

**CHALLENGES, OPPORTUNITIES AND ACHIEVEMENTS -
THE ST. JOHN'S SIDEROAD / MCKENZIE WETLAND PROJECT**

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ABSTRACT

Background of the Issues Addressed

Within a section of St. John's Sideroad, between Yonge Street and Bayview Avenue in the Town of Aurora, is the McKenzie Wetland Complex, an important environmental feature to the local community and a provincially-significant area. This road is under the jurisdiction of the Regional Municipality of York. As a result of highly-active community development in this area, the Class Environmental Assessment recommended this road be widened to a four-lane urban cross-section with profile improvements to satisfy design standards.

Construction within the wetland presented unique design challenges. In keeping with the conference theme, Transportation Without Boundaries, this project successfully overcame two significant limitations: First, it addressed the environmental constraints with unique solutions. Second, it overcame significant financial challenges through successful funding partnerships.

Objectives of the Project

The challenge was how these road improvements could be constructed while considering the following constraints:

- Minimize displacement of fish and terrestrial habitat due to wetland loss,
- Potential settlements to pavements, watermain and utilities due to poor subsurface soil conditions, and
- Utility relocation that could only be performed during construction and within tight schedule constraints.

The project also applied principles of "context-sensitive design", which recognized and developed upon the unique environmental features of the McKenzie Wetland Complex within an urban setting. These included:

- Improving the ecological sustainability of the wetland,
- Reducing high animal mortality due to road kill,
- Adding aesthetic enhancements to minimize impact of the road widening, and
- Promoting recreational enjoyment of the wetland's natural setting.

The cost of constructing these unique features through the wetland complex would increase the cost of the project, but would achieve a higher level of public satisfaction. This project therefore relied on partnerships with other stakeholders to fund the project.

Methodology

Workshops were held with the Town of Aurora, including its councillors, public works and parks staff to consider innovative ideas, or "thinking outside of the box", to make a good project better. This includes a meandering timber boardwalk elevated above the wetland for pedestrian enjoyment, which is linked to a bicycle trail network. Unique landscaping features are added to compliment the wetland's natural setting. Decorative lighting illuminate the roadway and boardwalk, without negatively impacting nocturnal wildlife.

The project constraints and design opportunities would make this project unique from a typical road improvement project. It was successfully completed through cooperative partnerships with the Town of Aurora. The result is a project that was constructed without complications and one that will be a source of pride for the public for years to come.

Conclusions

The St. John's Sideroad project successfully overcame significant environmental, technical and funding issues. This and other unique project features will be described further in this paper and through an in-depth visual presentation that includes concept renderings of the proposed design improvements before being constructed, and photographs during and after construction. It will provide an interesting comparison of how the completed work closely matched the concept renderings that were prepared during the design.

PROJECT OVERVIEW

The Regional Municipality of York is located north of the City of Toronto, and includes nine local municipalities, with a population of over 920,000. St. John's Sideroad, a Regional road, is located in the Town of Aurora and lies within the watershed of the East Holland River, under the management of the Lake Simcoe Region Conservation Authority. This unique project involves the widening and reconstruction of a two-kilometre section of St. John's Sideroad between Yonge Street and Bayview Avenue.

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

The project's unique features include:

- Improvements to the McKenzie Wetland Complex including sheet-pile retaining walls, timber boardwalk, unique landscaping and decorative lighting, wet culverts and dry culverts for wildlife passage.
- Bike paths throughout the length of the project, which linked the Town's existing bicycle trail network to the McKenzie Wetland Complex and its boardwalk.
- Railway safety improvements that included new gates and signals at an existing 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 project presented several challenges that provided an opportunity to develop unique designs that not only addressed the technical aspects of the project, but also complimented the surroundings by being sensitive to construction impacts, as well as the future enjoyment of the environment, long after construction is completed.

CONTEXT SENSITIVE DESIGN AT THE MCKENZIE WETLAND COMPLEX

St. John's Sideroad existed long before the wetland was created. In 1973, Environment Canada, as part of a habitat improvement program, created the wetland that is known as the McKenzie Wetland Complex. This was to fulfill the vision of Mr. Gordon McKenzie, to create a sustainable wetland on his property for fish and wildlife, and the overall enjoyment of the community. The McKenzie family continues to live on this property to this day. The McKenzie Wetland Complex is a 10-hectare area that has been designated as a provincially significant wetland by the Ministry of Natural Resources. It is recognized as a significant ecological feature, due to its wildlife habitat and aesthetic value to the community. Photo 1, depicts the limits of the overall project, including the location of the McKenzie Wetland Complex.



Photo 1 Project Limits, including McKenzie Wetland Complex.

Throughout the Class EA process, design, and construction, the potential effects of the road widening on the McKenzie Wetland Complex remained a key concern to the Town of Aurora, the Ministry of Natural Resources, the local conservation authority and the local residents. With this in mind, 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, design recommendations were made for minimizing the loss of wetland, reducing loss of wildlife, managing stormwater runoff quality, and accommodating a pedestrian boardwalk within the right-of-way that is linked to an overall bicycle trail system in the Town.

The road bisected the McKenzie Wetland Complex and its original profile was not more than a half metre above the water level on either side. The road profile did not meet road design standards and therefore had to be raised up to 2.5 metres above the original profile to meet those standards. Photo 2A depicts the original road section with the McKenzie Wetland Complex on either side. Photo 2B presents the improvements following construction.



Photo 2A: Available road platform at the McKenzie Wetland Complex prior to construction



Photo 2B: Road improvements through the McKenzie Wetland following construction

Retaining Walls to Reduce Wetland Loss

Various types of retaining walls - rather than embankment fills - were evaluated to raise the road platform on the basis of constructability and environmental impact during construction. The sheet-pile alternative could be performed with the equipment and personnel working from the existing road platform without entering the wetland. Once the sheet-piles were driven, the work area was immediately separated from the wetland area to avoid the wetland being disturbed by construction activities.

The sheet-pile retaining wall reduced the footprint of the road and thereby reduced the loss of wetland and fish habitat, for a distance of 300 metres through the wetland. This resulted in a loss of wetland of only 0.22 hectares, or just over 2% of the total area of the McKenzie Wetland Complex. Without using retaining walls, the wetland loss would have been much more significant.

Wildlife Loss

The McKenzie Wetland Complex also provides habitat for turtles, frogs, small mammals and waterfowl, which are particularly susceptible to roadkill. Both Snapping Turtles and Painted Turtles are present and historically, the female turtles laid their eggs in nests dug into the soft gravel shoulders of St. John's Sideroad. This also made the turtles particularly susceptible to roadkill, as they crossed the road in spring and again during September and October, when hatching or returning to their winter hibernation locations.



Photo 3: Wildlife in the wetland

Frogs and toads cross the road on warm wet nights in spring and again in fall. Ducks and geese that nest in the wetland also cross the road when moving their broods to seek feeding opportunities.

The sheet-pile retaining walls reduced the incidence of roadkill, by preventing the animals from actually gaining access to the road surface itself. Although the removal of the soft gravel road



Photo 4: Dry culvert – providing a road crossing for wildlife

shoulders eliminated the turtle nesting sites, alternative nesting areas north of the road were identified.

To facilitate the passage of fish and wildlife under the newly widened and raised road platform, three culverts – two wet and one dry - were included in the design. The wet culverts comprised of a 4-metre wide concrete box culvert and a 1.2 metre diameter corrugated steel pipe culvert that provided crossings for fish and waterfowl. A 1.2 metre diameter dry culvert, as shown in Photo 4, was also strategically constructed on higher ground beyond the wetland to provide crossings for wildlife, particularly turtles, frogs and small mammals. Drift fencing

was used to redirect the wildlife from crossing up the road embankment and guided them towards the dry culvert crossing.

These innovative methods were positively received by the Lake Simcoe Region Conservation Authority and were a key consideration in obtaining the necessary permits on time for construction.

Water Quality

Prior to its widening, the existing surface of St. John's Sideroad drained directly into the wetland with no opportunity for infiltration or treatment. Oil, grease and other contaminants that are commonly associated with road run-off were directly entering the wetland ecosystem without being treated.

Post-development water quality control was achieved using curb and gutters to contain the run-off and direct it to oil-grit separators. To maximize infiltration, nutrient uptake and sediment control, the runoff is conveyed from the storm sewer outfall into the wetland via grassed swales.

Water quality was also enhanced due to improved connectivity of the wetland on either side of the road. 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.

The 4-metre concrete box culvert and 1.2 metre diameter CSP culverts also improved the water circulation of the wetland by enhancing the connectivity and balancing the water levels on each side of the road.

Meandering Timber Boardwalk and Bicycle Trail Connections

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 Complex. The southern basin has been subjected to increasing pressure due to accessibility from the Town of Aurora's Atkinson Park and from adjacent residential development. 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-metre wide timber boardwalk was constructed to provide an elevated viewpoint along the north side of the road over the wetland environment.



Photos 5 and 6: Viewing platform and boardwalk at the McKenzie Wetland Complex.

The boardwalk is used by pedestrians as well as cyclists and has lookouts that provide excellent views of the wetland. The boardwalk is meandered so that its distinctive curves will promote interest, and relaxation for the public. Since the boardwalk is elevated, it prevents human access into the wetland itself, and provides a safe environment for walking and cycling that is separated from vehicular traffic, and establishes a key east-west link in the Town's walking and bicycle trail system through the East Holland River valley.

Unique Landscaping and Streetlighting

To further enhance the unique setting of the McKenzie Wetland Complex, special landscaping features are incorporated into the design, including irrigated planting beds consisting of armourstone walls, shrubs and plantings. A combination of these planting beds and bollards separate the boardwalk feature from the busy roadway. Streetscape furniture such as park benches allows the public to rest and enjoy the natural wetland environment from the look-outs provided on the boardwalk.

Interpretive signage mounted on pedestals is placed in strategic locations provided visitors with information about the unique features and functions of the wetland, its ecological significance, and how protection and enhancement of the McKenzie Wetland ecosystem has been incorporated in the design of the road.

Decorative lighting provides safe lighting levels to the boardwalk, and incorporates special distribution to prevent light spillage into the wetland itself and impacting nocturnal wildlife.

PROJECT CHALLENGES

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, 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.

Within the area of the McKenzie Wetland Complex, these challenges had to be implemented within a very limited area bound by water on each side of the existing narrow road platform. Photo 7 portrays the extensive construction activities that had taken place at the McKenzie Wetland Complex. Figure 1 depicts the typical cross-section of the roadway improvements within the wetland area.



Photo 7: Construction activities at McKenzie Wetland.

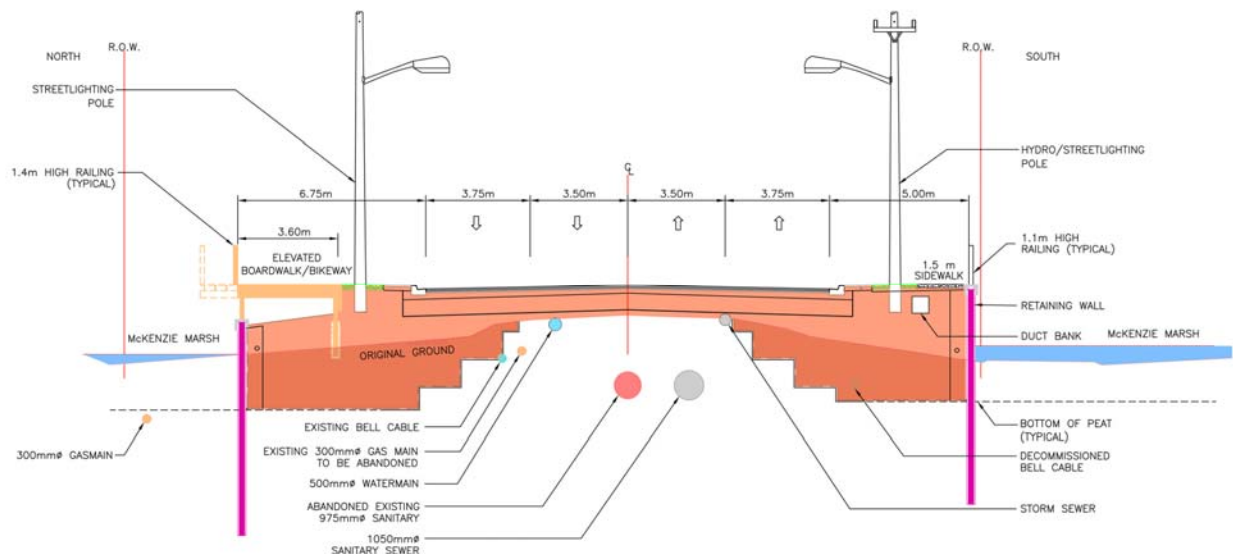
Subsurface Conditions

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, to avoid having to obtain a permit for pumping water.

The geotechnical investigations had also determined that a zone of sensitive silty clays and clayey silt materials were present at approximately eight metres below existing ground. Under the existing road platform, this zone of sensitive

material had already been consolidated, but additional settlement would be expected due to the raised road profile. Settlement would even be more significant in the areas of the road widening since that material had not pre-consolidated, and it was anticipated it could be up to 200 mm. The depth of the material made it impractical to sub-excavate.

Figure 1: Typical cross-section of St. John's Sideroad at McKenzie Wetland.



Due to anticipated settlements, and to prevent a long road closure, temporary asphalt would be placed and the soil settlement due to consolidation of the sensitive underlying material would be monitored over a nine-month period. Once the consecutive monitoring had determined that the

majority of settlement had occurred, the permanent works would be constructed, which included final asphalt, curbs, boardwalk and landscaping.



Photo 8: Pile driving in the McKenzie Wetland in the background. Sub-excavation and the placing of granular backfill in the foreground. Note the condition of the wetland adjacent to the work area.

Environmental Constraints

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, as shown in Photo 8.

Utilities

The difficult subsurface conditions were expected to cause significant settlement and therefore damage existing and newly placed utilities and services.

Gas Main - A 300 mm diameter gas main on the north side of St. John's Sideroad posed a potential conflict with the alignment of the proposed retaining wall, and it was anticipated that the vibrations resulting from the pile-driving operations could also endanger the gas main at its original location. Additional damage due to the anticipated settlement might also occur. As a result, the gas main was relocated prior to construction, and vibration and settlement readings were recorded on the gas main to ensure the gas main was protected during pile-driving and during the settlement monitoring period.

Sanitary Trunk Sewer – A large diameter concrete pipe sanitary trunk sewer is located under the existing pavement within the McKenzie Wetland Complex. It was expected that the additional settlement due to the increase in road profile would cause the pipe joints to open. To address this, the sanitary sewer was replaced with a 1050 mm diameter concrete pressure pipe having extra deep joints that could tolerate the anticipated joint movement as the pipe settled during the consolidation of the underlying soil. The replacement and construction of the connection chambers (Photo 9) around the existing sewer at each end were carefully staged to avoid sewer flows being interrupted.



Photo 9: Construction of a sanitary sewer chamber around the existing sewer to complete the connections

Watermain – The Town required a new 500 mm diameter watermain be constructed on St. John's Sideroad under the McKenzie Wetland Complex. It was important that the watermain have the flexibility to tolerate the anticipated consolidation that would commence when the additional fills were placed. High density polyethylene pipe was selected to address this issue, since it would be butt-fused together to eliminate all joints under the wetland. The watermain was also installed successfully by horizontal directional drilling to avoid any disturbance to the wetland, as shown in Photo 10.



Photo 10: Installation of watermain under the road platform within the wetland using horizontal directional drilling.

Hydro Pole Relocations – Although Hydro and Bell relocations were arranged in advance of construction in most areas within the construction limits, it was not possible to do so at the McKenzie Wetland Complex due to the future road fills and open water meeting the existing shoulders. This required that the relocations be included within the overall construction staging when the road was closed to the public. The retaining walls on the south side would first be constructed, but not yet backfilled to the design elevations. This was followed by a six-week interruption in construction to allow new poles to be installed on the south side with 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 (Photo 11). Once the overhead lines were transferred from the existing poles on the north side to the new poles on the south side, the poles on the north side were removed to permit pile-driving for the retaining wall.



Photo 11: Temporary support of new hydro pole

Financial Considerations

Securing funding for infrastructure to support our growing communities is achieved by an annual approval process by both Regional and Town of Aurora Councils. York Region's annual budget and business plan not only secures funding for the first year, but also provides a two-year outlook on expenditures. More importantly, Regional Council has approved ten-year capital construction programs for roads, water and wastewater projects. This allows staff to have a clear understanding of the upcoming projects and plan accordingly.

York Region's approved 2006 Roads Capital Budget is \$150 Million, with Water and Wastewater accounting for an additional \$250 Million. The value of the St. John's Sideroad contract as tendered was \$19.3 Million. The source of funding for our road construction projects is a combination of tax levy (approximately 24%) and development charges (approximately 76%).

This funding process for key infrastructure is not unusual in other municipalities. What is more unusual and sometimes difficult, 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.

We were able to work cooperatively with the Town of Aurora staff to secure funding for several project features that could easily be considered as not required or extra to the project.

As part of the context sensitive design, a number of features were added to the original scope of the project to make it better. These features included the meandering timber boardwalk / bikepath, timber railings, educational plaques, decorative lighting, upgraded benches and garbage containers.

The approach to securing the funding for the additional work recognized the needed participation of key individuals and organizations from the beginning of the project. On this project, the Town of Aurora was a critical stakeholder since they have the jurisdictional responsibility for sidewalks and lighting on Regional roads. We organized a workshop session, what we called a “design charrette”, to explore opportunities for adding enhanced features to the McKenzie Wetland Complex. Although we developed a functional design that had approved funding and met our minimum obligations, we recognized the importance of doing more. This design charrette was the first critical step in pushing the boundaries of possibilities.

The purpose of the design charrette was to present the existing design to the stakeholders and work together towards developing a better option. We believed it was critical to obtain the participation of decision-makers, since they would have to defend their recommendation for additional funding to their Council. Therefore, we invited senior staff from the Town of Aurora including the Chief Administrative Officer, Directors of both the Public Works and Parks and Recreation departments, as well as specialized landscape design consultants.

Proper up-front planning was essential so our design charrette could focus on the anticipated key issues. For instance, we expected funding would be a huge issue with the participants, but we asked that the funding issue be put aside for the time being to allow the team to develop several design enhancements as if money was no object. This allowed the team to explore the possibilities of what the road improvements could look like if money wasn't the only consideration.

The use of a rendering which showed guiderails and concrete walkways were very effective in achieving a common understanding of what would not be acceptable for this project. It was only then that we were able to direct the participants towards developing various features that were believed necessary to make this a special project. We came prepared to present ideas on what features could be added, however the real value was how the participants came up with most of the enhanced features themselves. Once the team had developed a list of enhancements that should be considered further, we committed to preparing cost estimates to these enhancements and prepare additional renderings that visually showed how the improvements might appear.

At a follow-up meeting, the renderings and the associated cost estimates were presented and the team selected the option that they believed balanced the vision for the McKenzie Wetland Complex while recognizing the financial constraints. Both the Town and Regional staff then used the renderings to recommend and obtain approval from their respective Councils for the additional funds to incorporate these context sensitive design features. It is through these features, in our opinion, that have transformed this into a unique project, with its successes worthy of sharing with others.

Public Acceptance

This project initially received much public resistance and negative feedback due to concerns that the road improvements would have a detrimental impact to the McKenzie Wetland Complex. In addition to the public consultation that was performed during the Class EA, there was a conscious decision from the beginning to do more than fulfill the minimum effort in obtaining public input. Three additional public consultation centres were arranged to present the project to the public to obtain their ongoing input and agreement to the project. The first two were performed during the development of the detailed design to present and obtain comments to the design team. The last public consultation centre was performed once the construction contract was awarded, with specific emphasis on the construction scheduling and phasing, anticipated environmental issues and mitigation measures, and to inform the public of the upcoming temporary road closure.

In addition to meeting with the public, one-on-one consultation with individual members of the public was arranged throughout the project, utilizing on-site meetings with politicians and various interested groups. During one meeting, the proposed footprint of the retaining walls was actually staked out in the field so that stakeholders could visualize the extent of the road widening into the wetland.

It was expected that the public may not visualize how the end result of the project might appear, and this could lead to unintentional misconceptions. Photo imagery was used to present how the project might appear before construction occurred. Photo 12 depicted the rendering that was created for the public consultation centres to present how the raised road profile with retaining walls would look. The rendering depicted how the retaining wall would appear when viewed from the backyards of the residential development to the south. One of the comments provided by residents was that they did not want to see a steel wall, and to address this concern, a timber veneer was applied to the face of the wall to improve the wall's appearance. This tool was very useful in easing the concerns of the public towards this project, and to obtain the public's buy-in.



Photos 12 and 13: Rendering of the proposed improvements at the McKenzie Wetland Complex (above) and photo of the actual work following construction (below).



PROJECT ACHIEVEMENTS

The St. John's Sideroad / McKenzie Wetland Project is characterized as being unique and not typical of most road construction projects, due to the various types of construction specialties and transportation modes. The project not only included roadworks, sewers, watermain, streetlighting and traffic signals, but also involved the construction of sheet-pile retaining walls, horizontal directional drilling, tunnelling, railway crossing improvements, timber boardwalks, bicycle trails, landscaping and work adjacent to sensitive wetlands and watercourses.

In particular, the McKenzie Wetland Complex 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 period.

In addition, 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 Complex, and to make this project more than a typical road widening project. With a clear vision of what the project could become, it also overcame funding challenges through partnerships with the Town of Aurora.



Photo 14: Opening Ceremonies at McKenzie Wetland.

The project was officially opened on June 26, 2006 with representatives from the local and regional governments coming together with the McKenzie family and other community stakeholders to celebrate the project achievements.



Photo 15: Aerial view of completed project