EROSION AND SEDIMENT CONTROL PRACTICES EVALUATION
Vaughan, Ontario




Prepared by: Toronto and Region Conservation

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EROSION AND SEDIMENT CONTROL PRACTICES EVALUATION

Final Report

Prepared by:

Toronto and Region Conservation

under the

Sustainable Technologies Evaluation Program

In partnership with:

City of Vaughan
City of Toronto
Environment Canada
Fisheries and Oceans Canada
The Great Lakes Sustainability Fund
Ontario Ministry of the Environment
Region of York
Region of Peel

2009

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THE SUSTAINABLE TECHNOLOGIES EVALUATION PROGRAM

The Sustainable Technologies Evaluation Program (STEP) is a multi-agency program, led by the Toronto and Region Conservation Authority (TRCA). The program was developed to provide the data and analytical tools necessary to support broader implementation of sustainable technologies and practices within a Canadian context. The main program objectives are to:

- monitor and evaluate clean water, air and energy technologies;
- assess barriers and opportunities to implementing technologies;
- develop tools, guidelines and policies, and
- promote broader use of effective technologies through research, education and advocacy.

Technologies evaluated under STEP are not limited to physical structures; they may also include preventative measures, alternative urban site designs, and other innovative practices that help create more sustainable and liveable communities.

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- City of Toronto
- Environment Canada;
- Fisheries and Oceans Canada;
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[1] The Great Lakes Sustainability Fund is a component of the Federal Government's Great Lakes program. The Sustainability Fund provides the resources to demonstrate and implement technologies and techniques to assist in the remediation of Areas of Concern and other priority areas in the Great Lakes. Although this report was subject to technical review, it does not necessarily reflect the views of the Sustainability Fund or Environment Canada.

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1.0 INTRODUCTION

1.1 Background

Construction is arguably the most environmentally destructive phase of the land development process. The clearing of vegetation, stripping of topsoil, and alteration of natural slopes and drainage features leave land susceptible to erosion, and adjacent watercourses vulnerable to pollution by sediment-laden storm flows.

Excessive levels of deposited and suspended sediment in lakes and rivers decreases the productive capacity of aquatic habitats and increases the frequency of dredging in reservoirs. Sediment deposited on gravel stream beds compromises spawning and alters the habitat of bottom-dwelling organisms and young fish. Suspended sediments can cause abrasion of gills, a reduction in visibility required for breeding and feeding, and decreased sunlight penetration, which inhibits photosynthesis by algae and aquatic plants (Fisheries and Oceans Canada, 2008). Practicing effective erosion and sediment control (ESC) on construction sites can reduce and even prevent these adverse impacts.

1.2 Study Objectives

This study evaluates structural and non-structural approaches to improving the practice of erosion and sediment control on construction sites. Approaches investigated have been identified as key areas for improvement through past research and field studies, and consultation with industry stakeholders. The specific objectives of the study are to:

- assess the potential for structural ESC measures applied within the catchment, upstream of the sediment control pond, to reduce sediment loads to the pond;
- identify barriers to effective communication and other construction practices that impede the application of effective ESC, and recommend solutions;
- pilot and refine a staged approach to ESC planning such that controls being used evolve based on the stage of construction; and
- examine and evaluate the adaptive process by which ESC practices are implemented and amended throughout the construction process.

The work undertaken to achieve these objectives has included evaluating the effectiveness of on-site structural controls, electronic inspection communication methods, and staged ESC planning. There are three distinct components of this study;

- Quantitative and qualitative field monitoring of the performance of conventional and innovative structural erosion and sediment controls
- Demonstration of ESC plan staging and documentation of successes and challenges
- Piloting of a web-based inspection tool for improved communication of inspection outcomes to project team members and governing agency representatives

Each of these is discussed separately in the following three chapters.

Study findings will help to improve understanding of how ESC is applied on the ground, and thereby ensure that future policies, guidance documents and practitioner training continue to promote improvements to ESC practice.

2.0 FIELD EVALUATION OF STRUCTURAL ESC MEASURES

2.1 Context

2.1.1 Background

While significant progress has been made in ESC practice over the years, recent studies have demonstrated that levels of sediment discharged from construction sites are still elevated above thresholds required to protect aquatic habitat (Greenland International and TRCA, 2001; Clarifica Inc., 2004; TRCA and University of Guelph, 2006). Monitoring of 'enhanced' level construction sediment ponds in Richmond Hill and Markham demonstrated that while ESC pond design improvements are an important part of the solution, sediment loads entering these ponds must also be reduced if effluent concentrations are to meet targets for aquatic habitat protection (TRCA and University of Guelph, 2006).

The most effective way to achieve this objective is to reduce both the total volume of water flowing into the pond and the total mass of sediment contained in the inflow. Techniques that prevent erosion and promote infiltration and evapotranspiration of stormwater are particularly effective in this regard. Practices such as development phasing, retention of existing vegetation, and provision of shallow soakaway areas throughout the site are all good examples of how this can be accomplished. In practice these techniques are seldom used, largely because they have proven difficult to reconcile with common construction practice, which typically involves the clearing of the entire site at the beginning of construction, and grading targeted at ensuring the site is well drained after a rain event so that work can proceed quickly.

In this study the development of Block 39 serves as a representation of common field practice on construction sites throughout the Greater Golden Horseshoe Area (GGHA). Results obtained from field monitoring at this site will improve understanding of which practices do and don't work, what construction operating practices impede effective ESC, and how these obstacles can be overcome.

2.1.2 Study Site

The study area is located within Block 39 in the City of Vaughan, near the intersection of Pine Valley Drive and Major Mackenzie Drive (Figure 2.1). The area is the future site of the 77 ha Vellore Village residential development, on which construction was initiated in the fall of 2007. The site drains to Marigold Creek within the East Humber River subwatershed.

Figure 2.1: Vellore Village Development study area in Vaughan, Ontario

2.1.3 ESC Measures Installed

The erosion and sediment control plans for block 39 have specified a variety of both innovative and conventional measures, including:

- cut-off swales stabilized with coir (coconut fibre) matting;
- coir logs;
- compost biofilters at site perimeter and in swales for flow interruption;
- spray and powder forms of erosion control polymers applied on select stockpiles, slopes and swales;
- flocculation polymer logs in cut-off swales for enhanced settling of suspended sediment
- seeding of slopes with annual (temporary) species;
- scour pools at discharge points;
- temporary ponding areas (other than ponds);
- erosion blankets on sediment pond embankments, slopes and spillways; and
- conventional measures such as sediment control ponds, rock check dams, silt fencing and rip rap.

Figure 2.2. shows several of these measures as installed at the study site. During the ESC planning stage, discussions with the project engineers, landowners, and municipal

staff focused on selecting measures to prevent erosion and provide as much on site detention and peak flow attenuation as possible.

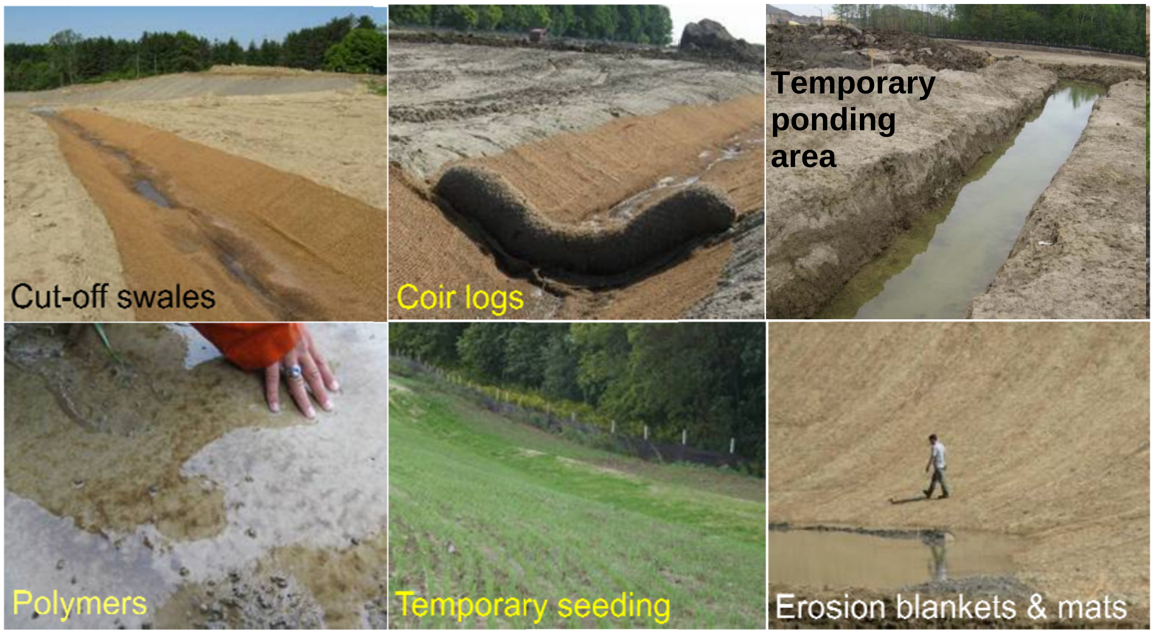

Figure 2.2: Examples of ESC Measures installed at the Block 39 study site

2.2 Approach

This study evaluates the effectiveness of both innovative and conventional erosion and sediment control practices implemented on a residential construction site in the City of Vaughan, Ontario. Effectiveness is measured through field monitoring, largely focused on assessing the quality of sediment control pond influent and effluent, as well as site effluent from other discharge locations.

2.2.1 Water Quality Monitoring

During the 2008 monitoring season, grab samples were collected during wet weather (events > 5mm) at the several key locations that would allow for characterization of suspended sediment concentrations in site runoff. Grab sampling locations are shown in Figure 2.3. They include sediment control pond inlets and all locations at which stormwater was discharged from the site (including pond outlets). Discharge from pond 2 was released through a geotextile bag into a riprap lined scour pool and passed through silt fence before leaving the site. It should be noted that local runoff from the sloping land surrounding the scour pool is also represented in samples collected at location P2S.

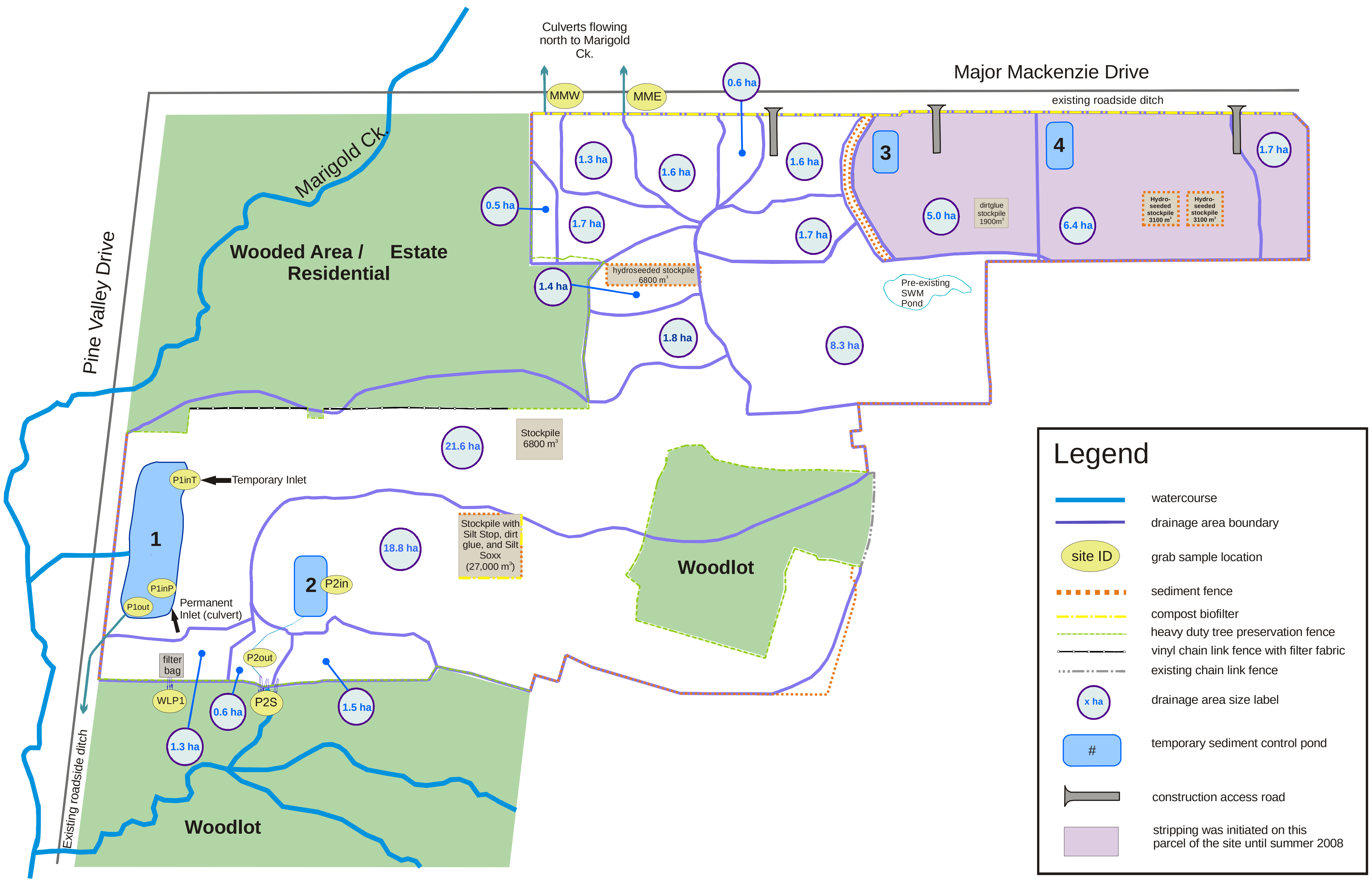

Figure 2.3: Schematic of study area showing grab sampling locations

While pond 2 (Figure 2.3) was operational for most of the 2008 monitoring season, pond 1 was not complete and fully functional until the fall. Due to delays in pond 1 outlet construction, pond 1 was regularly pumped down during dry weather to a filter bag installed in a scour pool near the southwestern perimeter of the site (WLP1 in Figure 2.3). Discharge from the bag was released through silt fence to the woodlot south of the site. All samples were submitted for processing by the Laboratory Services Branch of the Ontario Ministry of Environment and analyzed for suspended solids and turbidity.

Once pond 1 was fully operational, YSI sensors were installed at the inlet and outlet of the pond for continuous monitoring of turbidity levels. The sensors collected data during November 2008 before winter removal, and were re-installed in early April 2009. Samples from a November 2008 rainfall event were submitted to the laboratory for analysis of suspended solids concentrations. These results were used to establish a relationship between sensor turbidity measurements and TSS, and thereby convert YSI continuous turbidity readings from the sensor to a TSS concentration.

Since the stripping of the pond 3 and 4 sub-catchments and the construction of those ponds were delayed until summer 2008, they have not been included in this study.

2.2.2 Visual Assessment and Photo Documentation

The condition of the site and ESC measures installed were also documented with date-stamped photos and field notes taken during site visits. This qualitative assessment provided important information on the extent to which the measures installed were appropriately applied, installed and maintained.

2.3 Results

Total suspended solids concentrations and turbidity levels for samples taken at the site discharge locations are shown in Table 2.1. Turbidity levels higher than 2000 FTU are outside the measurement range of the instrument used by the lab.

While concentrations at the discharge points varied substantially from site to site and event to event, all but one sample were above the 25 mg/L threshold for the protection of fish and fish habitat (CCME, 1999; Newcombe, 1986; EIFAC, 1965). A more complete assessment of the impact of this discharge on aquatic habitat requires information on the TSS concentration in stream and the length of time aquatic organisms were exposed to that concentration.

Table 2.1: Total suspended solids (TSS) concentrations and turbidity of discharge from study site for rainfall events in 2008.

Sampling date	Rainfall (mm)	Pond 1 outlet (P1out)		Pond 2 stream (P2S)		Pond 1 to Woodlot (WLP1)		Major Mackenzie east (MME)		Major MacKenzie west (MMW)	
		TSS (mg/L)	Turbidity (FTU)	TSS (mg/L)	Turbidity (FTU)	TSS (mg/L)	Turbidity (FTU)	TSS (mg/L)	Turbidity (FTU)	TSS (mg/L)	Turbidity (FTU)
6/10/2008	13.4	-	-	5280	>2000	746	1310	2570	>2000	2450	>2000
7/20/2008	41	-	-	7190	>2000	-	-	-	-	-	-
7/23/2008	61.4	29200*	>2000*	14800	>2000	3650	>2000	460	656	54.4	145
8/9/2008	27	-	-	705	917	-	-	-	-	-	-
9/9/2008	19	-	-	181.0	180.0	-	-	1040	>2000	181	351
9/15/2008	15.2	-	-	66.0	162.0	-	-	-	-	-	-
10/25/2008	9.4	-	-	17.5	22.4	-	-	661	1450	-	-
12/15/2008**	n/a	51.6	92.9	-	-	-	-	3760	>2000	563	1400

* Pond 1 was overtopped during the July 23, 2008 event and samples taken represent this flood water, not stormwater that has passed through the pond outlet structure.
** Rain and snowmelt event

Figure 2.4a: Pond 2 outlet scour pool and surrounding slopes before stabilization.

Figure 2.4b: Pond 2 outlet scour pool and surrounding slopes on September 14, 2008, after stabilization.

Figure 2.5 displays pond 1 effluent turbidity levels recorded by the YSI sensors and corresponding rainfall data from March 27 to April 8, 2009. The chart also displays TSS concentrations which were calculated based on a relationship developed between turbidity readings from the YSI sensor and TSS concentrations in samples collected at the same location. These data show that effluent TSS levels consistently exceeded 25 mg/L during wet weather.

A receiving water impact assessment framework developed by Newcombe (1986; as cited by Ward, 1992) was used to assess the potential impact of these events on aquatic organisms downstream of the site. In assessing the severity of these impacts, both TSS concentrations and the duration of exposure of aquatic organisms to these concentrations are considered. The event is categorized as resulting in a minor, moderate or major impact to aquatic life. Within this framework, a TSS concentration of

25 mg/L or less is considered to have few ill effects, even when exposure time is as long as 700 hours. Figure 2.6 shows the impact that would be associated with pond 1 effluent based on data collected for the three events shown in Figure 2.5. Based on this impact analysis, all three events recorded would have a moderate impact on receiving water, if no dilution of this effluent occurred in the stream.

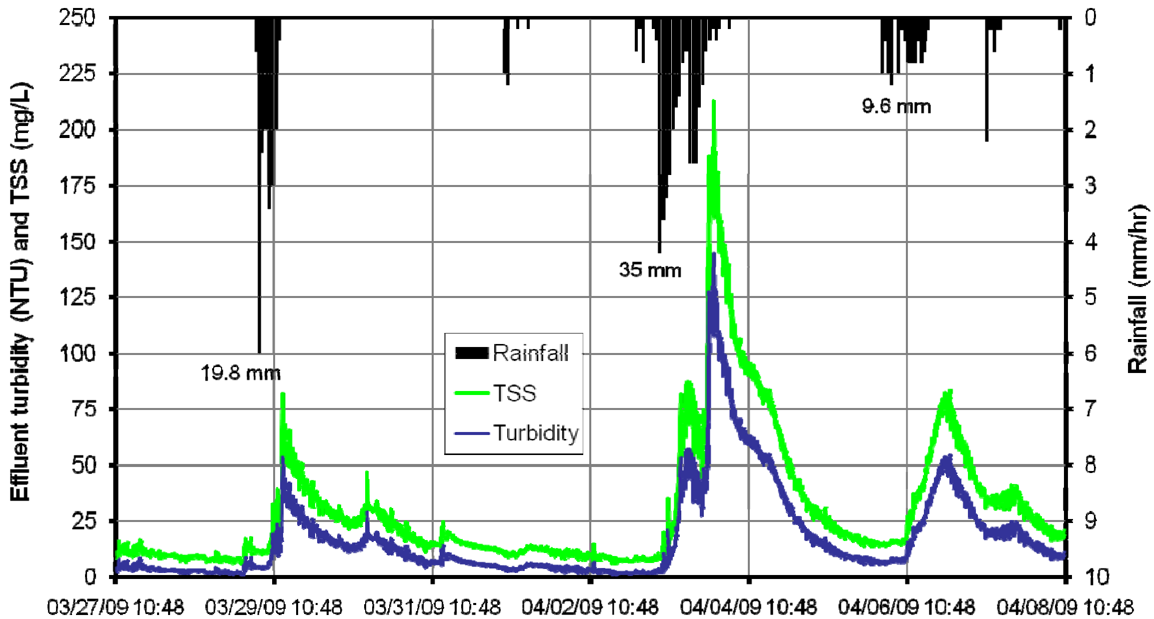

Figure 2.5: Pond 1 effluent turbidity and TSS levels for three rainfall events in April 2009

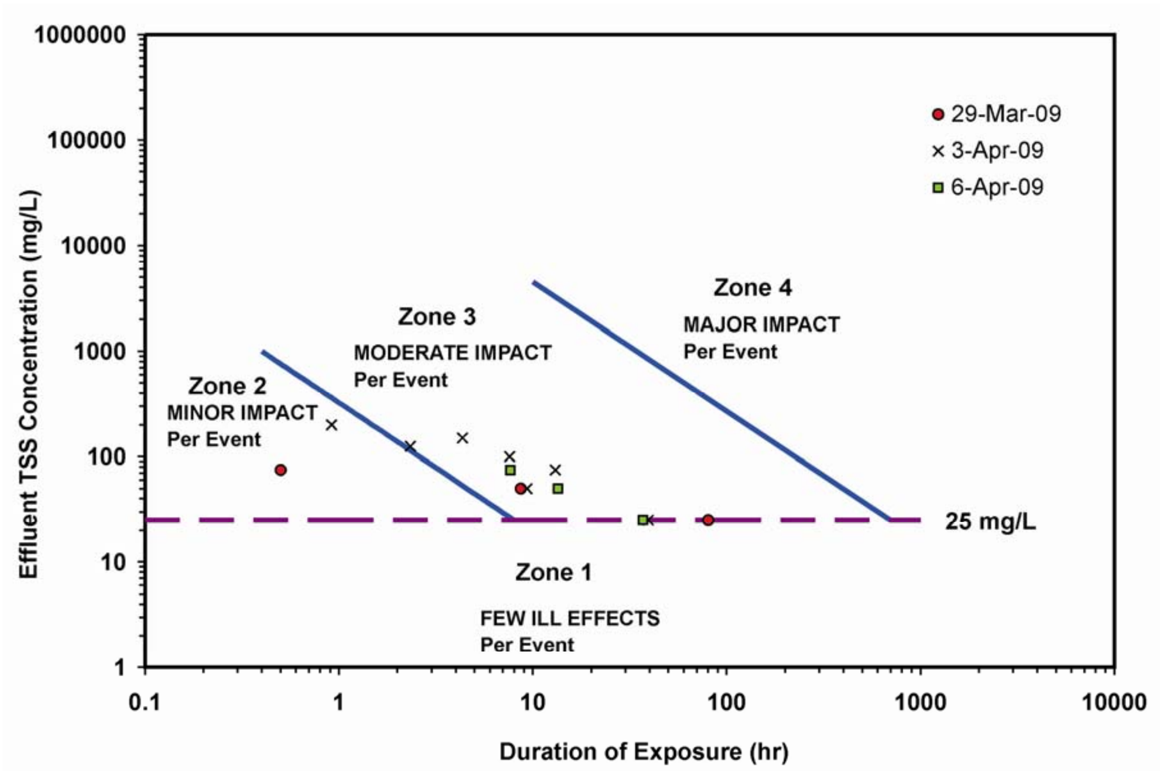

Figure 2.6: The concentrations and duration of effluent TSS for three events monitored in April 2009. The fisheries impact framework is from Newcombe (1986; as cited in Ward, 1992).

2.4 Lessons Learned

Practicing erosion prevention is an effective means of reducing the concentration of TSS in overland runoff.

A decrease in the TSS concentration of site runoff at the pond 2 discharge location was observed after the area upslope of this discharge point was stabilized. While several erosion control devices can serve the intended function of providing a physical barrier between rainfall and exposed soil, vegetative measures offer the added benefit of reducing runoff volumes through enhanced infiltration and evapotranspiration. The best method of preventing erosion is phased stripping, which is currently rarely practiced in the GGHA. In phased stripping only a portion of the site is developed at a given time while the remainder of the site retains its original vegetative cover until the portion under construction is complete and permanently stabilized. This technique minimizes the amount of time that bare soils are left exposed and susceptible to erosion.

Improving infiltration and evaporation of rainfall helps to maintain the pre-development water balance; small on-site soakaway areas can help to achieve this objective and thereby reduce flows to sediment control ponds.

As demonstrated by a TRCA and University of Guelph study (2006), reducing inflow volumes is more important to improving pond effluent quality than reducing influent TSS concentrations. This is largely attributable to re-suspension of settled sediments and displacement of the permanent pool that occurs when larger volumes flow into the pond.

At the study site, substantial quantities of stormwater were detained along the Major MacKenzie Drive (north) site perimeter. As a result, smaller events (<10mm) were often completely retained on site, resulting in no discharge to the stream at these locations. Figure 2.7 shows another example of on-site ponding areas, which were implemented during home construction. The image shows a designated ponding area located on one of the lots. A standpipe (perforated pipe) surrounded with stone was installed at the deepest part of the ponding area to allow for slow drainage to the storm sewer. In terms of maintaining the pre-development water balance, allowing water ponding in this area to completely infiltrate and/or evaporate would be more beneficial than allowing it to drain to the storm sewer. Nevertheless, the slow drainage promotes some additional infiltration and evaporation while also reducing peak flows to ponds.

Figure 2.7: Stormwater ponding area at the study site during home construction

When selecting ESC measures, it is important to consider the maintenance requirements of the controls specified and to select those that will function effectively without frequent monitoring and upkeep.

Several of the controls installed at the study site were either improperly installed or not maintained as often as needed. Maintenance of controls, particularly those that discharge to a sediment pond rather than a natural feature, are often considered low priority because the impact of their ineffectiveness is not immediately obvious, and construction staff time is occupied with other tasks that must be completed to keep the project on schedule.

Figure 2.8 shows a set of controls at Block 39 when first installed in late June 2008 (top) and after approximately one month during which the site received over 160 mm of rain (bottom), including over 115 mm received over 3 days from July 20 to 23, 2008. The images clearly demonstrate that these measures did not remain effective during these large rain events. Maintenance of these measures would require removal of accumulated sediment, replacement of blankets/mats, and re-staking of coir logs.

Figure 2.8: Coir matting and coir logs in a cut-off swale at the study site. Top images taken after installation in late June 2008 and bottom show their condition in late July 2008.

Sediment bags were also used extensively at the study site to filter water from sediment ponds prior to discharge off site. This technique was used to pump down pond 1 for several months in the spring of 2008, during pond outlet construction (see Figure 2.9).

Figure 2.9: Sediment bag and scour pool used for pumping down pond 1 during spring 2008

Based on TSS levels in grab samples from this sediment bag discharge location (WLP1 in Table 2.1 and Figure 2.3), this system of controls also failed to provide an adequate level of treatment. While these results are attributable to several factors, including the bare soils surrounding the bag, the high maintenance requirements of this system also make it more vulnerable to failure. Given the large flow volumes pumped to the bag it would require frequent replacement in order to remain effective, and since the pond can only be pumped down during dry weather, back-to-back or unexpectedly large rain events could cause the system to fail and lead to even higher levels of sediment discharged from the site. By contrast, the approved sediment control pond that was intended to treat these flows would provide a consistent level of treatment and much lower risk of significant sediment release off site.

Both these examples demonstrate the importance of selecting more robust ESC measures that will keep natural features protected even when labour is in short supply and large, infrequent rain events occur.

Protection of receiving water systems from construction-related sediment releases will require the adoption of new technologies and alternative approaches to ESC.

TSS levels in construction site discharge continue to exceed thresholds for the protection of receiving waters, which is consistent with findings of previous construction sediment studies (Greenland Inc. and TRCA, 2001; Clarifica and Ryerson University, 2004; TRCA and Guelph University, 2006). This problem must be addressed by acknowledging the shortcomings of current ESC practice and understanding the alternative approaches that will effectively deal with these problems.

In addition to the approaches described earlier in this section (*e.g.* on site detention, erosion prevention), polymer technology should be investigated as a potential means of reducing suspended sediment levels in construction site effluent. Polymer-enhanced flocculation is used extensively within the U.S. and Alberta, but has not been tested and approved for use in Ontario. If proven safe and effective, this technology has the potential to become an important component in a multi-barrier approach to ESC.

The absence of a formal guideline for concentration of suspended sediment in construction effluent makes it difficult for industry professionals to gauge the performance of ESC measures installed.

Environmental monitors for Block 39 and other ESC professionals have communicated the need for a point of reference when they are monitoring effluent TSS levels. To this end, a construction effluent TSS/turbidity guideline should be developed based on concentration and duration of exposure. The first step towards this guideline should be a thorough review of existing construction effluent standards from other jurisdictions, which will help to determine what thresholds and assessment methods would be most consistent with local guidelines, by-laws and legislation.

3.0 ESC PLAN STAGING

The term 'ESC plan staging' refers to the technique of designing a different set of plans for each stage of construction. This approach involves identifying distinct stages of construction during which specific activities take place (*e.g.* topsoil stripping, cut and fill, servicing, home construction), and then selecting the types and locations of ESC measures most appropriate for each stage. Staged ESC planning helps to ensure that the measures in place are always the most appropriate for the site conditions.

3.1 Background

Under the Conservation Authorities Act (R.S.O. 1990), the Toronto and Region Conservation Authority (TRCA) has the power to regulate development, interference with wetlands, and alterations to watercourses and shorelines. In this capacity, the TRCA provides technical advice related to flood and erosion control, stormwater management, and protection of natural features.

Erosion and sediment control plans are circulated for technical review by TRCA staff, and once approved these plans form the basis of a permit issued under Ontario Regulation 166/06 (Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses). For development sites that do not include part of an area regulated under O.R. 166/06, TRCA staff also provide technical review of ESC plans circulated under the Planning Act (R.S.O. 1990).

The current TRCA development review process includes only one ESC plan submission at the beginning of the project in order to obtain approvals required before earthworks can begin. The drawings submitted typically show measures to be installed at one fixed point in time during construction and provide little information on when each measure will be in place and how they will be relocated and/or modified based on site conditions. In particular, they fail to show how the types of controls and their locations will evolve from earthworks, to servicing, to home construction. For example, overland conveyance of storm flows during earthworks requires a different system of controls than those in place for conveying stormwater during underground servicing and home construction (Figure 3.1). In order to ensure environmental protection over the entire construction period, from breaking ground to final stabilization, the ESC plan must evolve as the landscape and drainage patterns of the site evolve.

(a)

(b)

Figure 3.1: (a) cut-off swale installed during earthworks and (b) storm drain inlet protection installed for underground services/building construction (*Note: control shown in (b) is not installed at study site*)

3.2 Approach

The planning and construction of the development at Block 39 has demonstrated a staged ESC planning approach in which separate plans were submitted for approvals at the following distinct stages of construction:

1) Topsoil stripping;
2) Cut and fill to pre-grade elevations;
3) Construction of underground services; and
4) Home construction

The initial permit approval granted based on the first set of drawings (for topsoil stripping) was revised at each new stage of construction as new drawings were submitted and approved.

3.3 Lessons Learned

The approach used has demonstrated a distinct improvement over the existing development review process (summarized in Figure 5.1). In particular, the fact that each set of drawings clearly showed the condition of the construction site during that stage helped to facilitate discussions regarding the types and locations of ESC measures to be implemented. The demonstration of this method also revealed potential areas for improvement in this four-stage approach. The key challenges that were encountered by regulatory agency staff (*i.e.*

enforcement, plan reviewers) and project team members (*i.e.* consulting engineers, construction staff, landowners, environmental monitors) are described below.

Timing of ESC plan submissions

The requirement to submit each plan for approval prior to the commencement of the associated stage of construction proved somewhat difficult to coordinate from a practical standpoint. In practice, some plans were submitted after the activities depicted on the plans had already begun, largely due to the unpredictable nature of the construction process and a lack of communication among project team members.

Definition of construction stages

While the four stages of construction are a useful way of categorizing the main activities that take place in a development project, in practice these stages are not always distinct from one another. Construction sites are very dynamic; it is common for different areas to be at different stages of construction, making it challenging for regulatory agencies to interpret whether a site is conforming with approved plans.

Increased workload for design engineer and regulatory plan reviewers

This demonstration of staged ESC planning involved a greater number of submissions prepared by project design engineers and reviewed by regulatory staff. The multiple submissions were generally regarded as making the development review process more onerous and complicated without adding a substantial benefit.

Moving forward, the ESC staging approach could be improved if all plans are submitted and reviewed at the beginning of the project. This would make the submission and review process simpler while still achieving the main objective of stage-specific ESC planning. All ESC plans submitted would still be considered dynamic and open to modification by the design engineer as needed based on site conditions. As the need for modification of any of the plans arises, regulatory agencies should be provided with updated drawings.

Further, the adoption of a two-stage rather that a four-stage approach could also streamline the process and reduce workload. The first plan should show ESC measures to be installed prior to the start of earthworks (pre-earthworks plan) while the second plan (pre-servicing plan) shows measures to be installed before construction of underground services. Any key alterations planned during cut and fill, home construction and decommissioning could then be included as notes on either the earthworks or servicing plans.

4.0 PILOTING OF A WEB-BASED INSPECTION TOOL

4.1 Background

Communication among construction project stakeholders is essential in the design, implementation and maintenance of effective erosion and sediment controls. The GGHA Guideline outlines the roles and responsibilities of key construction project team members, emphasizing the importance of communication, particularly with respect to ESC plan changes, inspection outcomes and emergency response.

The use of a web-based tool for documentation and reporting of ESC site inspections has the potential to improve transparency and communication among project team members and regulatory agency staff. Ultimately, this improved communication allows for better management of ESC on site and promotes a heightened awareness of site conditions to all individuals involved in the project.

4.2 Approach

The construction of the Block 39 development has provided the opportunity to pilot a web-based tool for inspection of construction site erosion and sediment controls. A screen capture of the inspection tool interface is shown in Figure 4.1. The tool has been developed for TRCA by Certified Erosion Control (CEC), and has been used as a means of sharing ESC inspection reports among project stakeholders since December 2007.

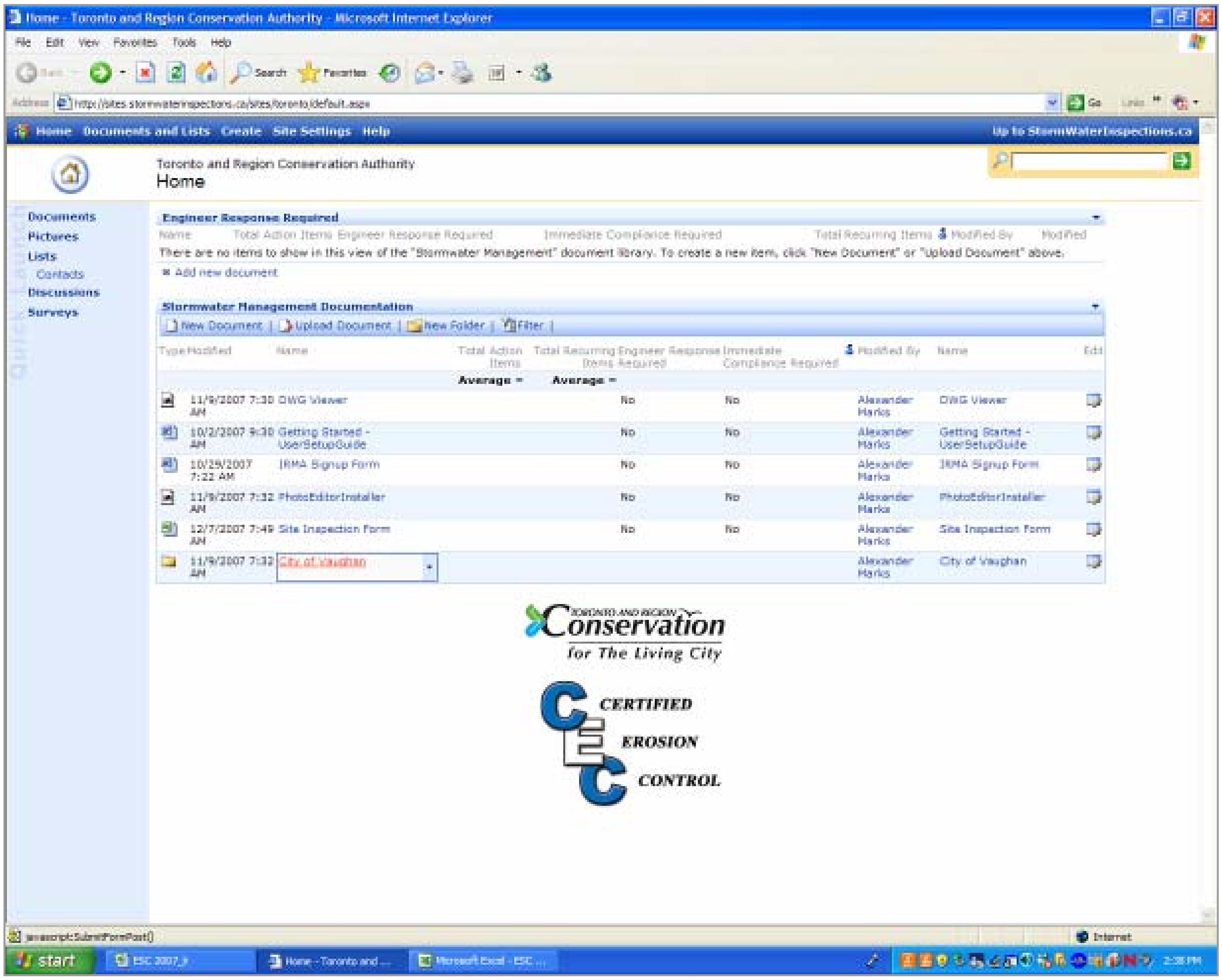

Figure 4.1: Screen capture of web-based inspection tool interface

The tool is accessible via the web by authorized users with a login ID and password. Authenticated users include the developer, contract administrator and/or consulting engineers, contractor, environmental monitor, and TRCA and municipal staff. Email alerts are set up based on the profile of the user, with some registered users receiving regular updates of all activity and others only when a spill or other emergency occurs.

The following items are accessible to users logged into the tool:

- all ESC plan drawings
- inspection form spreadsheet template (provided in Appendix A)
- completed inspection forms
- digital photos taken during inspections
- list of contact information for key project personnel and governing agency staff
- various applications to assist in the uploading, downloading or viewing of information from the site (*i.e.* DWG viewer, photo upload software)
- other relevant files added by authorized users, e.g. TRCA enforcement staff inspection reports

Over the course of the study, feedback from practitioners using the tool has been provided to Certified Erosion Control to assist in determining what improvements are needed to ensure that it remains relevant, versatile and easy-to-use.

4.3 Lessons Learned

Based on feedback from users of the tool several improvements were made during 2008 and early 2009. Some of the key improvements and additions to the online tool have included:

- construction site image to be used for indicating locations where measures need to be repaired and/or added
- facilitation of photo uploading with the addition of quick uploading software
- modification of inspection form to include additional space for comments on specific ESC measures
- added capability to count and display the total number of new and recurring action items from an inspection report in a menu list of inspection reports, without requiring users to open the completed inspection report (Figure 4.2)

Stormwater Management Documentation

New Document | Upload Document | Up | New Folder | Filter |

Type	Created	Name	Total Action Items	Total Recurring Items	Engineer Response Required	Immediate Compliance Required
	11/30/2007 1:17 PM	Site Inspection Report 11-30-07	1		No	No
	12/4/2007 1:16 PM	Site Inspection Report 12-03-07	2		No	Yes
	12/7/2007 4:24 PM	Site Inspection Report 12-07-07	2		No	Yes
	12/10/2007 4:41 PM	12-10-07	0	0	No	No
	12/12/2007 4:13 PM	Site Inspection 12-10-07	0	0	No	No
	12/14/2007 4:36 PM	Site Inspection Report 12-14-07	0	0	No	No
	12/18/2007 1:12 PM	Site Inspection Report 12-17-07	0	0	No	No
	12/20/2007 2:49 PM	Site Inspection Form 12-19-07	0	0	No	No
	12/27/2007 2:28 PM	Site Inspection Form 12-27-07	0	0	No	No
	1/4/2008 11:05 AM	Site Inspection Report 1-03-07	0	0	No	No
	1/7/2008 4:12 PM	Site Inspection Report 1-07-08	2	0	No	Yes
	1/9/2008 2:01 PM	Site Inspection Report 1-09-08	3	0	No	Yes
	1/11/2008 4:19 PM	Site Inspection Report 1-11-08	1	0	No	No
	1/15/2008 6:15 PM	Site Inspection Report_2 1-14-08	1	1	No	No

Figure 4.2: Screen capture of the list of completed inspection reports with columns showing the number of action items for each report and whether immediate action was required.

5.0 RECOMMENDATIONS

The recommendations presented in this section are targeted towards improving ESC practice in three key ways:

- Advancing practice in the field by promoting the best available methods, bringing new technologies forward, and facilitating practitioner training.
- Increasing transparency in ESC plan design, inspection and reporting, and fostering co-operation between the industry and regulatory agencies.
- Increasing accountability and clarifying each party's roles and responsibilities.

They have been developed based on the results described in the preceding chapters, as well as through ongoing consultation and discussion with industry and regulatory agency stakeholders. Flowcharts of the existing development review process (Figure 5.1) and the process with proposed changes (Figure 5.2) are also provided to better depict some of the policy recommendations in this section.

Approved ESC Plans must be considered dynamic; measures should be upgraded and/or amended as needed to protect against sediment releases at all times.

Even when measures are implemented according to approved plans, adjustments must be made as necessary when ongoing monitoring identifies a risk of ESC failure. Plans submitted should include a note with the following standard wording: *The ESC strategies outlined on the approved plans are not static and may need to be upgraded/amended as site conditions change to minimize sediment laden runoff from leaving work areas. If measures prescribed on the plans are not effective in preventing the release of a deleterious substance, then alternative measures should be implemented immediately to minimize ecological impacts.*

The proponent should be required to submit an ESC plan in at least 2 stages as part of development applications to TRCA and the local municipality

The four-stage ESC planning approach piloted on Block 39 did not yield a substantial improvement in the existing process due to challenges with the timing of submissions, increased workload and lack of clarity on the different stages. Submission of a two-stage plan is less onerous than the four-stage plan piloted, while still providing adequate detail on the ways in which controls will evolve as site conditions change.

The first submission, called pre-earthworks, should detail all measures to be installed prior to the initiation of topsoil stripping and earth moving activities. The second submission, called pre-servicing, should show measures that will be in place prior to the construction of underground services. The second submission should include notes detailing the methods of ESC to be used during subsequent construction activities, including home construction.

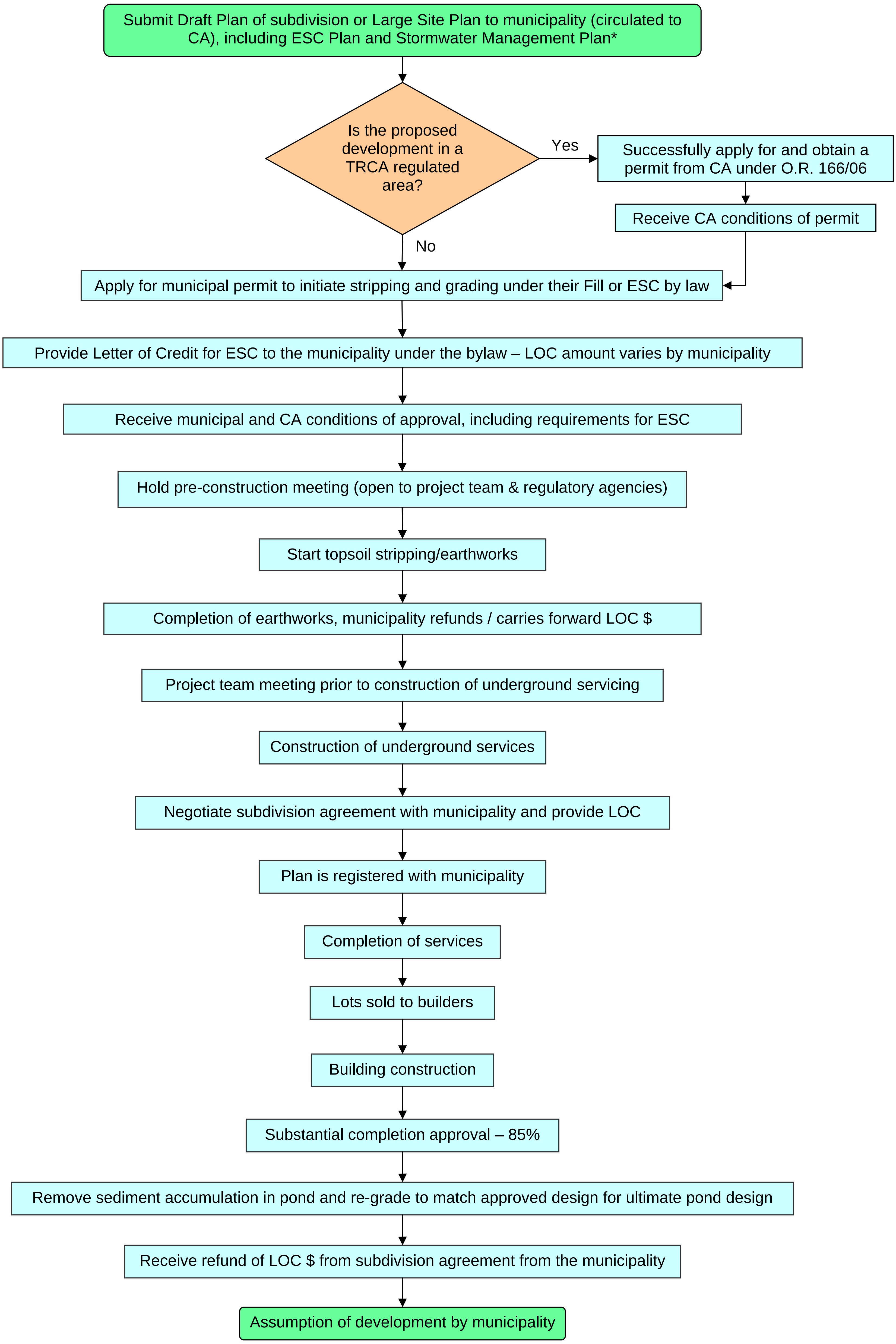

Figure 5.1: Flowchart of existing ESC plan review process from the perspective of the landowner
* Type of first submission may vary from development to development.

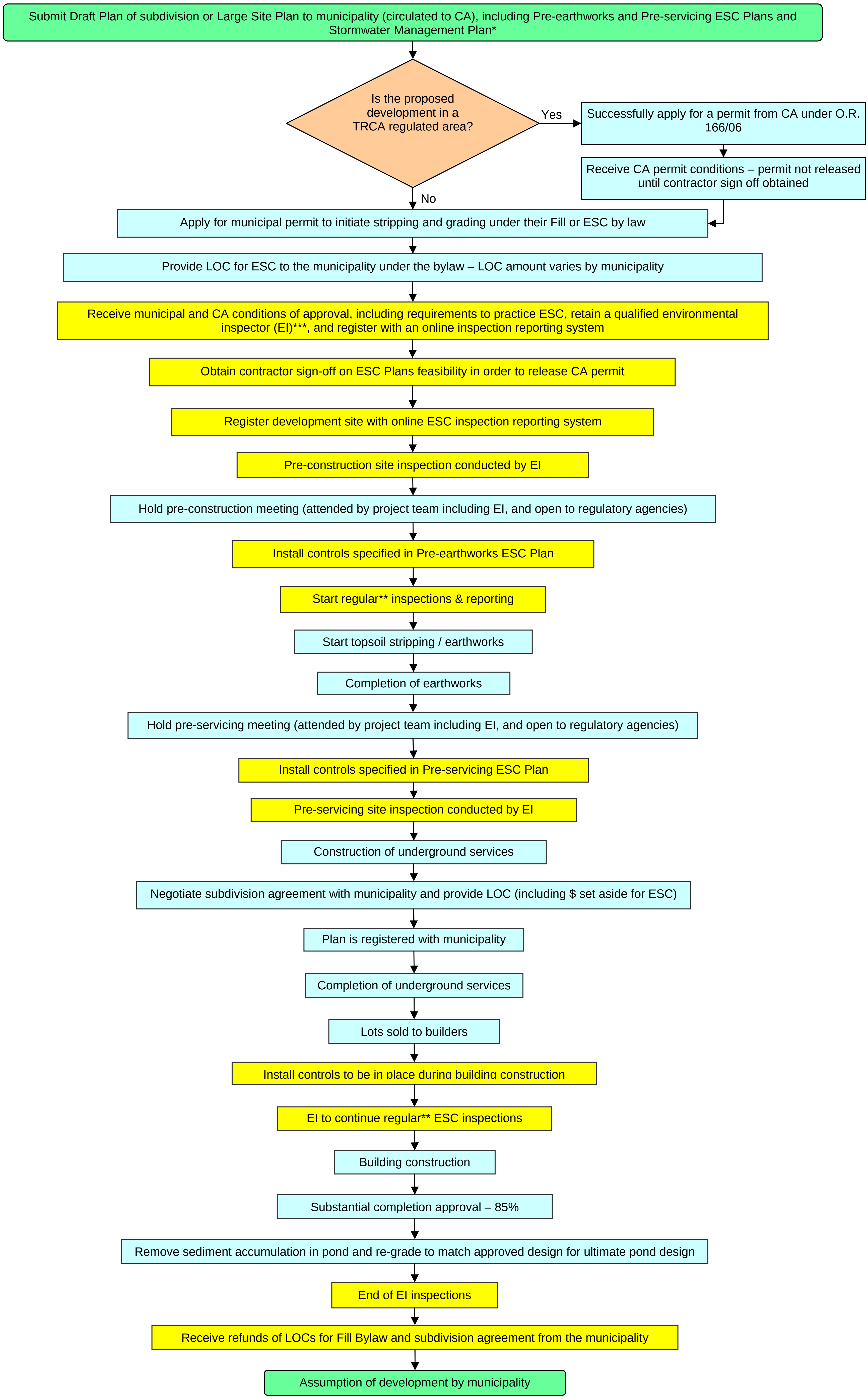

Figure 5.2: Flowchart of ESC plan review process including recommended changes (shown in yellow)

*Type of first submission may vary from development to development.
** ESC inspections should be conducted (i) at least every 7 days during active periods, (ii) monthly during inactive periods, and (iii) before and after all rain and snowmelt events.
*** Qualified Environmental Inspector – an individual with specific training and experience in evaluating the effectiveness of erosion and sediment controls, and assessing whether natural features are being protected from construction-related impacts. Ideally the inspector should have a recognized certification, like CISEC.

The proponent should be required to use a web-based inspection reporting tool and provide TRCA and other regulatory agencies involved with access to the secured website.

Using a web-based system for documentation and reporting of ESC inspections promotes transparency and allows the proponent to demonstrate that due diligence was exercised in addressing problems on their site. This will also foster improved co-operation between the project team and regulatory agencies, and encourage improved management of ESC.

The proponent should employ a qualified environmental inspector who will regularly inspect and report on the condition of ESC measures to the satisfaction of TRCA and the local municipality.

A 'qualified environmental inspector' is defined as an individual with specific training and experience in evaluating the effectiveness of erosion and sediment controls, and assessing whether natural features are being protected from construction-related impacts.

The inspector should be retained prior to removal of topsoil and remain on the project team until substantial completion (*i.e.* 85% build-out). The employment of a designated inspector is encouraged to a greater extent on larger sites and/or those close to natural features, however some basic level of inspection should be completed on a regular basis for all sites.

The environmental inspector should use a web-based system (described above) for reporting of all inspection outcomes, communicating significant issues, and recommending actions to address those issues. Municipalities and other regulatory agencies accessing the system will then have the ability to view these recommendations and then make decisions on whether to take further action, *e.g.* issuance of developer notifications.

A certification and licensing program (*e.g.* the U.S. Certified Inspector of Sediment and Erosion Control Program) should be developed for practicing environmental inspectors in Ontario. A program of this nature would empower inspectors in the industry and emphasize the importance of unbiased reporting and professional ethics.

A guideline for construction site effluent quality should be developed.

The existence of a formal and consistent standard for suspended solids concentrations in construction site effluent would provide an important reference point against which ESC practitioners could evaluate the effectiveness of the control measures they have installed, and thereby encourage them to make improvements when they are not meeting this target. To this end, a construction effluent TSS/turbidity guideline should be developed based on both concentration and duration of exposure. An important first step towards this guideline is a thorough review of existing construction effluent standards from other jurisdictions. This will help to determine what thresholds and assessment methods would be most consistent with local guidelines, bylaws and legislation. The threshold developed should be based on turbidity, which can be measured on site in real time, as opposed to TSS concentration, which must be measured in a laboratory.

A software tool should be developed to interpret effluent turbidity data and assess compliance with the new guideline.

The development of a software tool capable of analyzing effluent turbidity and duration data and classifying the impact to receiving waters should also be considered once standards have been set. A tool of this nature would ease the transition towards the adoption of the new guideline and minimize the environmental monitor's workload associated with effluent monitoring.

Sediment Control Ponds must be constructed according to approved plans and a bathymetric survey should be completed and provided to the local municipality for verification.

All construction sediment control ponds must be constructed in accordance with approved ESC plans. Pond designs are approved when they meet the criteria laid out in the *GGHA Erosion and Sediment Control Guidelines for Urban Construction* (TRCA, 2006). In situations when the ultimate stormwater management pond is built at the beginning of construction and used as a sediment control pond, the pond should not be over-excavated in an effort to increase the space available for settling of sediment and avoid the need to dredge the pond at the end of the construction period. The pond must be constructed according to the approved design drawings, and this should be verified by the completion of a bathymetric survey to be provided to TRCA and the local municipality. At the end of the construction period, the pond must be dredged and re-graded to comply with the approved ultimate pond design.

ESC Planning should focus on enhancing infiltration and evaporation on site in order to reduce the total volume of runoff conveyed to sediment control ponds.

Enhancing infiltration and evaporation of rainfall helps to maintain the pre-development water balance, and will result in less runoff volume from a construction site. Decreasing volumes of sediment-laden runoff conveyed to ponds allows them to function more effectively, resulting in lower effluent TSS concentrations. The inclusion of several small on-site soakaways areas on ESC plans may be an effective means of achieving this volume reduction objective.

Erosion prevention should be a key consideration during ESC planning.

Erosion prevention, and phased stripping in particular, is one of the most effective means of reducing the concentration of TSS in site runoff. Phased stripping minimizes the amount of time that bare soils are left exposed, while also allowing pre-development infiltration and evapotranspiration to continue on the parts of the site that remain un-cleared.

Polymers and other innovative technologies should be evaluated to determine suitability for local use.

The use of polymers to enhance construction sediment pond settling dynamics is a promising technique with the potential to substantially reduce effluent suspended sediment concentrations. While polymers have recently been used in Alberta and throughout the U.S., and many studies have investigated their potential benefits and risks, little research has been conducted within Ontario. There are also several new technologies that have been developed to enhance sediment removal at pond outlets. Examples include products that employ sand media and filtration membranes as a means of removing fine suspended sediments in pond effluent. Evaluation of these technologies under local soil and climate conditions, and in the context of local policy, is necessary in order to determine their future role in improving stormwater and construction site management in the GGHA.

6.0 REFERENCES

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APPENDIX A:

Erosion and Sediment Control
Electronic Site Inspection Form

☐ *Update E & SC Plan*
☐ *Work Order/Invoice #*
0 1/0/1900

5 Shoreham Drive
Downsview, ON
M3N 1S4
(416) 661-6600

DATE/TIME:

EROSION AND SEDIMENT CONTROL INSPECTION REPORT

PROJECT: ________	INSPECTOR: ________	CURRENT WEATHER: ________
PRIME CONTRACTOR: ________	QUALIFICATIONS: ________	LAST MAJOR RAIN: ________
PROJECT NUMBER: ________	INSPECTION DURATION: ________	PERMIT NUMBER: ________
SITE AREA: ________	DISTURBED AREA: ________	RECEIVING WATER: ________

Reason for Inspection: ________ (weekly, rainfall, or other) Rainfall (mm): ________ Other Reason: ________

INSPECTION OF BEST MANAGEMENT PRACTICES

MUST HAVE COMMENTS AND RECOMMENDED IMPROVEMENTS NOTED. ANY MODIFICATIONS MUST BE SKETCHED AND DESCRIBED ON THE BACK. DATES AND INITIALS ON THE DRAWING MUST BE INCLUDED WITH THE POLLUTION PREVENTION PLAN. TO COMPLETE THIS FORM, THE DATE IMPLEMENTED AND ACTUAL WORK SECTION MUST BE COMPLETED AND INTIALED BY THE OPERATOR PERFORMING THE WORK.

BEST MANAGEMENT PRACTICE	CONTROL PRACTICE EFFECTIVE			MAINTENANCE/ MODIFICATION NEEDED				Action Items	Photos	DATE IMPLEMENTED
	Yes	No	N/A	Yes	Week #	No	N/A			
Erosion Prevention										
Vegetative Filter Strips	☐	☐	☐	☐	________	☐	☐	________ ________	Photo	________
Seeding	☐	☐	☐	☐	________	☐	☐	________ ________	Photo	________

Top soiling	☐	☐	☐	☐	___	☐	☐	___	Photo
Sodding	☐	☐	☐	☐	___	☐	☐	___	Photo
Mulching	☐	☐	☐	☐	___	☐	☐	___	Photo
Riprap	☐	☐	☐	☐	___	☐	☐	___	Photo
Re-vegetative Systems	☐	☐	☐	☐	___	☐	☐	___	Photo
Tree and Shrub Planting	☐	☐	☐	☐	___	☐	☐	___	Photo
Growth Media Erosion Control blankets/mats	☐	☐	☐	☐	___	☐	☐	___	Photo
Netting	☐	☐	☐	☐	___	☐	☐	___	Photo
Plastic sheeting	☐	☐	☐	☐	___	☐	☐	___	Photo
Buffer/Riparian Zone Preservation	☐	☐	☐	☐	___	☐	☐	___	Photo

Surface Roughening (Scarification)	☐	☐	☐	☐	________	☐	☐	____________________	Photo
Dust control	☐	☐	☐	☐	________	☐	☐	____________________	Photo ____________
Other______________	☐	☐	☐	☐	________	☐	☐	____________________	Photo ____________
Other_____________	☐	☐	☐	☐	________	☐	☐	____________________	Photo ____________

Slopes and stockpiles

Stabilization of slopes and stockpiles	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Erosion Control Mats/Blankets/Netting	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Diversion dikes	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Compost biofilters	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Silt fencing	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Filter berms	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Straw logs	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Straw bales	☐	☐	☐	☐	______	☐	☐	______	Photo	______
Other______________	☐	☐	☐	☐	______	☐	☐	______	Photo	______

Swales and channels

Stabilization of swales and channels	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Interceptor swales/diversion dikes	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Compost biofilters	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Check dams	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Filter berms	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Straw/Wood Fibre Logs	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Straw Bales	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Other______________	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________
Other______________	☐	☐	☐	☐	______	☐	☐	____________________	Photo	____________

Storm Drain Inlets

Compost biofilters	☐	☐	☐	☐	______	☐	☐	____________	Photo	______
Organic or inorganic berms	☐	☐	☐	☐	______	☐	☐	____________	Photo	______
Geotextile fabric filters	☐	☐	☐	☐	______	☐	☐	____________	Photo	______
Other______________	☐	☐	☐	☐	______	☐	☐	____________	Photo	______

Sediment Traps and Basins

Stabilization of embankments	☐	☐	☐	☐	______	☐	☐	____________	Photo	______
Sediment traps	☐	☐	☐	☐	______	☐	☐	____________	Photo	______
Rock check dams used with sediment traps	☐	☐	☐	☐	______	☐	☐	____________	Photo	______
Pond/basin (check inlet, forebay, outlet, emergency spillway)	☐	☐	☐	☐	______	☐	☐	____________	Photo	______

Other______________	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Other______________	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________

Perimeter devices

Silt fencing	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Compost biofilters	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Filter berms	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Interceptor swales and dikes	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Vegetative filter strips	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Mud mats	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________
Vehicle wheel washers	☐	☐	☐	☐	______	☐	☐	______________________	Photo ____________

Straw bales/logs (**note:** cannot be used alone at	☐	☐	☐	☐ ________	☐	☐	____________________	Photo
							____________________	____________
Other____________	☐	☐	☐	☐	☐	☐	____________________	Photo

Title ____________________

____________________ Signature of Inspector

____________________ Date