

Project Overview – The Bayview Corridor Project

Bayview Avenue is a major north-south arterial corridor under the jurisdiction of The Regional Municipality of York (York Region). Located in the Town of Richmond Hill, Ontario, the lower segment of the project corridor contains a principal tributary of the Rouge River that is fed, at this location, through significant steady state groundwater upwellings from the Oak Ridges Moraine Aquifer directly below. The principal tributary and former road side ditches now all contain significant brook trout population and habitat. The watershed is managed by the Toronto and Region Conservation Authority and the brook trout habitat is managed by Fisheries and Oceans Canada.

York Region and the Town of Richmond Hill are undergoing tremendous growth in population and employment. In response to this growth, the Bayview Corridor Project improves mobility for all corridor users including motorists, pedestrians, cyclists and fish, with an innovative design enhancing the environment. The design of the project included extensive consideration of artesian conditions resulting from the Oak Ridges Moraine Aquifer and resulting brook trout habitat which contributed to the overall duration and complexity of the project.

Protecting and Enhancement the Environment

The project was planned in accordance with the Ontario Environmental Assessment Act. All impacts to the natural environment including air, land, water, plant and animal life, and community environment including social, economic and cultural life, were minimized to the greatest degree possible. The natural environment was protected through stormwater Quality Control and Secondary Treatment including oil grit separators and infiltration swales to provide enhanced water quality treatment, and outlet pools to provide erosion control.

This project widens Bayview Avenue from two to four lanes within the study area, and creates 2,000 linear metres of new stream channel and more than 9,000 square metres (2.2 acres) of new brook trout fish habitat along the east side of the corridor. Pedestrians and cyclists can view the new stream corridor and wildlife from a newly constructed multi-use trail and two lookouts built on the east side of the corridor. The multi-use trail connects Richmond Hill with its neighbouring municipalities to the north and south, and a portion of this trail is a segment of the 121 kilometre Lake to Lake Cycling Route and Walking Trail, connecting Lake Ontario to Lake Simcoe. The majority of fish habitat along the west side of the corridor was protected and preserved during construction.

Depressurizing the groundwater upwellings from the Oak Ridges Moraine Aquifer was critical to project success. The Permit to Take Water required a detailed Groundwater Management Plan

which included safe excavation depth calculations, monitoring and adaptive management planning (pre-, during and post-construction). The dewatering contractor installed 40 production wells and 28 monitoring wells along a 1.5 kilometre long alignment where dewatering activities occurred between spring 2016 and fall 2017.

This four-kilometre corridor of Bayview Avenue, extending from Elgin Mills Road to Stouffville Road, and a 400 metre portion of 19th Avenue west of the Bayview Avenue intersection, were transformed between October 2015 and September 2018 when both two-lane local roads were widened to four-lane urban arterials. With a high degree of community engagement, the project included dewatering, utility relocation, road widening, new stream channel construction, culverts, retaining walls, rail crossing upgrades, sidewalks, street lighting, active transportation infrastructure, stormwater management, local sanitary sewers and a watermain.

The project took place in the Rouge River Headwater Wetland Complex, which is part of the Jefferson Forest Natural Area, containing significant species and habitat. This area is one of the highest valued brook trout habitats in the Greater Toronto Area according to the Toronto and Region Conservation Authority.

All construction activities were performed in accordance with environmental permits from the Ontario Ministry of the Environment Conservation and Parks, Ministry of Natural Resources and Forestry, Toronto Region and Conservation Authority and Fisheries and Oceans Canada.

All work was completed in the dry while protecting the existing East Groundwater Channel. The new watercourse was allowed to build up adequate vegetation both instream and riparian to ensure the food sources (benthics) would be established before any fish were introduced to the new stream. The East Groundwater Channel and ancillary habitat areas include numerous vernal pool areas for salamander breeding habitat and turtle nesting areas. The vernal pools and sand areas were constructed to provide breeding habitat for salamanders, turtles, butterflies and bees.

Naturalized buffer areas were created using an integrated approach to provide enhanced water quality and temperature mitigation to protect the cold water brook trout fishery habitat, as well as to provide habitat for large mammals and birds.

Fifteen culverts were removed from the project corridor and replaced with seven concrete box culverts. Only biodegradable materials were used for erosion and sediment control. Riprap was limited to only areas where it was absolutely necessary. This minimized the material that was sent to landfill sites and helped limit the carbon footprint of trucking in large quantities of riprap.

Mobility was improved for all corridor users. Growth in population and employment in the area required upgraded transportation infrastructure in the corridor. In addition, artesian conditions resulted in water ponding in the summer and frost heaving and the need for excessive road salt application in the winter, further reducing the life expectancy of the existing roadway. The Bayview Municipal Class “C” Environmental Assessment (Class EA) completed in 2006 identified the need to widen Bayview Avenue to four lanes, along with active transportation including a multi-use trail. Partly due to the high water table, lands to the east were slow to develop. This gave York Region the opportunity to work with local stakeholders to acquire lands on the east side of Bayview Avenue where the new fish channel could be relocated.

Fish habitat was preserved and enhanced. Both East and West Groundwater Channels (originally road side ditches) contained healthy populations of brook trout habitat. To minimize the disturbance of existing fish habitat, Fisheries and Oceans Canada, through the Class EA process required York Region to maintain the West Groundwater Channel in its current location and required all road widening to occur to the east. Accordingly, a 50 metre wide swath of land was negotiated with the landowners on the east side of the corridor to provide space for the new fish channel. This protected swath of land comprises 43,500 square metres (10.75 acres) within which the new fish channel and brook trout habitat was constructed and will also provide terrestrial habitat for large mammals and birds. Suitable green space buffers between the new fish channel and any future development will be maintained.

The project is sustainable. The project was driven by the sustainability principles of quality communities, an enhanced environment and infrastructure for a growing community and engaged communities.

The following was noted by the Toronto and Region Conservation Authority (TRCA) in its Living City Impact Award 2018 Nomination: “The project is located in an ecologically sensitive area with artesian groundwater conditions, Provincially Significant Wetlands, the Oak Ridges Moraine landform, and some of the highest quality coldwater aquatic habitat in TRCA’s jurisdiction. The project required years of intensive ecological and groundwater investigations and collaboration amongst various technical experts, stakeholders, agencies and landowners. York Region and their project teams showed leadership, creativity and innovation in developing and implementing a context sensitive ecological design with a net ecological gain.”

This project is commercially viable. Construction was completed with all major interim milestones met. The construction of the infiltration gallery required a full three month closure of Bayview Avenue, which was ended on schedule at the end of the summer of 2017 to limit traffic impacts to the local school (Holy Trinity School) and to other road users. The timing of

works included the mid-contract completion of a culvert which allowed the North Leslie Developer Group to continue with grading activities during the construction contract, which allowed adjacent land development activities to proceed.

An Innovative Dual Storm Sewer Solution Addresses Artesian Aquifer Conditions

In the project area, a clay till cap covers a 10 to 15 metre thick artesian aquifer (Oak Ridges Moraine Aquifer), which produces a five metre pressure head. An excavation incident occurred during construction of the Bayview Avenue CN Bala rail grade separation north of 19th Avenue in 1968 resulting in uncontrolled flow of soil and water from the excavation area. In order to finish construction, a drainage pad was installed within the excavation area and an artificial groundwater spring was established for permanent groundwater pressure relief. The creation of this groundwater spring led to the development of fish habitat in the road-side ditches adjacent to Bayview Avenue. Since 1968, approximately 40 litres per second (l/s) of groundwater has discharged to what were the ditches, in to what have now become the East and West Groundwater Channels. The east channel connects with the Principal Tributary of the Rouge River.

Maintaining flow in the newly constructed stream channel was critical to project success. This relied on an innovative dual storm sewer design, separating road surface runoff from the groundwater upwellings into two separate storm sewer systems. The infiltration gallery permanently depresses the local groundwater pressure head by approximately five metres, preserving the road structure integrity while diverting the steady-state groundwater flows to feed the watercourses on the east and west sides of Bayview Avenue, maintaining a basal flow level of approximately 2,000 metres cubed per day. The infiltration gallery was designed as an elaborate system of perforated 375 millimetre and non-perforated 450 millimetre diameter pipes with 250 millimetre diameter “ribs” embedded in a drainage layer of coarse sand under the road pavement, arranged such that groundwater is collected and conveyed to east and west outlets on the south side of the CN Bala structure where the groundwater fed watercourses originated. Flows to the watercourses pass through a manhole with a weir structure, allowing control of the flow levels such that the West Groundwater Channel maintains a 15 litres per second minimum as is required by the environmental permit conditions. There is no minimum flow level requirement noted for the East Groundwater Channel due to the confluence of the Rouge River Principal Tributary.

There were concerns that once ground-water pressures were restored to the site the subdrains under the curb and in the storm sewer trenches would be conveying groundwater from the subbase as a steady-state condition, running full of groundwater. Connecting these subdrains to the proposed storm sewer system would reduce the capacity of the storm sewer system to

handle actual rainfall events and would also unnecessarily stress the oil and grit separator units (OGS) at the downstream outlets with having to process clean groundwater thereby reducing the OGS units' abilities to handle required volumes during rainfall events.

As such, the Bayview Avenue design includes a separate subdrain collection system, independent to the storm sewer system however running in parallel, collecting flows from the curb and storm sewer trench subdrain and out-letting regularly to the new east side ditch/watercourse and helping to maintain basal flow volumes of clean, cold groundwater in the watercourse. Finding locations to outlet the subdrain collection system was a challenge due to the elevation of the adjacent watercourse relative to the curb and sewer subdrains.

Financial Implications Associated with the Initiative

The project was tendered in 2015 and all interim milestones were met. Final payment to the contractor was \$38.3 million and within budget. New stream channel construction including dewatering, channel excavation, culverts, plantings and the construction of brook trout habitat and habitat for large mammals and birds totalled approximately \$8 million.

The dewatering plan was collaborative and the risk was shared. For the Bayview Corridor Project, York Region recognized uncertainty with respect to ground conditions could lead to third party damages resulting from ground movement. York Region therefore adopted a 'risk sharing' philosophy in developing the construction contract. Recognizing the risk of basal heave would likely decrease with greater number of depressurization wells, the construction contract recognized unit pricing for depressurization well installation and a reference to the quantities recommended by the engineer. These quantities could be increased, provided the contractor could justify the need based on soil conditions encountered. The benefit of this risk-sharing approach is two-fold: 1. Contractors are not forced to carry "risk" money for change of conditions within in their bid prices; and 2. This flexibility allowed for a collegial relationship between owner, contractor and engineer, with the common goals of establishing a robust dewatering system and stable excavations.

Ultimately, the 40 depressurization wells installed were less than the engineer's estimate of 46. While significant changes in aquifer boundary, transmissivity, storativity and confining layer thickness were encountered in the southern reach of the construction area, the well spacing recommended by the design consultant's performance testing produced satisfactory depressurization results, and no claims arose during the depressurization well drilling program.

The road closure for constructing the infiltration gallery was lifted on schedule. The construction of the infiltration gallery required a full three month closure of Bayview Avenue. Given the importance of the corridor and high traffic volumes, and to avoid impacts to the local

school (Holy Trinity School) and other road users, the full closure period of June to August 2016 was selected to coincide with summer recess. The contractor worked overtime and on weekends to ensure the road opened in time for the first day of school following summer vacation.

The developer access culvert C1 was completed mid-contract to allow land development activities to progress. The timing of works included the mid-contract completion of culvert C1 and was coordinated with the activities of adjacent stakeholders, including developers. Providing culvert C1 mid-contract allowed the developer to continue with grading activities during the construction contract and provided access to the future entrance to the North Leslie subdivision to the east of the corridor.

Utility relocation was included as part of the construction contract. A non-standard delivery process was used. Typically utility relocation occurs prior to construction to ensure no overlapping construction activities occur and only one constructor is on-site. Due to the high groundwater pressures, some utility works were incorporated into the general contract to allow the utilities to take advantage of the general contractor's site dewatering/depressurization efforts. This solution required extensive coordination with the utility companies to establish their design and staging requirements well in advance of tendering, as well as integrating their specifications and work items/quantities into the final tender documents.

Overall Applicability to Transportation

Growth in population and employment in the area required upgraded transportation infrastructure in the corridor. In response, the Bayview Corridor Project connects growing communities and improves mobility within York Region and beyond for all corridor users through increased road capacity, sidewalks and a multi-use path.

In 2002, Bayview Avenue was a two-lane north-south road with a rural cross-section carrying 9,800 vehicles per day, with a 40 per cent traffic increase estimated by 2011, requiring the need for additional roadway capacity. In addition, artesian conditions resulted in water ponding in the summer and frost heaving and the need for excessive road salt application in the winter, further reducing the life expectancy of the existing roadway. The Bayview Municipal Class "C" Environmental Assessment (Class EA) completed in 2006 identified the need to widen Bayview Avenue to four lanes, along with active transportation including a multi-use trail. Partly due to the high water table, lands to the east were slow to develop. This gave York Region the opportunity to work with local stakeholders to acquire lands on the east side of Bayview Avenue where the new fish channel could be relocated. Traffic volumes in 2018 have already reached 20,000 AADT vehicles per day, reaffirming the need for the project.

2019 TAC Full Nomination Form for the Bayview Corridor Project

The new at-grade rail crossing improves mobility by reducing pedestrian/vehicle/train conflicts, and was designed to facilitate a future grade separation when it is built.

The multi-use trail and lookouts along the east side of the Bayview Avenue corridor promote active transportation and connect this portion of Richmond Hill to the communities to the north and the south. This trail is also part of the 121 kilometre Lake to Lake Cycling Route and Walking Trail, connecting Lake Ontario to Lake Simcoe.

The context sensitive design complies with the Accessibility for Ontarians with Disabilities Act.

The Bayview Corridor team capitalized on opportunities that arose from the project's most unique and challenging features: the artesian conditions and resulting brook trout habitat.

These challenges provided the project team with the opportunity to:

- Transform the area in a sustainable way to accommodate growth and improve traffic flow
- Improve mobility for all corridor users including motorists through increased road capacity and pedestrians and cyclists through the introduction of new sidewalks, multi-use paths and lookouts
- Enhance the environment with a new stream channel, brook trout habitat and protected green space

The project promotes active transportation. The multi-use trail and lookouts along the east side of the corridor promote getting outdoors and connecting this portion of Richmond Hill to the communities to the north and the south. The new multi-use path and lookouts from which to view the channel and buffer will attract cyclists and pedestrians and create a sense of pride in the community as already demonstrated during walking tours with Holy Trinity School.

The project protects and promotes the environment. The Bayview Corridor Project is important because it improves mobility for motorists, pedestrians, cyclists and fish in an area challenged by a high water table and artesian conditions. The project includes a new stream channel located within an ecological corridor with terrestrial and aquatic habitats including wetlands, woodlands, streams and meadows.

Measured against the key project priorities of environmental protection and enhancement, worker safety, community engagement, schedule adherence and the provision of active transportation infrastructure, the project was a success and its best practices continue to be implemented on current and future Regional projects.



THE BAYVIEW CORRIDOR PROJECT

Improving mobility for motorists, pedestrians, cyclists ... and fish with an innovative design enhancing the environment

Transportation Association of Canada
2019 Environmental Achievement Award Submission
The Regional Municipality of York
Transportation Services



WHAT THIS PROJECT ACCOMPLISHES

Facing north: newly constructed east groundwater channel and developer access culvert



WHERE THE PROJECT IS LOCATED

STOUFFVILLE ROAD

19TH AVENUE

WEST
GROUNDWATER
CHANNEL

EAST
GROUNDWATER
CHANNEL

HOLY TRINITY
SCHOOL

ROUGE RIVER
PRINCIPAL TRIBUTARY

REALIGNED
ROUGE RIVER
PRINCIPAL TRIBUTARY
(EAST GROUNDWATER
CHANNEL)

ROUGE RIVER
PRINCIPAL TRIBUTARY

BAYVIEW AVENUE

ELGIN MILLS ROAD

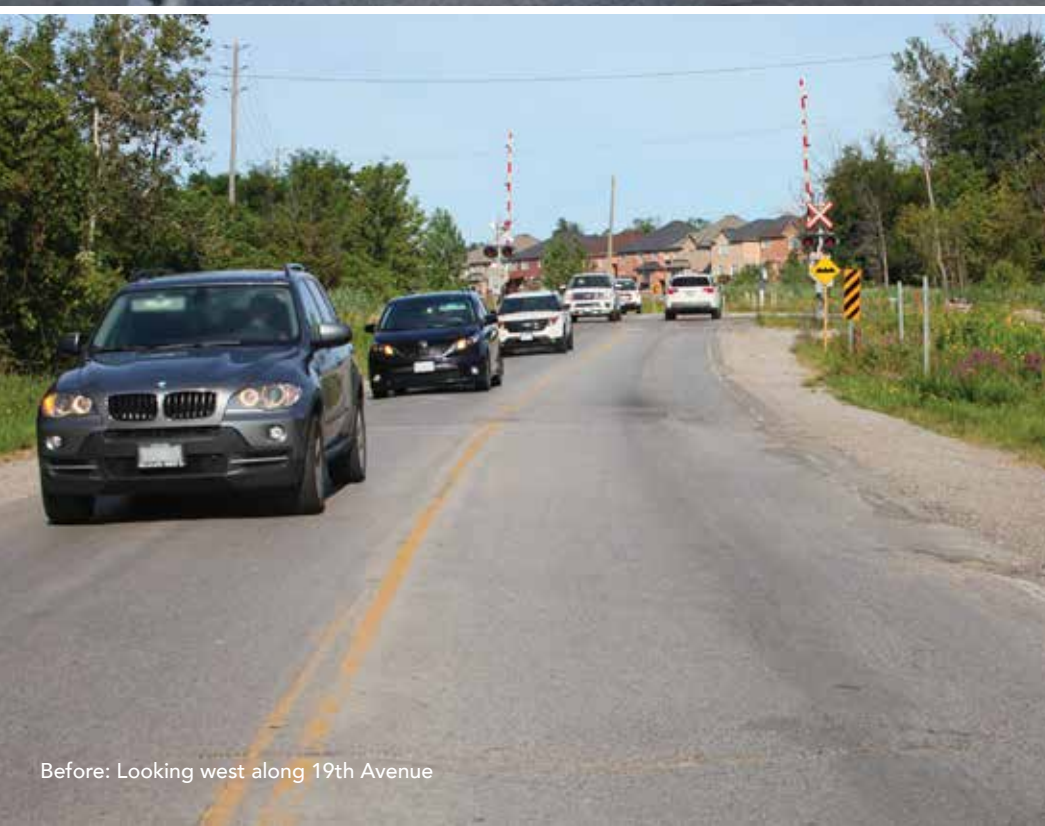




Before: Looking south along Bayview Avenue



After: Looking south along Bayview Avenue



Before: Looking west along 19th Avenue



After: Looking west along 19th Avenue

**THIS PROJECT CREATED
9,000 m² OF NEW BROOK TROUT HABITAT**



Upper reach constructed using bioengineering techniques to mimic headwater streams



Live fascines in constructed watercourse



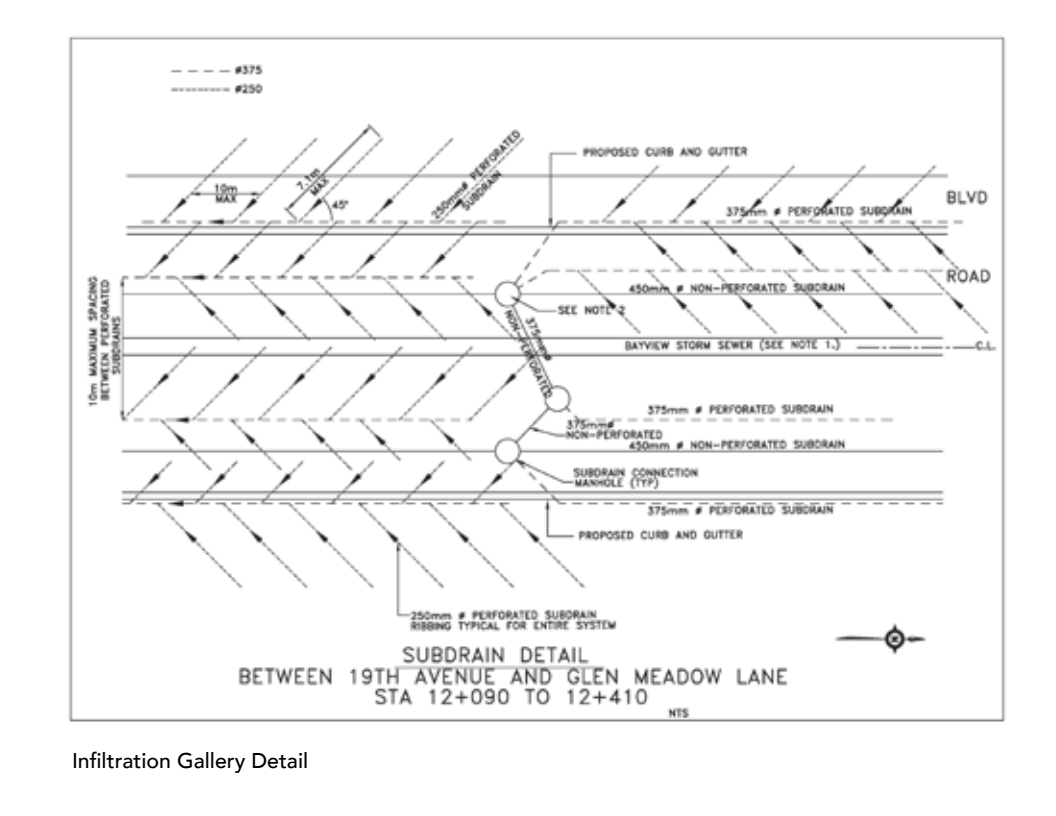
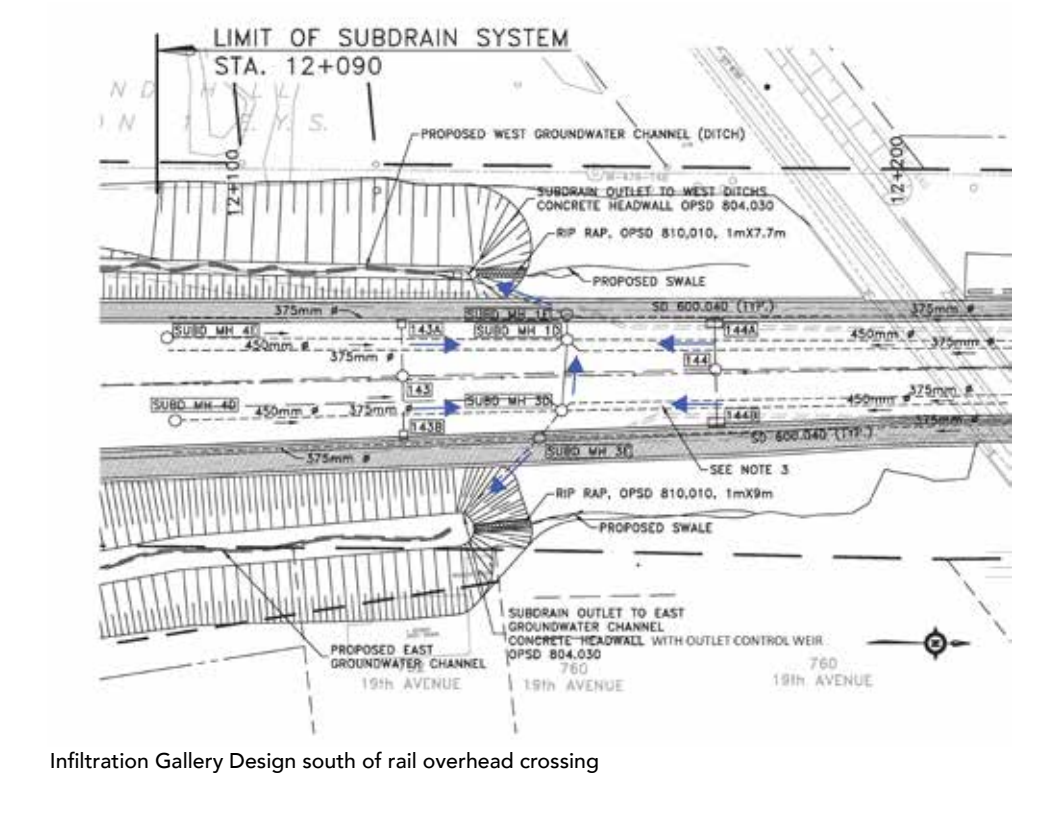
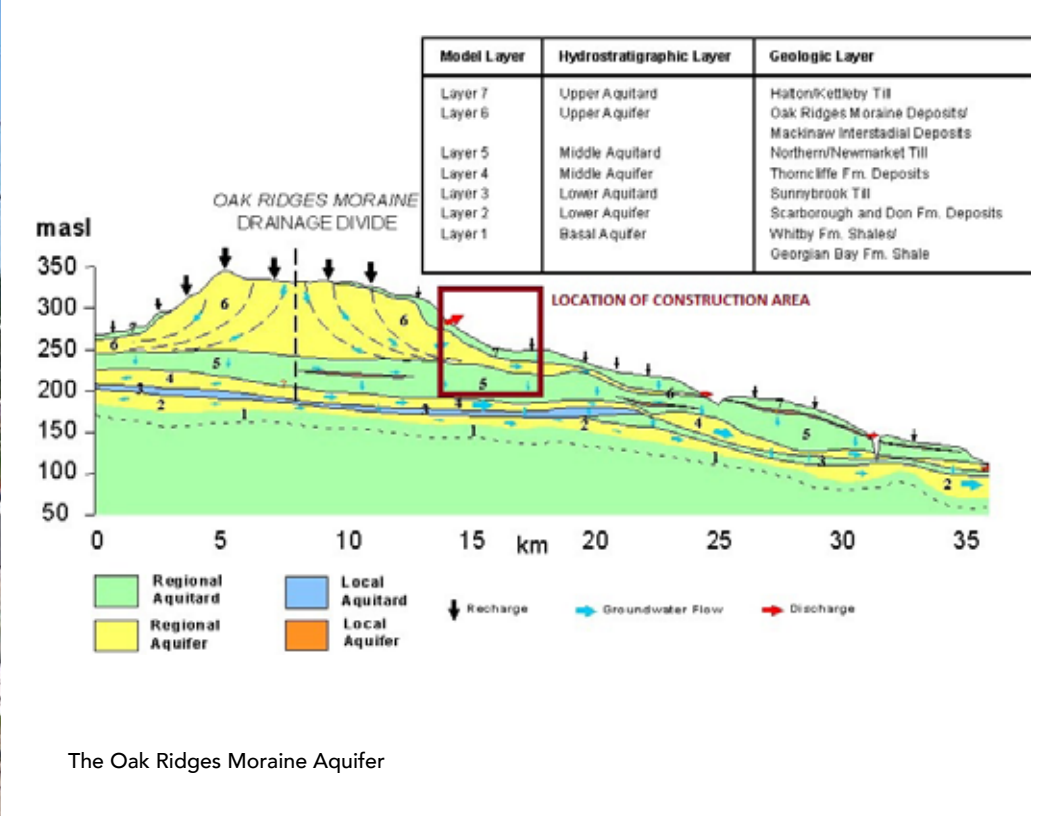
New watercourse allowing vegetation to establish prior to watercourse connection



Facing south: lower reach habitat created for fish and turtles

A COMPLEX CONSTRUCTION PROJECT

Facing east: construction of culverts at Bayview Avenue





**THIS PROJECT PROMOTES ACTIVE
TRANSPORTATION AND ENHANCES
THE ENVIRONMENT**

Multi-use path and lookout facing south



Brook trout (*S. Fontinalis*) captured on-site



Aerial view of groundwater channel



Watercress establishment in creek indicative of upwellings



Facing south: new channel vegetation