# MORRISON CREEK BANK/SLOPE REPAIR
# SHERIDAN COLLEGE LANDS

## EXECUTIVE SUMMARY

## TOWN OF OAKVILLE

Submitted to:

**Sheridan College**

Submitted by:
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# 1.0 INTRODUCTION

## 1.1 Purpose and Objectives

Amec Foster Wheeler Environment & Infrastructure has been retained by Sheridan College to evaluate the existing condition of erosion on the main branch of the West Morrison Creek and its two tributaries within the Sheridan College lands. The purpose of the study is to determine the processes causing the identified erosion problems, generate alternatives to mitigate the problems, and to recommend a Preferred Alternative that best meets the requirements of all of the stakeholders.

The primary objective for the college is to identify areas of potential risk to property, both that of the college, and its neighbouring landowners. The areas have been fully characterized, ranked and then a prioritized list of projects has been generated. This results of this study will enable the college to plan remedial maintenance and repairs to the erosion problems.

This objective will be accomplished through an assessment of the existing conditions of the creek and valley, generation of a prioritized list of creek and valley areas of concern, development of a conceptual solution at each area, and development of a preliminary cost estimate for all of the work projects.

A secondary goal is, to the extent possible, to coordinate the proposed works in a manner consistent with the overall works being proposed by the Town of Oakville for the creek and valley both upstream and downstream of the college lands.

Ultimately, the college will need to seek approvals for works through the Town, Conservation Halton, and potentially the Region of Halton. The Town has agreed in principle to advancing an integrated approach to planning, and to developing a holistic solution that is both acceptable to Sheridan College, and ultimately approvable by the Agencies. While the two projects would proceed independently, there would be several opportunities for liaison between the Town and Sheridan College.

Finally, the study will identify opportunities to integrate other sustainability features into the proposed works, such as: invasive species management, removal of barriers to fish migration, updating of pedestrian bridges, planting plans, and educational possibilities, such as the involvement of various college departments with portions of the works, e.g. post-construction monitoring.

## 1.2 Background

Urban creeks are important elements of municipal stormwater infrastructure. These systems are relied upon to drain both the natural and urban areas of the municipality. They provide important stormwater conveyance (flooding), natural functions related to terrestrial (wildlife/vegetation), aquatic (fisheries and habitat), and sediment transport (fluvial) systems and support social functions by providing public access through trail networking. The College has identified the creek

and its tributaries as a high priority for erosion mitigation due to risk to adjacent property caused by ongoing watercourse erosion. Negative impacts of erosion include:

- *Loss of Tableland* - Potential impact to private property, including use and enjoyment
- *Slope Stability* - Uncontrolled toe and slope erosion which can cause surficial failures
- *Environmental Degradation* - As the creek erodes, it can affect the stability of the bed and bank of the creek. Due to the accelerated rates of erosion, there may be an imbalance in sediment transfer downstream which could influence fisheries and aquatic habitat potential; in addition, riparian vegetation is disturbed or lost

### 1.3 Study Area

The Study Area is comprised of the West Morrison Creek and associated valley lands, as well as the tributaries that traverse the main campus of the Sheridan College lands. The valley lands remain predominantly forested with adjacent residential and institutional land uses (Sheridan College & White Oaks Secondary School). The McCraney Valley Trail system provides pedestrian access along the valley.

### 1.4 Project Team

Sheridan College has retained the Amec Foster Wheeler Team to conduct the current investigation; the Team consists of the following:

- Amec Foster Wheeler Environment & Infrastructure: Project Management, Water Resources Engineering, and Geotechnical Engineering
- PARISH Aquatic Services, A Division of Matrix Solutions Inc.: Stream Morphology
- C. Portt and Associates: Fisheries
- Dougan and Associates: Terrestrial Ecology

## 2.0 FIELD WORK

Independent hydrology/hydraulics, fluvial geomorphology, geotechnical, aquatic ecology and terrestrial ecology assessments have been completed for both the main branch of Morrison Creek and its tributaries, located within the property owned by Sheridan College.

Members of the Amec Foster Wheeler Team (Water Resources Engineer, Stream Morphologist, Terrestrial Biologist, Aquatic Biologist, and Geotechnical Engineer) have walked the full length of the Study Area. Based on this field reconnaissance, the Amec Foster Wheeler Team identified roughly twenty (20) sites that may require various forms of treatment and system stabilization. The field visit has identified the following: severe and moderate valley wall erosion with and without connected private tablelands, five (5) pedestrian bridges in the main valley (out of six (6)

in total) that require some form of bank treatment; one (1) pedestrian bridge on the main campus tributary which needs to be maintained for hydraulic efficiency; existing armour stones that are undermined, and three (3) stormwater outfalls/channels that would benefit from stabilization works.

The following is a summary of the Study Area findings and characteristics specific to the various disciplines evaluated as part of the study (i.e. hydrology, hydraulics, stream morphology, geotechnical, fisheries, and terrestrial ecology).

## 2.1 Summary of Key Findings and Recommendations

*Hydrology & Hydraulics*

- College records for site development and stormwater management are limited, however a stormwater management report for the north parking lot expansion detailed some of the hydraulics of the tributary that traverses the campus, and under pedestrian bridges between the student centre, B and C wings, and the cafeteria and G wing
- No buildings or structures or conveyance infrastructure is subject to flooding for design events up to and including the Regional Storm;
- Hydraulic duration analyses have demonstrated that the main branch of Morrison Creek is subject to prolonged exposure to erosive flows for all design events including the frequent 25 mm event

*Stream Morphology*

- Slumping/failure of existing bank stabilization works (gabions and armour stone), undercut banks, exposed pedestrian bridge footings, perched storm sewer outfalls and falling/leaning trees have been observed, generally indicating systemic erosion;
- Local erosion/sedimentation concerns include undersized pedestrian bridge, debris jams and valley wall contact points;
- Erosion rates range from 5.9% to 8.9% which is in excess of typical natural erosion rates (0.1-5.5%)
- Dominant channel forming processes include widening and plan form adjustment;

*Geotechnical*

- toe protection is recommended to minimize the risk of future slope instabilities caused by continued erosion;
- Slope flattening by filling the toe of slope in combination with toe protection could be considered at select locations;
- The storm outfall from McCraney is recommended to be redesigned to reduce outflow contact with the adjacent valley wall;

*Fisheries*

- No Species at Risk or Endangered Species are present within the Study Area;
- The Study Area is part of a commercial bait harvest area;
- Fish habitat quality generally decreases from upstream to downstream;

- no reach specific constraints exist for potential watercourse relocation/restoration works;

Terrestrial

- The Study Area consists of largely high quality forest communities with the remainder cultural communities;
- Disturbance in forest communities can result in many consequences including increase in plant invasions such as Common Buckthorn (Derickx and Anrunes, 2013) which is a concern with respect to potential impacts to overall health of the existing native forest communities as it poses a threat to biodiversity;
- Three (3) Species-at-Risk (SAR) have been reported within or near the Study Area including: Twisted Sedge, Honey Locust, and Woodland Pinedrops. None of these species were noted during the vascular plant Survey or Tree Inventory but it is possible that the Woodland Pinedrops were not visible during the time of the surveys;
- The Tree Inventory determined that the majority of the trees in the Study Area are native. There were no regionally or locally significant species found, nor any endangered species;
- Watercourse works should avoid where possible numerous Red Oak and Sugar Maple trees, many of which have a dbh of greater than 50 cm. The removal of these trees would result in large gaps in the canopy where invasive species may establish and threaten biodiversity. Large trees root zones provide significant erosion control. By removing these trees the disturbed area will be more susceptible to erosion and bank collapse.
- Two (2) SAR were noted to have habitat within a 1 km of the study site; Chimney Swift and Eastern Wood-Pewee. Of the two (2) species, only the Eastern Wood-Pewee was noted during the breeding bird survey in the north end of the Study Area;
- To verify compliance with the Migratory Birds Convention Act (MBCA 1994) any vegetation clearing for construction purposes should take place outside of the breeding bird season, which in Halton extends from approximately May 1 to September 1. If vegetation clearing proceeds within these dates, then a qualified avian ecologist will need to conduct a nest check of the area to be cleared to be sure that no birds are presently nesting within it. If nesting birds are found, then clearing should be halted until a suitable buffer is placed around the nest and no further clearing should take place until it has been determined that the young have fledged and are able to leave the area;
- It was determined during the June 2013 wildlife survey that no suitable habitat was present for amphibian breading as there were no ponds or wetland and the majority of the site is too steeply sloped.

## 3.0 ALTERNATIVE ASSESSMENT

The following three (3) general categories of works, and eight (8) specific potential alternatives have been developed to mitigate the identified problems. Detailed descriptions of each potential alternative can be found in the main report.

**A. Repair Minor Erosion with Spot Treatments**

1. Vegetation
2. Bioengineering
3. Hard or structural solution

4. Combination

**B. Creek Rehabilitation**

1. Protect-In-Place
2. Realignment

**C. Infrastructure Improvements**

1. Pedestrian Bridge Upgrades
2. Trail Realignment

### 3.1 Preferred Alternative: Protect In-Place

The protect-in-place alternative employs local or spot treatments to address channel issues which are small-scale or isolated. Generally, it is used for concerns such as bank erosion or issues related to infrastructure within the channel (sewers and bridges). Protect-in-place is preferable for areas where the channel is highly constrained by the surrounding area and therefore the channel footprint cannot be altered. Surrounding constraints could consist of development, infrastructure, topography, or sensitive habitat (trees, wetlands, etc.). In these cases, protect-in-place is a preferred solution as it limits disturbance to the surrounding area and can address immediate concerns at the selected locations.

For bank protection there are a number of different treatments that can be used that vary based on the severity of the issue and the risk to the surrounding area. Generally the treatment is only needed for the eroding bank, which minimizes overall disturbance. For areas that are low risk, and/or low scour potential, a simple treatment which consists primarily of vegetation (e.g. brush mattress) can be used (ref. Figure 1). When there is higher risk due to constraints, surrounding infrastructure or high scour potential, more rock is incorporated to provide added stability (Figures 2 and 3).

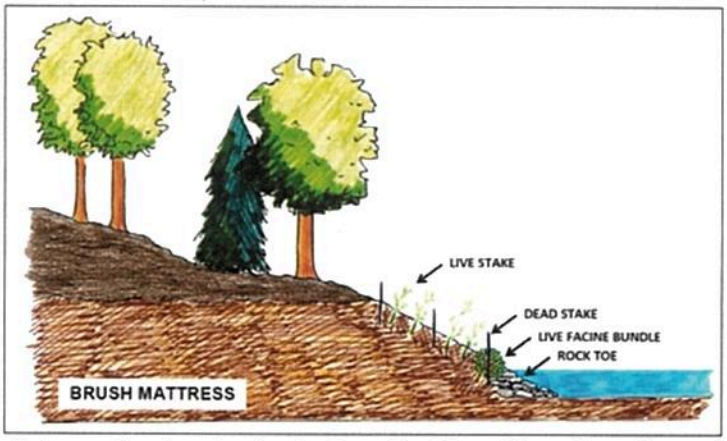


**Figure 1: Schematic showing typical application of brush mattress treatment**

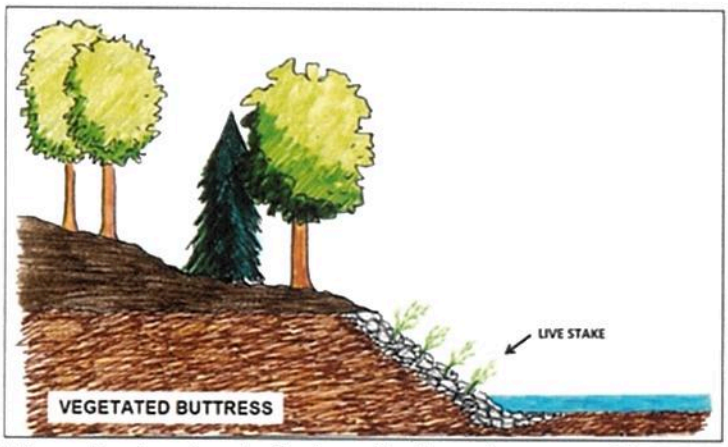


**Figure 2: Schematic showing typical application of vegetated buttress treatment**

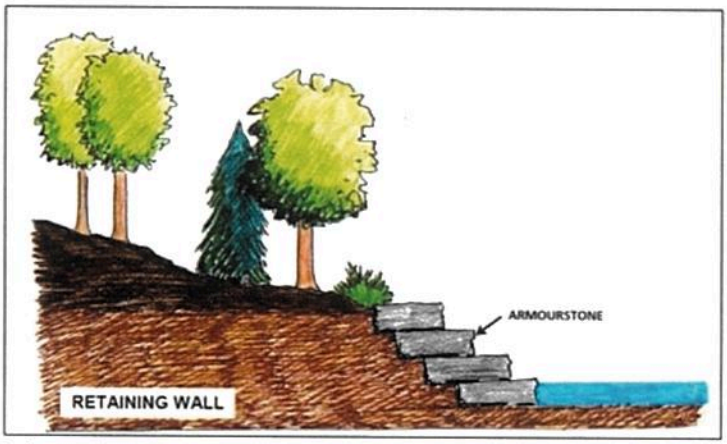


**Figure 3: Schematic showing typical application of armour stone retaining wall.**

Within the study area, most of the issues are related to erosion at valley wall contacts and through existing pedestrian bridges. Applying the protect-in-place alternative would involve protecting the toe of the valley wall, or the reach through the pedestrian bridges to reduce fluvial erosion. In both cases, the existing bank and/or toe of slope would need to be protected using one of the more substantial treatments such as a vegetated buttress or vegetated rip-rap. Drawing 1 illustrates the potential location of protect-in-place bank and toe stabilization works. The disadvantage of this alternative is that the risk of fluvial action is not fully addressed because the channel alignment is unaltered and will continue to flow proximate to the feature at risk. Therefore, there is a long-term risk that the treatment could require maintenance in the future.

### 3.2 Secondary Alternative: Infrastructure Improvements

As previously noted, the McCraney Valley Trail system provides pedestrian access throughout the Study Area (ref. Drawing 1). The trail crosses West Morrison Creek in several places, as well as traversing along the banks in several locations, often where active erosion has been observed. The Town of Oakville, under an easement agreement with Sheridan College, maintains the

McCraney Valley Trail, including the pedestrian bridges. As such, this alternative considers works that could potentially be completed with the Town, on Sheridan College lands.

## 4.0 PREFERRED SOLUTION

In accordance with the discussions with staff, the field work, and the evaluation of alternatives, the following combination of alternatives has been recommended as the Preferred Solution:

***The recommended solution to the erosion problem is a combination of minor spot treatment and repair, protecting the existing bank and slopes in-place, with minor creek adjustments, and protecting bridge abutments in-place.***

Each of the pedestrian bridges within the reach has insufficient spans, rise and/or alignment. In the long-term it is recommended that these structures be replaced. In the short-term, with consideration for capital cost and structure design life, it is recommended that the existing channel be protected-in-place through the pedestrian bridge sections by way of bank stabilization to reduce the risk to the existing bridge and abutments and trail.

There is also a large outfall (OF-5) which is perched and poorly connected to the main channel which would be addressed as part of the realignment work near the downstream end of the reach. As it exists currently, the spillway for the outfall is aligned perpendicular relative to the location of the outfall. The spillway would be redesigned to both raise the bed elevation to the invert of the outfall and create an alignment that properly connects to both the outfall location and the main channel. At the downstream end of the reach a second outfall channel (OF-6) requires protect in-place repairs to reduce bank erosion adjacent to a trail and pedestrian bridge. In-channel work at this location may also be required to provide additional stability. At the upstream end of the reach, OF-B consists of a 300 mm diameter CSP projecting in to the creek, which requires some bank treatment.

This preferred solution addresses three primary erosion concerns:

1. Slows down the erosion process by dissipating energy, and by reducing some of the scouring of the banks at the toe by the creek.

2. Rehabilitates those areas currently negatively impacted by erosion and scouring.

3. Indirectly addresses part of the cause of the problem in order to prevent future erosion and scouring problems.

***Advantages:***

- Removes the creek from severe slope erosion at valley wall contact points
- Stabilizes the slope against further erosion from undermining of the toe.
- Provides a base for the slope to build upon, and over time reach a stable inclination, reducing the risk of slope failure and damage to property.

***Disadvantages:***

- Some local removal of vegetation on banks.

Additional Considerations

Based on the foregoing factors, as well as input received from the College, stabilizing the slope by buttressing the toe with armour stone, and shifting the creek to compensate for 'lost' hydraulic conveyance capacity, has been advanced as the preferred solution for the more severe erosion locations. This solution embodies the most positive aspects of the design considerations and features discussed above.

The opportunity for improving fish habitat was identified at the inventory stage, and in the recommendations. This reach has been classified by the Study Team as indirect habitat, as there are currently no fish within this reach, and there are numerous barriers to migration between this reach and the Sixteen Mile Creek, 3 - 4 km downstream. Given that primary objective of this study has been to address the erosion and instability of the reach, the design will necessarily address erosion, and where feasible will incorporate design features for improving local fish habitat. CH supports the long-term goal of removing barriers to migration. The existing channel thalweg (low flow channel) is on shale bedrock in many locations, however, where material is proposed to be added, an opportunity will exist to incorporate a low-flow channel into the new creek invert. Similarly, several stabilized bank locations will offer an opportunity to include plantings and bioengineering, as long as the creek velocities are low enough to permit the works.

Opportunities to remove the numerous fish barriers on the tributaries could also be reviewed however there is little potential to develop and sustain fish habitat on the tributaries.

In addition to the above, consideration should be given to the opportunity to enhance the ecological function of the watercourses through plantings as part of the construction works. Given the opposition to loss of vegetation, the creek will be designed to be the minimum width required to convey the Regulatory flood, without a decrease in flood storage (otherwise the design will not be approved by the Conservation Authority).

### *4.1.1 Prioritization of Works*

Drawing 1 shows key observations including the location of culverts, pedestrian bridges, storm sewer outfalls, existing creek bank stabilization works, and valley wall contact points.

The priority for implementing the various works has been established based on the potential damages to private, municipal or Sheridan College property. The following is a summarized list of project priorities:

1. Valley toe stabilization behind 1135 McCraney Street East
2. Valley toe stabilization behind Kelsey Court
3. Valley toe stabilization adjacent to the McCraney Street right-of-way, and storm outfall
4. Creek stabilization through McCraney Valley Trail pedestrian bridges
5. Creek stabilization where trail is impacted
6. Valley toe and storm outfall stabilization on north side of Morrison Creek
7. Minor erosion repairs on campus tributaries

### *4.1.2 Preliminary Cost Estimate and Implementation*

Works on Sheridan College lands would be planned and designed by Sheridan College and implemented at their discretion and subject to regulatory approvals.

The preliminary cost estimate for the proposed locations of creek rehabilitation is shown in Table 1. The unit costs for the restoration per metre are slightly higher than previous contracts in the area, on account of the difficulty expected in accessing the work site, as well as the requirement for minimizing the disturbance to the valley.

**TABLE 1**
**SHERIDAN COLLEGE - MORRISON CREEK EROSION CONTROL**
**PRELIMINARY COST ESTIMATE**

| Location/Description | Unit | Quantity | $/Unit | Total $ | Rank |
|---|---|---|---|---|---|
| | | | | | |
| 1 Slope stabilization at the toe, with up to triple row of armour stone, and adjustment to far bank to preserve conveyance | m | 25 | 1,000 | 25,000 | High |
| 2.1 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 40 | 800 | 32,000 | High |
| 2.2 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 15 | 800 | 12,000 | High |
| 3.1 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 50 | 800 | 40,000 | Medium |
| 3.2 Storm channel regrading and stabilization from outfall to creek (assume headwall intact) | m | 15 | 500 | 7,500* | Medium |
| 4 Creek bank protection at all 6 bridges, bioengineering and stone for channel lining, including excavation | m | 100 | 500 | 50,000* | Medium |
| 5.1 Bank stabilization with rip rap and bioengineering for path | m | 15 | 300 | 4,500 | Medium |
| 5.2 Storm channel regrading and stabilization from outfall to creek at OF-6 | m | 40 | 500 | 20,000 | Medium |
| 6 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 40 | 800 | 32,000 | Low |
| 7 Minor slope stabilization within campus | LS | 1 | 10,000 | 10,000 | Medium |
| Vegetation removal and replanting within campus | LS | 1 | 20,000 | 20,000 | High |
| *Temporary Access Road and Restoration* | LS | 1 | 30,000 | 30,000 | |
| Subtotal | | | | 243,000 | |
| Engineering and Approvals (15 %) | | | | 42,450 | |
| Contingency (15%) | | | | 42,450 | |
| **Total Cost (excl. H.S.T.)** | | | | **$367,900** | |

The amount of work that the college may decide to undertake at any given time will primarily be a function of available budget, and the priority of the works.

The top two priority categories (i.e. 1 and 2) should be considered high priority, however we note that as of the summer 2015, there was not any significant erosion occurring on the table lands above these locations. The potential for erosion at the toe remains high, and therefore the same can be said for the valley slope, and top of slope.

## Recommendations

At the request of the college, we have broken the list down into a proposed set of groups, based on priority, and with the total of each work program targeted to be approximately $100,000. There will necessarily be some increase in the total cost estimate when multiple contracts are proposed to be let over several years. We have assumed that there is a possibility to leave some of the temporary access road in place between contracts. We have also assumed that the vegetation management plan on campus can be spread out over at least two contracts. Finally, we have assumed that since the college is a private landowner, that the agencies will not require additional environmental studies for the erosion works. Should further studies be required, this could easily add another 10-15 % to each project.

**TABLE 2**
**SHERIDAN COLLEGE - MORRISON CREEK EROSION CONTROL**
**PRELIMINARY COST ESTIMATE – Four Phases**

| Location/Description | Unit | Quantity | S/Unit | Total S |
|---|---|---|---|---|
| Phase A | | | | |
| 1 Slope stabilization at the toe, with up to triple row of armour stone, and adjustment to far bank to preserve conveyance | m | 25 | 1,000 | 25,000 |
| 2.1 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 40 | 800 | 32,000 |
| Vegetation removal and replanting within campus | LS | 1 | 10,000 | 10,000 |
| Temporary Access Road | LS | 1 | 10,000 | 10,000 |
| Subtotal | | | | 77,000 |
| Engineering and Approvals (15 %) | | | | 11,550 |
| Contingency (15%) | | | | 11,550 |
| **Total Cost (excl. H.S.T.)** | | | | **$100,100** |
| | | | | |
| Phase B | | | | |
| 2.2 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 15 | 800 | 12,000 |

| | | | | |
|---|---|---|---|---|
| 3.1 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 50 | 800 | 40,000 |
| 3.2 Storm channel regrading and stabilization from outfall to creek (assume headwall intact) | m | 15 | 500 | 7,500* |
| Vegetation removal and replanting within campus | LS | 1 | 10,000 | 10,000 |
| Extend Temporary Access Road | LS | 1 | 10,000 | 10,000 |
| Subtotal | | | | 79,500 |
| Engineering and Approvals (15 %) | | | | 11,925 |
| Contingency (15%) | | | | 11,925 |
| **Total Cost (excl. H.S.T.)** | | | | **$103,350** |
| | | | | |
| **Location/Description** | **Unit** | **Quantity** | **$/Unit** | **Total $** |
| Phase C | | | | |
| 4 Creek bank protection at all 6 bridges, bioengineering and stone for channel lining, including excavation | m | 100 | 500 | 50,000* |
| Temporary Access Road and Restoration | LS | 1 | 10,000 | 10,000 |
| Subtotal | | | | 60,000 |
| Engineering and Approvals (15 %) | | | | 9,000 |
| Contingency (15%) | | | | 9,000 |
| **Total Cost (excl. H.S.T.)** | | | | **$78,000** |
| | | | | |
| Phase D | | | | |
| 5.1 Bank stabilization with rip rap and bioengineering for path | m | 15 | 300 | 4,500 |
| 5.2 Storm channel regrading and stabilization from outfall to creek at OF-6 | m | 40 | 500 | 20,000 |
| 6 Slope stabilization at the toe, with double row of a armour stone, and adjustment to far bank to preserve conveyance | m | 40 | 800 | 32,000 |
| 7 Minor slope stabilization within campus | LS | 1 | 10,000 | 10,000 |
| *Temporary Access Road and Restoration* | LS | 1 | 20,000 | 20,000 |
| Subtotal | | | | 86,500 |
| Engineering and Approvals (15 %) | | | | 12,975 |
| Contingency (15%) | | | | **12,975** |
| Total Cost (excl. H.S.T.) | | | | **$112,450** |
| **Combined Total Cost (excl. H.S.T.)** | | | | **$393,900** |

Ultimately, the college will need to seek approvals for works through the Town, Conservation Halton, and potentially the Region of Halton. The Town has agreed in principle to advancing an integrated approach to planning, and to developing a holistic solution that is both acceptable to Sheridan College, and ultimately approvable by the Agencies. While the two projects would proceed independently, there would be several opportunities for liaison between the Town and Sheridan College.

Each Phase design will identify opportunities to integrate other sustainability features into the proposed works, such as: invasive species management, removal of barriers to fish migration, updating of pedestrian bridges, planting plans, and educational possibilities.