Resistance - Transformed to Acceptance

This project initially received much public resistance over concerns that the road improvements would have a detrimental impact to the McKenzie Wetland. However, through the Context Sensitive Solution approach and sound construction management, York Region was able to change public opinion from resistance to that of acceptance, praise and pride for the community (figure 12).

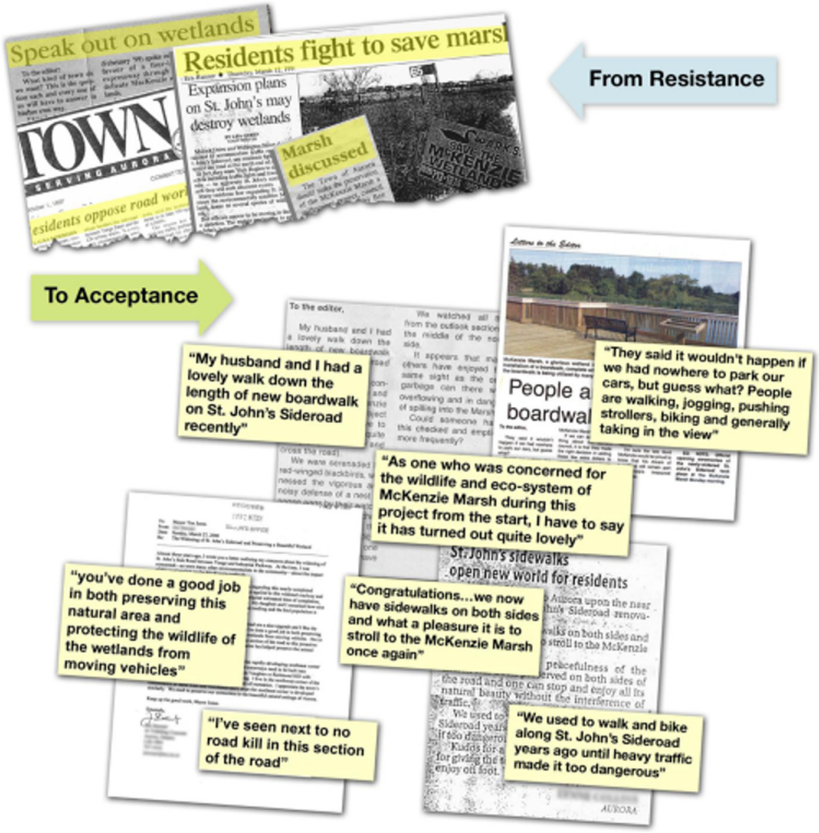

Figure 12. Articles taken from local newspapers, demonstrating a shift in public opinion.

Conclusion

The St. John's Sideroad/McKenzie Wetland Project is characterized as being unique and not typical of most road construction projects. This project implemented a wide variety of different environmental mitigation and restoration techniques, and utilized a combination of different construction specialties.

The $20 million project completed in June 2006, included a variety of environmental restoration and enhancement techniques concurrent with roadworks, sewers, watermain, streetlighting and traffic signals, with the construction of sheet-pile retaining walls, horizontal directional drilling, tunneling, railway crossing improvements, timber boardwalks, bicycle trails, and landscaping.

In particular, the McKenzie Wetland posed several operational constraints that required the design improvements to be carefully planned to address the complex construction staging requirements and to achieve the project's interim and final completion dates. Up-front planning and preparation of detailed construction schedules during design was vital to properly coordinate the critical activities that had to be completed within the available road closure time window. The construction of this project was completed on time, on budget and with no accidents or time lost through work related injuries.

York Region was able to overcome initial resistance to the project from a concerned community through a context sensitive solutions approach and constructive engagement. This project was an opportunity for the design team, in consultation with stakeholders, to include environmental enhancements which recognized the unique setting of the McKenzie Wetland, and to make this project much more than a typical road widening project. As a result of this project, York Region was able to not only protect the sensitive natural environment but enhance it by designing and constructing the infrastructure to address natural environment and social concerns. Overall the road widening and habitat enhancement have served to create an area where local residents and wildlife can safely co-exist side by side (figure 13).

York Region received the Ontario Public Works Association's Project of the Year Award for this project in 2006, and was honoured to present a paper at the 2006 APWA Congress and Exposition in Kansas City, Kansas.

Figure 13. Before and after pictures of the St. John's McKenzie Wetland project.