ENVIRONMENTAL MANAGEMENT and BENEFITS in a MAJOR CAPITAL PROJECT

Teston Road and Highway 400, York Region, Ontario, Canada
Project Managed by the Regional Municipality of York

Transportation of Canada Environmental
Achievement Award Submission
March 2011

Submission Prepared by:
Arup Mukherjee, P.Eng, Senior Project Manager
(York Region employee and Project Manager for this project)

PROJECT BACKGROUND

The Regional Municipality of York has experienced significant growth over the last 5 years with maturation and urbanization occurring in many areas. Vellore Village is an area that has experienced tremendous growth and it is located adjacent to Highway 400, near Canada's Wonderland. It is one of the areas earmarked for ongoing growth to support the economic needs of the Region and population growth projected in accordance with approved Provincial, Regional and local Official Plans.

In 2008, York Region initiated a major capital project in the vicinity of Highway 400 and Teston Road as a result of this planned growth. Teston Road is located north of Major Mackenzie Drive and it is the main interchange for traffic destined for the development in this area. The interchange at Major Mackenzie Drive also serves one of the largest theme parks in Canada known as Canada's Wonderland, resulting in a significant amount of demand and congestion at this interchange, particularly during the summer season.

In order to alleviate the congestion at the Highway 400/Major Mackenzie interchange, a new interchange was built at the next major concession to the north at Highway 400/Teston Road. In addition to a new interchange, there were two other major components to the overall project. The first component involved the widening of Weston Road from two to four lanes and the second component involved the reconstruction and widening of Teston Road, from a two lane rural arterial road to a 4 lane urbanized road.

The area surrounding Highway 400/Teston Road is undergoing rapid transformation. The south side of Teston road, west of Highway 400, has been planned and built with commercial uses and several large subdivisions. The north side of Teston Road, east of Highway 400, currently remains largely agricultural with some large estate housing on the west side of Highway 400. The north side has maintained its rural character including large areas with mature trees and valley lands. Cold Creek which forms part of the headwaters for the main Humber River flows through the site along with several minor tributaries. This creek is an important environmental feature which required special consideration as part of the overall design and construction of the project.

"Special environmental treatment required in three key areas"

As noted earlier, this major capital project encompassed a large geographical area centred around the Highway 400/Teston Road intersection. There were three key areas that required special environmental management measures to ensure that construction activities did not affect aquatic and terrestrial habitats near Cold Creek. These key areas and the measures undertaken are noted in the following sections.

Culvert 13 Extension- westbound to northbound ramp at highway 400

As part of the new interchange, an on-ramp was constructed from westbound Teston Road to northbound Highway 400. In order to construct this ramp, the ramp had to traverse across an existing tributary that feeds Cold Creek from east of Highway 400. The tributary crosses under Highway 400 at a culvert referred to as Culvert 13. In order to cross the tributary, the culvert had to be extended to the east so that the ramp could be constructed on top of the new extended culvert.
The extension of the culvert impacted the existing tributary and as a result, additional measures were implemented to address this impact and enhance the area.

The tributary is an intermittent cold water tributary of Cold Creek which provides indirect fish habitat for brook trout and the recently designated endangered red side dace. Drainage from agricultural fields to the north-east flows into this tributary. In the area where the tributary enters the culvert, this section is low wetland area with slopes leading down from the edge of active farmland. Slopes were sparsely vegetated and there was already some evidence of loss of erosion. There was evidence of increased peak flows with minor rain due to the drainage from farm fields which are void of vegetation. As a result, the existing channel was disturbed and laden with sediment due to agricultural practices upstream.

As part of the environmental plan for this area, several natural features in the wetland and the tributary were enhanced. The existing degraded tributary was enhanced by installing substrate stones to provide more natural habitat for fish. Vegetation was planted along the banks to provide food and cover for aquatic life. Six dissipation pools were constructed to allow for sediment from the agricultural lands to settle and provide shallow areas for fish. The dissipation pools were vegetated to capture sediment and excessive nutrients from the fields, which can have a negative effect on the stream. The slopes leading into the wetland were planted to remove previously eroded areas.

Finally, several options were considered to remove the build up of sediment within the existing culvert under the highway. These options included potential manual removal by shovel; however, this was not pursued due to the length of the culvert, the confined space and concerns for worker safety. Ultimately, a more innovative solution was accepted which involved damming the downstream end, flushing the culvert and removing the entire resultant residue by vacuum trucks. The flushing was undertaken at a flow rate that would simulate high spring run off conditions that would normally occur. Vacuum trucks were located on the shoulder of the highway which was approximately 20 m higher than the dammed area.

The overall costs for the flushing operation were approximately $40,000. York Region determined that it would be difficult to access the culvert after construction was complete and it would also disrupt any natural growth in the area. As a result, measures were undertaken to complete the sediment cleanup under the highway at the same time that the natural features were being enhanced in the tributary. Overall, the tributary was improved with new substrate, plantings and additional dissipation pools.

"it was cost effective to complete additional flushing of the culvert"

Replacement of Teston Road culvert with a Techspan Bridge

"York Region incorporates environmental enhancements to the project area"

Another area where special environmental measures were undertaken is on Teston Road, west of Highway 400. At this location, Teston Road was widened from a two lane rural road to a four lane urban road. An old box culvert provided a crossing for Teston Road over Cold Creek at this location.

Cold Creek provides cold water habitat for aquatic species in this area including two game-fish species, brook trout and brown trout. Cold Creek runs through a natural valley in this area as it crosses under Teston Road. There are mature trees north and south of structure crossing and evidence of high water levels on the old culvert. The stream is flash prone with significant sediment due to poor flow conditions through the culvert.

One of the initial alternatives identified for this crossing was to extend the existing box culvert for the widened road. This would have resulted in an increase in culvert length of 40 m and added significant fill in the low lying area. Although this would have been the most cost efficient solution, York Region determined that there was an opportunity to enhance this area from an environmental perspective. As a result, the box culvert was removed and replaced with an arch techspan structure with retaining walls on both sides to reduce fill. The cost to extend the box culvert would have been approximately $100,000. The alternative techspan structure cost approximately $800,000.

"A more elegant clear span crossing provided several enhancements to the environment by removing the old box culvert"

The initial box culvert was 3 m x 6 m x 13 m long. The techspan structure is 5 m x 18 m x 30 m long providing a much larger open space. The open space allows better air flow which in turn allows for more vegetation and cover. The opening provides greater light which also helps to improve the terrestrial environment. With the techspan, the creek is able to flow through a more natural terrain as opposed to a box culvert. The flows are now slower which helps to reduce bed and bank erosion.

The techspan provides for more open cross sectional areas and thus improves the hydraulic capacity for floods. During construction of the techspan, Cold Creek was dammed and by-pass pumped. This provided an opportunity to clean the stream bed by placing mats within the stream to protect the natural substrate and using vacuum trucks to suck up sediment. This clean up enhanced the stream bed and improved the aquatic habitat.

"Innovative thinking led to a better solution for this creek crossing"

Drainage control (quality) at the interchange

The construction of the interchange itself required significant earth moving activities immediately adjacent to the highway. The highway is at a low point at this interchange, therefore there is significant drainage from the highway ditches along with drainage from the adjacent lands. All of the drainage channelled to a single large ditch which ultimately entered the previously noted Culvert 13 under the highway. As a result, there were significant challenges in managing the sheet flow from the highway and adjacent excavated areas.

"Sediment tanks helped to provide treated water back into the system"

Initially, several traditional sediment control methods were installed. These included, check dams to slow down the flow in the ditches, covering slopes with erosion control blankets, lining ditches with geotextile and placing rip rap on top, hickenbottom dams, sediment ponds and regular cleaning of the ditches. However, these methods were not as effective as initially envisioned and there was a concern regarding the quality of water run-off from this area of construction.

The final solution was to implement sediment tanks in combination with filtration systems. This system was deployed just before the outlet to Culvert 13. The ditch leading to Culvert 13 was dammed and water was pumped into the tanks. The water flows through a series of baffles in the tank to reduce sediment. After some initial sedimentation, the water in the tank flows through several sand filters designed to remove finer particles. Finally, the fully treated water was released back into Culvert 13.

"A more expensive and innovative technical solution was used to protect the environment during construction"

The overall costs to deploy the tanks and filtration systems were approximately $1.5M. The Region determined that given the sensitivity of Cold Creek, the costs were justified as it provided treated water back into the natural system.

Financial Implications of this project

The overall project cost $35M and took 3 years to construct. The portion related to environmental design and construction issues was approximately $4.25M. This represents a higher investment on environmental issues than what has traditionally been considered in standard infrastructure projects.

Lessons learned and applicability to other Municipalities

The environmental controls that were utilized for this project provide a good framework for the types of issues that other municipalities may encounter in delivering transportation infrastructure. They demonstrate York Region's approach to reviewing various engineering options and selecting one that ultimately leaves a net overall benefit to the environment, while achieving the infrastructure needs for the community.

ENVIRONMENTAL MANAGEMENT and BENEFITS in a MAJOR CAPITAL PROJECT

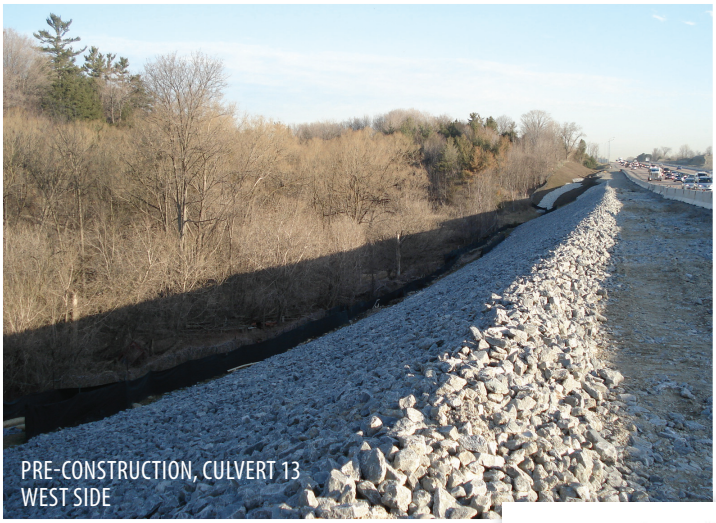
Teston Road and Highway 400, York Region, Ontario, Canada
Project Managed by the Regional Municipality of York

A P P E N D I C E S

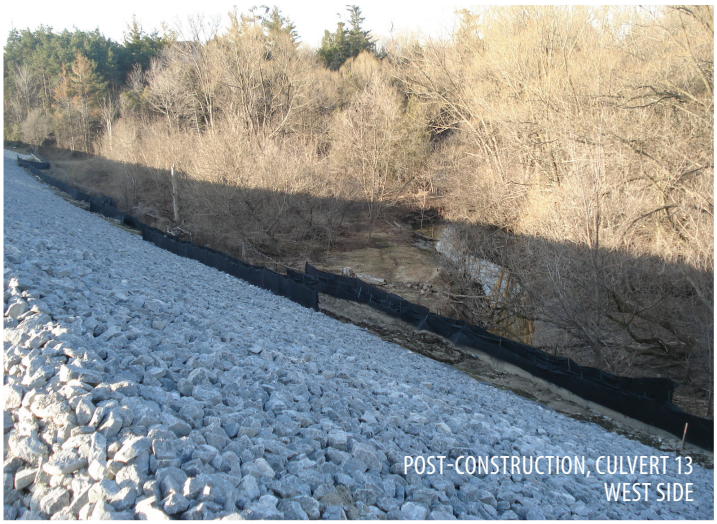
Transportation of Canada Environmental
Achievement Award Submission
March 2011

Submission Prepared by:
Arup Mukherjee, P.Eng, Senior Project Manager
(York Region employee and Project Manager for this project)

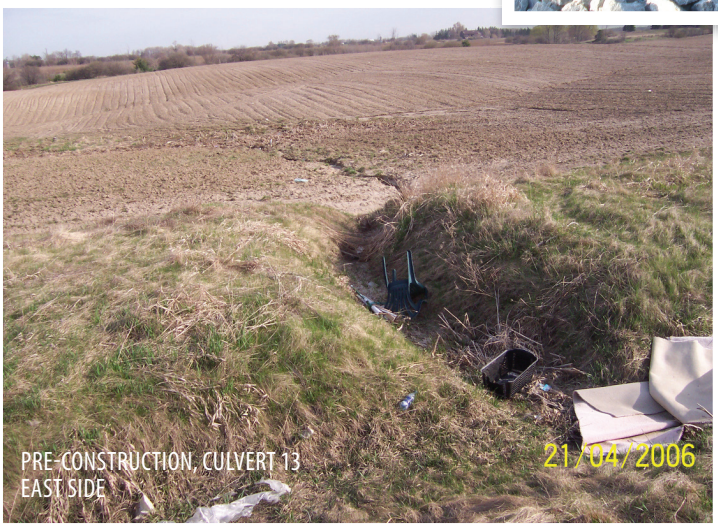
AREA 1 - CULVERT 13



PRE-CONSTRUCTION, CULVERT 13
WEST SIDE



POST-CONSTRUCTION, CULVERT 13
WEST SIDE



PRE-CONSTRUCTION, CULVERT 13
EAST SIDE

AREA 2 - CATCHMENT AREA for CULVERT 13

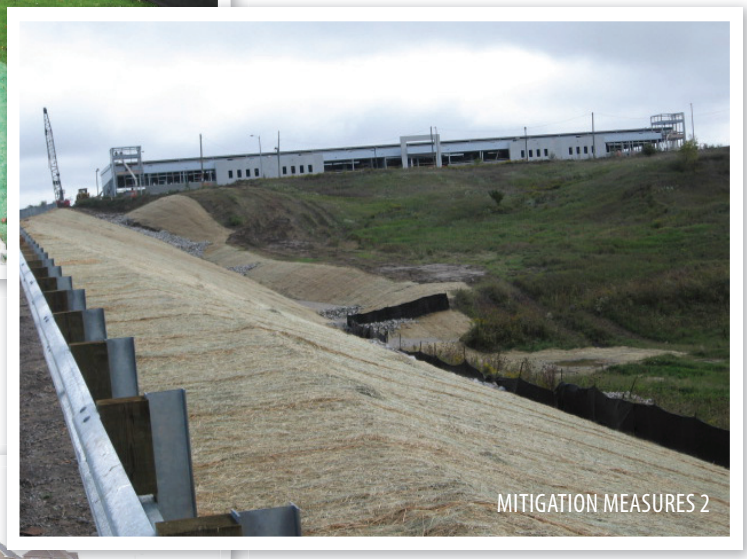
PRE-CONSTRUCTION,
CATCHMENT AREA 2

PRE-CONSTRUCTION, CATCHMENT
GENERAL, AREA 2

PRE-CONSTRUCTION,
CATCHMENT AREA 4

MITIGATION MEASURES


MITIGATION MEASURES 1

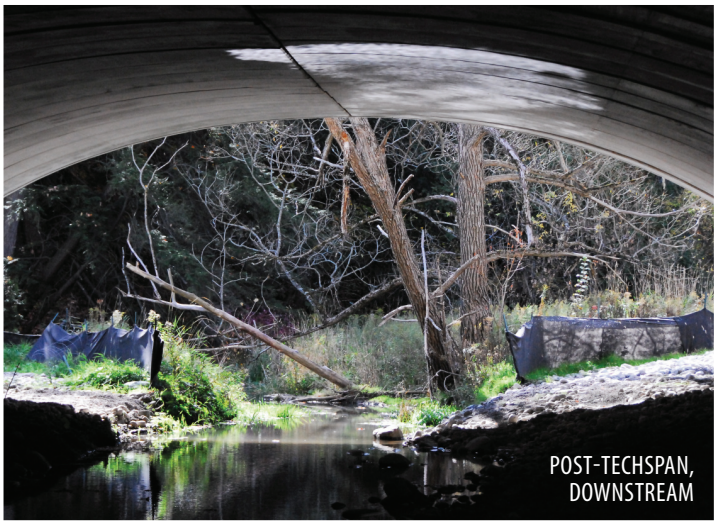

MITIGATION MEASURES 2

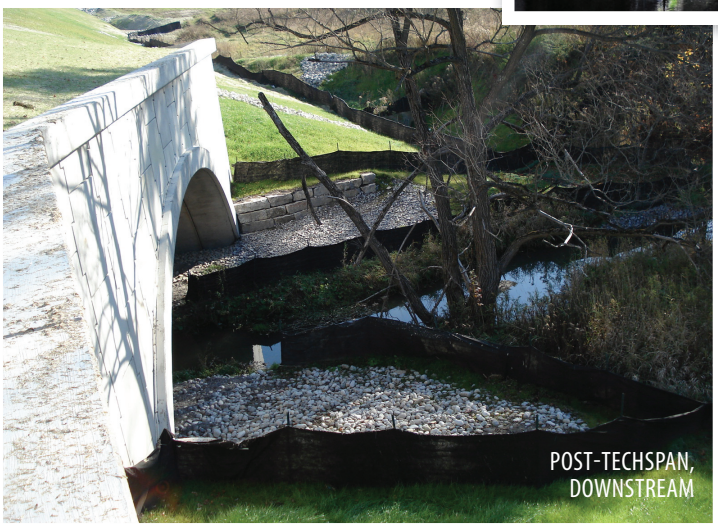

MITIGATION MEASURES 3


MITIGATION MEASURES 4

TECHSPAN


PRE-TECHSPAN,
DOWNSTREAM
21/04/2006


POST-TECHSPAN,
DOWNSTREAM


POST-TECHSPAN,
DOWNSTREAM