

Calgary



City of Calgary Water Resources

Erosion and Sediment Control Field Manual, 2017

Objectives

The objectives of this *Erosion and Sediment Control Field Manual* are to educate field staff so they can confidently carry out their ESC duties on a construction site. This manual provides stakeholders with information that will enable them to:

- **Comply** with applicable ESC regulatory requirements (municipal, provincial, and federal)
 - Follow the approved ESC Plan, which is a legally binding document
 - Minimize environmental risk and damage to infrastructure from dust and sediment-laden runoff
 - Protect watercourses, adjacent sites, and other environmentally sensitive areas
- **Conserve** scarce soil resources and protect water resources
- **Continually improve** ESC practices and measures within Calgary
- **Communicate** approved ESC methods to colleagues working on the site, and ask the right questions to the ESC designers when things aren't working as planned.

To help field staff reach their ESC objectives, The City also provides the following documents, which need to be used in conjunction with this manual:

- **Standard Specifications for Erosion and Sediment Control, 2017 edition.** Consider the document as a playbook of general requirements, standard specifications, and drawing details for approved ESC measures and controls. This document outlines the rules you must follow when installing standard ESC practices, such as silt fence, hydromulch and sediment ponds. Field personnel should become comfortable using the Standard Specifications to help them do a good job, and to ensure they are consistently using approved ESC practices.
- **Erosion and Sediment Control Guidelines, 2017 Edition.** The guidelines speak to the ESC designers. The guidelines discuss the need for ESC, regulatory and ESC submission requirements, how sites are assessed, and an overview of ESC practices. The guidelines get into the details of design requirements and are focussed on providing ESC designers with choices when selecting ESC measures.

Within this *ESC Field Manual*, you will find:

- Important information about understanding your site's approved ESC Plan.
- Regulatory information that governs ESC, such as release reporting and submission requirements.
- Guidance for the installation, inspection, maintenance, and removal of ESC measures and controls.
- Sources for additional information and help.

The following common terms and definitions are used in this manual:

- **Drainage** refers to the flow of collected rain or melt water on a site.
- **Erosion** refers to the physical detachment, entrainment, and transportation of soil particles by erosive agents, commonly wind and water.

- **Sediment** refers to soil particles that have been detached and mobilized by soil erosion agents.
- **Sedimentation** occurs when the energy of wind or moving water is less than the force of gravity on soil particles, resulting in their deposition.
- **Storm Drainage System/Stormwater Infrastructure** are used synonymously and refer to engineered conveyance systems for stormwater.
- **Stormwater** refers to rain or melt water collected on site.

Note: This *Erosion and Sediment Control Field Manual* provides information on ESC implementation, maintenance, and inspection requirements. For guidance during the planning and design stages of projects, refer to The City of Calgary's Erosion and Sediment Control Guidelines.

EROSION AND SEDIMENT CONTROL CONTACT INFORMATION

CONTACTING THE CITY OF CALGARY:

General ESC Questions: 3-1-1

Key phrases to ensure that you are promptly connected with the ESC staff are:

- Erosion and Sediment Control
- Erosion and Sediment Control Inspection
- Erosion and Sediment Control Approval
- Drainage Permit
- Drainage Permit Self-Assessment

EMERGENCIES:

Immediate response required from Police, Fire and/or Emergency Medical Services: **9-1-1**

RELEASE REPORTING:

Reports of releases (including sediment) must be made to:

- 3-1-1 (The City of Calgary)
- 1-800-222-6514 (Alberta Environment and Parks) 24-hour release reporting line

Publication Information

LEGAL DISCLAIMER

Construction activities, including the operations, maintenance, and repair of infrastructure and utilities, commonly disturb soil or sediments and create the potential for erosion, sedimentation, and offsite releases of sediment and associated contaminants. The design, implementation, and management of stormwater and erosion and sediment control practices require detailed knowledge and practical expertise.

Guidance in this document is solely provided to assist users with basic information on requirements, processes, and practices. While believed to be accurate, content is provided strictly as is and without warranty of any kind.

The City of Calgary, its agents, and its consultants are not responsible for the accuracy of the contents, and do not accept any liability for the results of any action taken on the basis of the information provided in this document. In addition, information in this document must not be construed as legal advice.

TITLE: Erosion and Sediment Control Field Manual

INTENT: This document is intended as a resource for field staff and complements the Erosion and Sediment Control Guidelines.

PREPARED FOR: The City of Calgary, Water Resources

VERSION: 2017 Edition

ADDITIONAL COPIES: To download an electronic copy: www.calgary.ca/esc

INFORMATION: Corporate Call Centre: 311 (within Calgary)

NOTE: Due to changing regulations and technology, The City of Calgary may periodically update this manual. Please ensure you have a current version by visiting our website at: www.calgary.ca/esc

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Commonly Used Acronyms

CPESC	Certified Professional in Erosion and Sediment Control
ESC	erosion and sediment control
ha	hectare
LID	low-impact development
m	metre
m ³	cubic metre
manual	Erosion and Sediment Control Field Manual
mm	millimetre
P.Ag.	Professional Agrologist
P.Eng.	Professional Engineer
P.L.Eng.	Professional Licensed Engineer
R.S.C.	Revised Statutes of Canada
RECP	rolled erosion control product
RSA	Revised Statutes of Alberta
RUSLEFAC	Revised Universal Soil Loss Equation For Application in Canada
S.C.	Statutes of Canada
SSESC	Standard Specifications for Erosion and Sediment Control
t	tonne
t/ha/y	tonne per hectare per year
The City	The City of Calgary

1.0 Introduction

1.1 Why Control Erosion and Sediment

Construction sites can generate tremendous amounts of sediment caused by stripping protective vegetation and topsoil off the land. Sediment can, during rain and snowmelt events, travel into and clog existing storm drainage systems. If the plume is large enough, it can travel via the storm drainage system and enter water bodies.

The removal of soil-stabilizing vegetation, and the exposure and compaction of fine-grained soils, can result in stormwater runoff and soil erosion rates that are 10-40 times greater than natural rates.

Even small construction sites and operations, such as underground utility repairs, can generate large amounts of dust and sediment runoff through cumulative effects. Therefore, there is a need for field staff to implement practices to minimize or control mud tracking, wind-blown dust, and water-borne sediment regardless of the size of the project.

1.2 Erosion and Sediment Control Responsibilities

Effective planning and implementation of ESC is everyone's responsibility. Just like in site safety management, everyone involved on a construction site has a role to play.

The successful control of runoff, erosion, and sedimentation requires the cooperation of many project stakeholders (including The City, regulators, landowners, consultants, project managers, homebuilders, and contractors). This section provides an outline of the general division of responsibilities among stakeholders.

During the preconstruction meeting, and throughout the project, the intent and details of the ESC Plan must be discussed among all appropriate parties. This may include the field staff, the project manager, and contractors.

1.2.1 Owner

- **The owner is ultimately responsible for ESC on their land and for confirming compliance with approvals and regulations.** The owner may be a private developer or a City Business Unit, and the development and implementation of the ESC Plan may be contracted out to others, but the owner is still responsible for performance of construction site ESC measures.
- ESC Plans are tied to the land and are valid until such time that they are replaced with a new, approved, ESC Plan(s) or final stabilization has been established.
- The owner is responsible for obtaining an Approved ESC Plan (Plan) and ensuring amendments occur when there are changes to the Plan.
- If an owner buys a piece of property that is already exposed to erosion, the owner is responsible for:
 - Ensuring they have a copy of the previously approved ESC Plan,
 - Following the Plan and
 - Ensuring the Plan is properly amended when and if required.

- At the end of the project, the owner is responsible for confirming that the site is stabilized and the decommissioning or removal of temporary ESC measures, as well as the continued inspection and maintenance of ESC measures until final site stabilization.
- At the end of the project, the owner is also responsible for the storage of all ESC-related documentation on or off site for 2 years.

1.2.2 Project Manager

- The owner may serve as the project manager.
- The project manager serves as the owner's representative on a specific project.
- The project manager may also delegate authority of implementing ESC on the project to an onsite qualified ESC inspector.
- The project manager must confirm that:
 - The ESC Plan has been submitted and approved.
 - Information contained within the Plan is followed, including site inspection requirements.
 - The ESC Plan is understood by all site stakeholders.
 - A copy of the Plan is available onsite.
 - Changes to the Plan are brought to the attention of the appropriate City ESC Inspector via amendments.

1.2.3 Designer

The City requires that an ESC Plan be prepared by a Qualified Practitioner. A Qualified Practitioner must hold a CPESC (Certified Professional in Erosion and Sediment Control), P.Eng. (Professional Engineer), P.L.Eng. (Professional Licensee Engineer), or a P.Ag. (Professional Agrologist). In general:

- The ESC designer must develop an ESC Plan that meets regulatory requirements, can be integrated with project scheduling, and can be clearly understood and implemented by contractors.
- During the development of the initial site ESC Plan, the ESC designer must visit the project site to conduct a thorough site evaluation and risk assessment.
- The ESC designer must emphasize that the ESC Plan is a legally binding document that is approved by The City ESC Inspector prior to commencement of project construction and will need to be frequently reviewed. The ESC Plan must be updated as necessary, by the Qualified Practitioner, to accommodate changes throughout project construction stages.

1.2.4 ESC Contractor (Implementation and Maintenance)

- The ESC contractor is responsible for understanding and following the approved ESC Plan.
- The ESC contractor must implement the practices prescribed in the ESC Plan (including amendments), and support the Site ESC Inspector with the defined inspection and maintenance program.
- When practices do not function as intended or the contractor has concerns with the ESC measures, they should discuss deficiencies and resolutions with the Site ESC Inspector.
- Depending on contractual agreements, contractors may also be responsible for the removal of temporary ESC practices once the contributing area is stabilized.

1.2.5 Site Erosion and Sediment Control Inspector

- Site ESC inspectors observe, inspect, and report on ESC site practices and their alignment with the ESC Plan.
- Site ESC inspectors must clearly understand the ESC Plan; have experience in construction, inspection, and maintenance of ESC practices; can recognize the effective application of controls; and communicate concerns to the contractor.
- Site ESC inspectors must understand the need to document ESC practices (photos, inspection and maintenance records, and amendments to the ESC Plan), and follow documentation requirements.
- Site ESC inspectors must consult with the ESC designer before changing the ESC Plan or prescribing ESC measures. Changes to the ESC Plan will require an amendment to the Plan. All amendments must be reviewed and approved by the City ESC Inspector prior to implementation.
- Inspections must be conducted by a Qualified Inspector. A Qualified Inspector is a person who has training in ESC inspections or someone who is directly under the supervision of a person who has ESC inspection training and provides assistance in understanding the purpose and requirements of ESC inspections.

1.2.6 The City of Calgary ESC Inspector

- The City ESC Inspector is responsible for:
 - Reviewing and approving ESC Plans submitted for construction projects, and clearly communicating submission requirements to customers.
 - Conducting ESC inspections on sites to assess compliance with approved ESC Plans.
 - Identifying areas of non-compliance and ensure they are communicated to the owner.
 - Enforcement on non-compliant sites.

2.0 Regulatory Requirements

Disclaimer: This section provides an overview of the common regulatory requirements that may apply to projects and activities that could result in erosion and sedimentation. This information is NOT offered or intended to be used as legal advice. Always obtain specific legal advice, and contact all relevant regulatory agencies when planning a construction project. All information is with respect to the latest edition of statutes, regulations, codes of practice, and bylaws at the time of writing.

2.1 Overview

This section provides a summary of federal, provincial, and municipal statutes, regulations, codes of practice, and bylaws containing provisions addressing ESC, construction site water management, and dust control. Although requirements are outlined in the following subsections, the list is not intended to be all-inclusive or encompassing.

2.2 Municipal Legislation (The City of Calgary)

The following bylaws and standards are applicable to erosion and sediment control in Calgary. Copies of all City bylaws are available on The City's website.

2.2.1 Drainage Bylaw

ESC Plans are triggered under the *Land Use Bylaw 1P2007*; however, they are approved under the *Drainage Bylaw 37M2005*. An approved ESC Plan is legally required before commencing soil movement on any construction site larger than 0.4 hectare (ha). The ESC Plan outlines the owner's commitment to reduce soil losses and reduce the release or discharge of sediment into The City's storm drainage system.

Authorization in the form of a Stormwater Drainage Permit is required from The City prior to pumping or directing impounded surface water or groundwater into storm drainage systems. To obtain a Drainage Permit, contact 3-1-1. Information on Drainage Permits is also available at <http://www.calgary.ca/esc>

2.2.2 Wastewater Bylaw

The *Wastewater Bylaw 14M2012* prohibits person from releasing or allowing the release of wastewater into the wastewater system that contains prohibited substances (such as sediment), a substance that exceeds an allowable concentration limit, or a substance may negatively impact a treatment plant or receiving environment.

2.2.3 Street Bylaw

Except in special cases approved by The City's Roads Business Unit, the *Streets Bylaw 20M88* does not permit storage of stockpiles on streets or back lanes as this material may erode and wash into offsite areas such as neighbouring properties and storm drainage systems. Likewise, material must not be stockpiled (e.g., on driveways) where it could leave a site and enter a City street. When it is necessary to store piles of gravel or soil on streets, the owner must first obtain a City Street Use Permit through 3-1-1.

2.3 Release Reporting

The City, through the Release of Prohibited Substances section of *Drainage Bylaw 37M2005*, requires that all releases of sediment and other prohibited material into the storm drainage system be reported.

In addition, under the *Environmental Protection and Enhancement Act (EPEA)* a person who discovers, is informed of or who investigates a release of a substance into the environment must ensure Alberta Environment and Parks has been notified. If the employee is unable to confirm release reporting has occurred, they have a legal obligation to report the release.

The names and phone numbers of the agencies that must be notified are provided on page 3 of this manual.

Note: Releases must be reported as soon as a person knows or ought to have known of the release. A person “ought to have known” a release has occurred when, based on the information available, it is possible a release has occurred. That person should then confirm whether a release has occurred and report accordingly.

2.4 Provincial and Federal Regulations

2.4.1 Provincial Regulatory Requirements

Current versions of all provincial acts, regulations, and codes of practice are available online from the [Alberta Queen's Printer](#).

2.4.1.1 *Environmental Protection and Enhancement Act*

Under the act, it is prohibited to release or permit the release of a substance into the environment in an amount, concentration, or level, or at a rate of release that is in excess of an approval or a regulation, or may cause a significant adverse effect. The act creates a duty to report a release (See Release Reporting section above).

Other applicable provincial regulations include the following:

- *Water and Storm Drainage Regulation AR119/93*
- *Water Act W-3 Revised Statutes of Alberta (RSA) 2000*
- *Water (Ministerial) Regulation 205/1998*
- *Water Act: Codes of Practice*
- *Public Lands Act P-40 RSA 2000*
- *Soil Conservation Act S-15 RSA 2000*

Refer to the Erosion and Sediment Control Guidelines for more information.

2.4.2 Federal Regulatory Requirements

The *Fisheries (Alberta) Act F-16 RSA 2000* prohibits the deposition of deleterious substances into waters frequented by fish. Sediment is considered a deleterious substance; therefore, the erosion of exposed soils and offsite transport of sediment into natural water bodies can violate the pollution prevention provisions of this act.

Other applicable federal acts include the *Navigation Protection Act*, Revised Statutes of Canada (R.S.C.), 1985, chapter (c.) N-22, and the *Canadian Environmental Protection Act*, Statutes of Canada (S.C.) 1999, c. 33. Refer to the Erosion and Sediment Control Guidelines for more information.

3.0 The Erosion and Sediment Control Plan

3.1 Overview

Erosion and Sediment Control (ESC) Plans describe how releases of sediment into storm drainage systems and waterways will be prevented. ESC Plans must identify the location, design, and timing of appropriate erosion and sediment controls and practices throughout the stages of construction.

ESC Plan Key Points:

- Approved ESC practices must be designed, implemented, inspected, and maintained for all stages of construction.
- The owner or person responsible for a construction site with a total disturbed area of more than 0.4 ha is responsible for creating an ESC Plan and obtaining approval under the *Drainage Bylaw*. For sites less than 0.4 ha, ESC for small sites must be implemented on site (see the Standard Specifications for Erosion and Sediment Control for more details).
- For the duration of the project, the construction site should either match a drawing or be in a well-timed transition from one drawing to the next. As construction schedules and conditions will change, the ESC Plan will need to be amended.
- The Standard Specifications for Erosion and Sediment Control in its entirety is referenced as part of the proposed ESC Plan and standard practices must follow the referenced requirements. When a specific ESC product is used, it must be installed, maintained, and inspected per the manufacturer's specification and, at a minimum, the requirements outlined in the Standard Specifications for Erosion and Sediment Control.
- If a practice that is not listed in the Standard Specifications for Erosion and Sediment Control is to be used the requirements for a non standard specification must be followed. For the most up to date requirements for non-standard specifications please refer to www.calgary.ca/esc.

Note: An approved ESC plan consists of the Approval letter, Erosion and Sediment Control Plan Application form, Standard Specifications for Erosion and Sediment Control, all applicable drawings, and supplementary documents (including the nomograph, sieve analysis data, site photos and manufacturer's specifications).

3.1.1 Finding Your Way Around the ESC Plan

Some important information that can be found in your ESC Plans includes:

- The name of your project, its street address and legal description.
- The overall size of your project, in hectares. The City uses project size to determine whether a project needs an ESC Plan in the first place, and then whether it is acceptable to strip the whole site at once, or if a staged stripping plan is required.

- Details on how stormwater flows onto and off of your site. No project exists in isolation, so The City ESC Inspector needs to understand who your upstream and downstream neighbours are, and what storm water issues your project could cause or be subjected to.
- A list of critical areas like steep slopes, highly erodible soils, local water bodies, known contamination and environmental reserves that would require protection from erosion and sedimentation caused by your project.
- Existing or required permits: You may require a stripping and grading permit or a development permit before starting work at your site. The City ESC Inspector needs to know that these permits are in place prior to development. Also, if you are working on a site owned by someone else, The City ESC Inspector needs to see that you have permission from the landowner to work on the property.
- Stockpile Control Plans: historically stockpiles have been the source of large amounts of unmitigated soil erosion. The City ESC Inspector needs to know how many soil stockpiles you plan to have on site, the length of time, and what ESC controls will be in place to reduce erosion of the soils in the stockpiles.
- Winterization Plan: Calgary experiences an average of 21 freeze-thaw cycles in a year and each cycle can allow water on your site to runoff across the frozen ground. The City requires developers to have a winterization plan in place, along with a viable inspection and maintenance program, to manage the construction site through the winter months. For ESC purposes, winter has been defined as November 15th - April 15th. However, site representatives must begin considering and taking steps to implement their site's winterization plan by September 15th.
- ESC Drawings: For each stage, a drawing will show the work site divided into areas based on catchments (areas on site where stormwater flows and is collected), and the work currently underway. Some of the important items that must be on a drawing include:
 - A drawing title block naming the project, where it's located, and the stage of construction.
 - Catchment boundaries.
 - The area of each catchment area selected in hectares.
 - Local roads and other important municipal features located around your project.
 - Critical areas on and off site (Ex. Steep slopes, storm ponds, adjacent environmental reserves).
 - Flow arrow(s) showing the general direction of drainage within each catchment area along with ESC slope information (length, percent slope, LS value).
 - The location of proposed stockpiles.
 - The presence and location of proposed ESC measures. The ESC measures will be represented by symbols and explained in the drawing legend.

Figure 1 shows the type of ESC drawings that could be present in your ESC Plan. For detailed information and a complete, up-to-date list of ESC Plan requirements and templates, please visit The City's ESC website at <http://www.calgary.ca/esc>.

- ESC Plan attachments:
 - Recent photos of the site.

- Soil Sieve Analysis. This analysis is generally a part of the site's Geotechnical Report. The information contained within this analysis provides the percentages of different soil particles on site. This information assists designers in determining the erodibility of soils on site.
- Soil Classification nomograph. The information from the soil sieve analysis is used to complete a soil nomograph. The nomograph allows The City ESC Inspector to follow the logic used by the ESC designers in selecting appropriate values of soil erodibility (K-value). The K-value is then used to determine the annual soil loss for the site.
- Manufacturer's Specification Sheet(s). These sheets will highlight specific design values (C or P values) to be used for the product you've chosen, as well as specific installation and maintenance considerations.

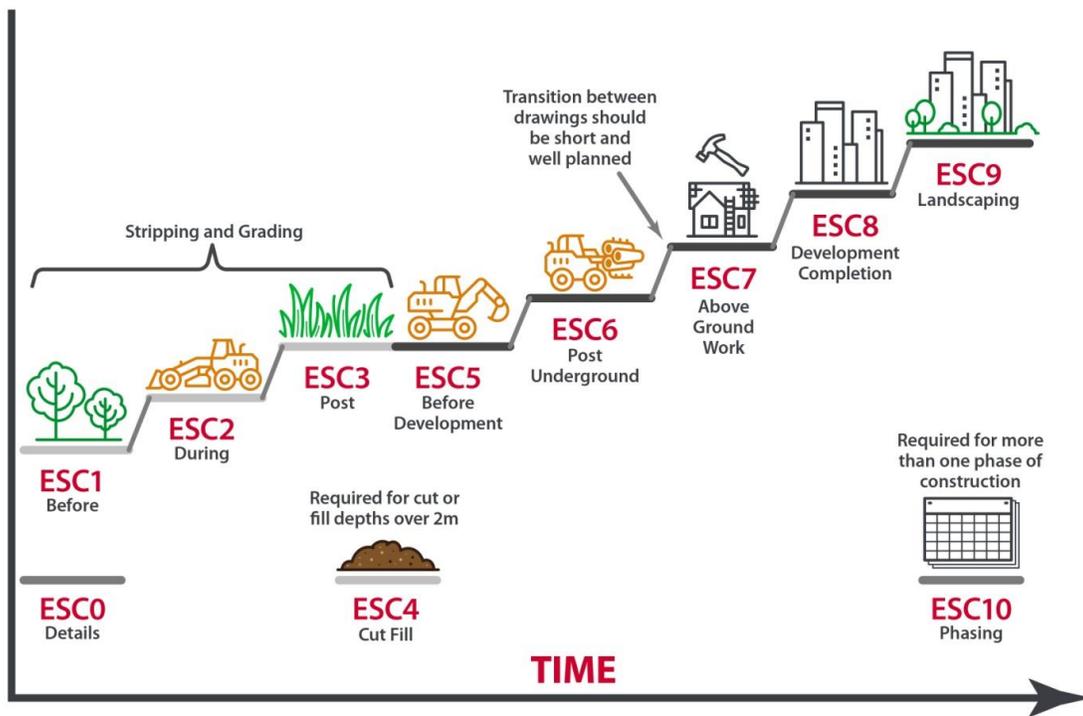


Figure 1 Erosion and Sediment Control Drawings for Stages of Construction

Typical information included within each ESC drawing is summarized in Table 1.

Table 1 Erosion and Sediment Control Drawings by Construction Stage

ESC Plan No.	Drawing Description	Details
ESC 0	Non-standard drawing details	<ul style="list-style-type: none"> Only required when a non-standard control or practice is used. This drawing will show control or practice details.
ESC 1	Before Stripping and Grading	<ul style="list-style-type: none"> Describes site conditions prior to stripping and grading activities beginning
ESC 2	During Stripping and Grading	<ul style="list-style-type: none"> Describes ESC measures required during stripping and grading operations May not be included in the ESC Plan if the intention is to move from ESC1 immediately to ESC3.
ESC 3	Post Stripping and Grading	<ul style="list-style-type: none"> Part of the Stripping and Grading ESC Plan This drawing details the site conditions and ESC measures used to protect the site once stripping and grading is complete
ESC 4	Cut and Fill (cut and fill > 2 m)	<ul style="list-style-type: none"> Shows areas of cut and fills when estimated to be over 2 meters
ESC 5	Before Development	<ul style="list-style-type: none"> Represents the present conditions and ESC measures at the start of a new development after stripping and grading has occurred
ESC 6 ^a	Post Underground	<ul style="list-style-type: none"> Details the site conditions and ESC measures required after underground utilities have been installed
ESC 7 ^b	Above Ground Work	<ul style="list-style-type: none"> Describes site conditions and ESC measures installed as permanent buildings are constructed on the site
ESC 8 ^c	Development Completion	<ul style="list-style-type: none"> Describes the site conditions and ESC measures to be installed after the major buildings are finished but prior to final landscaping
ESC 9 ^d	Landscaping	<ul style="list-style-type: none"> Details the final landscape treatments that will serve as permanent erosion control for the site
ESC 10	Phasing Plan	<ul style="list-style-type: none"> Required if the entire site area is not to be developed at the same time Delineates the different areas to be developed and provide approximate start dates and durations

^a ESC 6 is a time when many new construction access points are introduced. They need to be addressed with the appropriate ESC measures to ensure mud isn't tracked off site (for example).

^b ESC controls proposed on ESC 7 should consider an increase in vehicle traffic. During this stage, more and more trade vehicles will be present so vehicle mud-tracking will need to be monitored closely with any concerns addressed immediately.

^c At this stage people might be occupying the building(s).

^d Vigilant maintenance is still required of all ESC measures until vegetation has been established.

3.2 Implementation of Erosion and Sediment Control by Construction Stages

Note: Some projects, such as multi-family and commercial developments, occur on land that has already been stripped and graded, and has some degree of underground servicing installed, so construction stages may be different from those identified here.

There are typically three major stages of construction involving land development activities, each with very different site conditions. These include:

1. Initial clearing and grubbing of surface vegetation (ESC 1)
2. Stripping and grading of the organic and mineral soils (ESC 2, ESC 3, ESC 4)
3. Construction of the proposed development and post-construction cleanup of the site (ESC 5 to ESC 10)

To optimize ESC selection, installation, and effectiveness, designers and contractors need to understand the types of practices to be implemented at each stage. These practices will be shown in the ESC Plan. In addition, the Standard Specifications for Erosion and Sediment Control includes good housekeeping practices and minimum requirements applicable to all types and stages of construction.

Each of the major stages usually involves different speciality contractors. Between stages the construction site might see no activity for months, or work might quickly progress between stages. Therefore, the ESC measures used during each stage are important but the ESC measures used between stages are just as important.

Inspection and maintenance is required throughout the project's life, starting at the installation of preliminary controls. The time of year and weather conditions encountered during the construction project can greatly influence the amount of maintenance required. To verify the continued performance of ESC practices, it is especially critical to monitor them before, during, and following significant storm events and snowmelt.

3.3 Stripping and Grading Stages

Stripping and grading occurs in stages, as defined as:

- ESC 1: Before Stripping and Grading
- ESC 2: During Stripping and Grading
- ESC 3: Post Stripping and Grading
- ESC 4: Cut and Fill

The stripping and grading stages see the first transformation of the site from its previous use to an intermediate stage where underground utility installation can begin. Existing trees, shrubs, and vegetation will be removed, the site will be graded to design, and then the site will be left for the underground crews to begin their work.

3.3.1 ESC 1: Before Stripping and Grading

Before stripping and grading the site is taken down to the level where there is very little vegetation remaining. Critical areas identified in the ESC Plan must be protected during this phase.

Good ESC practices before stripping and grading include:

- Prior to commencing work, review the approved ESC Plan
- Flag the limits of clearing and all vegetative buffer areas.
- Delineate and protect wetland buffer areas, riparian areas, ravines, environmental reserves, and other critical areas specified in the approved ESC Plan. Consult with your site's City of Calgary Parks Inspector for any specific requirements for your site.
- Provide stabilized construction entrances/exits, as shown on the ESC Plan.
- Divert clean runoff away from disturbed areas using diversion channels and berms. The advantage is that your site will be less impacted during precipitation and there will be less stormwater to manage.
- Where approved, install perimeter controls and sediment containment systems prior to soil-disturbing activities.

3.3.2 ESC 2: During Stripping and Grading

During stripping and grading, the organic soil is stripped from the site and stockpiled or removed. On larger sites, the organic soils may be processed and reused. The mineral soils are often used as grading materials and may be regraded to meet the site design needs. Natural drainage patterns will likely change.

Construction sites often generate more soil than they can use, so the excess needs to be trucked away. Truck traffic will increase, so the construction access pad(s) need to be functional, and the drivers need to use them. Additional approved ESC measures are now introduced, and may include the excavation of sediment ponds and additional perimeter controls. Soil stockpiles will need to have down gradient perimeter protection and stabilization as measures implemented as approved within the ESC Plan.

Points to remember during stripping and grading include:

- Limit the duration of soil exposure, and provide adequate soil stabilization and cover as soon as possible. *A plan's just a plan; it's only when ESC measures are installed that the ESC Plan becomes effective.*
- Continue to verify that clean runoff is diverted around the site and not through exposed soil areas. *Remember, if you let clean water onto your site and it gets dirty, you must clean it before it is released from your site.*
- Only strip and grade within the limits of the area allowed to be exposed at one time. Consult Drawing ESC10 in the approved ESC Plan for your site for more information. *Remember, if you strip it, you must protect it.*
- Think about where site runoff will go. Verify the ESC Plan has an ESC measure identified to manage the runoff.

3.3.3 ESC 3: Post Stripping and Grading

After the site has been completely stripped and graded it may sit dormant of any construction activity for long periods of time. Drawing *ESC 3 After Stripping and Grading* will describe the ESC measures required during this time-period when the construction site may be left unattended. Both cover practices and sediment containment practices will require vigilant inspection and maintenance to ensure they are functioning as approved in the ESC Plan.

3.3.4 ESC 4: Cut and Fill

If soil cut and/or fill greater than 2 meters is planned for the construction site ESC 4 will be included as part of your approved ESC Plan. Cuts and fills of this magnitude will likely:

- result in large soil piles that may require approved ESC measures
- significantly change the natural drainage pattern of the area

The City ESC Inspector needs to understand the grade changes and earth balances. When there is a net cut (more soil on site than required) The City ESC Inspector will cross reference this information with the reported stockpiling volume to ensure they match.

3.4 Construction Stages

Construction occurs in many stages. For the purposes of ESC the stages have been defined as:

- ESC 5: Before Development
- ESC 6: Post Underground
- ESC 7: Above Ground Work
- ESC 8: Development Completion
- ESC 9: Landscaping

3.4.1 ESC 5: Before Development

During the *Before Development* stage, preparation for the installation of underground utilities and permanent drainage structures is completed, second grading is completed, and by the end of this stage underground infrastructure is installed. This phase can result in exposure and stockpiling of non-stabilized soil. Continuous ESC inspection and maintenance are key to ensuring the measures prescribed are working properly.

Larger amounts of mineral soils may be excavated and piled up next to the utility trench while the underground utility is installed. Soil stockpiles will need to be stabilized to reflect the approved ESC Plan.

3.4.2 ESC 6: Post Underground

This stage occurs after underground utilities have been installed, but prior to the start of above-ground work. This ESC Plan will speak to how the site will be left after the underground utilities have been installed, but prior to above ground work. Note that this is typically the last stage of construction where inlet protection such as socks, donuts, and screening products may be approved. After the first lift of asphalt all inlet protection must be removed from site. Consult your approved ESC Plan for any location where inlet control has been approved for installation.

3.4.3 ESC 7: Above Ground Work

During this stage construction grading is largely completed, and construction of buildings is underway. Typically, the first lift of asphalt along with curbs, gutters, catch basins and sidewalks have been installed in this stage, which means that all inlet protection must be removed. During this stage, more and more trade vehicles are coming to and leaving the site, meaning the construction access pads in areas that transition from asphalt to soil need to be well maintained. This is a high-risk period because each and every catch basin becomes an access point for sediment. Sediment ponds are often removed and replaced with other ESC measures. During this period there can be the highest soil loss potential of all the stages of construction.

3.4.4 ESC 8: Development Completion

This stage speaks to how the construction site is left after completion of above ground construction, but prior to landscaping.

During the *Development Completion* stage, construction is completed but the permanent site vegetation stills needs to be established. Some erosion and sediment controls and practices will remain in place.

3.4.5 ESC 9: Landscaping

The Landscaping stage recognizes that vegetated areas may have been planted but they will need time to establish.

During the *Landscaping* stage, remember to:

- Verify all areas requiring vegetation are established to ensure there is permanent stabilization.
- Work to quickly establish permanent vegetation cover.
- Remove all remaining temporary controls once final stabilization is complete.

3.5 Key Steps for Ensuring Compliance with the ESC Plan

Some of the key steps that field personnel must take prior to construction include:

- Review the ESC Plan, specifications, and construction documents to become familiar with the site and project. Review the ESC Plan prior to, during and after each construction stage.
- Visit the site to become familiar with the surroundings, and record any ESC issues or problem areas that may not be shown in the ESC Plan. These findings help to proactively address concerns that could be raised by neighbouring site owners or City ESC Inspectors.
- Review the ESC Plan with the ESC designer and project manager to address issues identified during the site visit and review critical aspects of the plan, such as the objectives, schedule, and resources.
- Attend the preconstruction meeting before any new works are carried out to review the ESC Plan, permitting, responsibilities, and scheduling of key items that trigger controls and practices to be implemented. The meeting provides a check-in opportunity to avoid wasted effort and resources once construction begins.

During construction, the following tasks must be completed:

- Conduct regular inspections at a minimum of every 7 days and as directed in the ESC Plan,
- Identify and record deficiencies
- Followed up with deficiencies by ensuring prompt corrective work is completed
- Identify changes in field conditions that may trigger an amendment to the ESC Plan, and communicate those proposed changes with the ESC designer.
- Only install approved ESC measures, and ensure those called for in the ESC Plan are installed.

Upon completion of the construction project, complete all documentation relating to project closure, and ensure that those individuals responsible for short- and long-term maintenance are aware of ESC Plan requirements.

3.6 Inspection and Maintenance

3.6.1 Overview

If the field staff notice that the site ESC measures have or might be about to fail, then the field staff need to notify the person responsible for the site to discuss mitigation and start repairs or replacement. In many cases, it will be necessary to consult with the City ESC Inspector and an ESC designer regarding required amendments to the ESC Plan.

3.6.2 Documentation Required Onsite

After an ESC Plan is approved and construction commences, the following hard copy documentation is required onsite:

- Approved ESC Plan
- The Standard Specifications for Erosion and Sediment Control
- City ESC Approval Letter
- 7-day Inspection records
- Product application tags (if applicable)

It is the site owner's responsibility to ensure ESC files are kept onsite for the duration of construction (until final stabilization). After construction these files must be available onsite or offsite for an additional 2 years following final site stabilization.

Note: A good practice for field staff is to prepare an ESC Audit Binder, containing all the ESC information in one accessible place. This binder can then be made readily available when a City ESC Inspector comes to the construction site.

3.6.3 Erosion and Sediment Control Inspections

The working condition of ESC measures on a construction site is always changing. Significant weather events can overwhelm ESC measures, or different construction stages can require different ESC strategies. For these reasons, ESC field staff must regularly inspect and document the ESC efforts underway.

Inspections must be completed every **7 days**, and after every **significant** precipitation event.

3.6.3.1 7-day Inspection Requirements

A site needs to be inspected at least every 7 days until permanent erosion control cover has been established.

The following ESC inspection activities need to be completed and documented on the inspection and maintenance form:

- Walk the site to confirm that all measures located on the approved ESC Plan have been implemented in the field, including critical inspection locations identified in the plan
- Verify that erosion is being controlled and that sediment or other pollutants are not being transported offsite or into critical areas onsite
- Note any improper installations, failing controls, and necessary maintenance required
- Perform or communicate the additional actions required to be compliant with the ESC Plan, such as reseeding, fertilizing, completing erosion repairs, and installing or repairing irrigation until the vegetation is established and the required erosion control function is provided

3.6.3.2 During or After Significant Rainfall or Runoff

Significant rainfall or runoff events are defined as events that include:

- Intense downpours, prolonged rainfall, hailstorms, and heavy snowmelt
- More than 12 mm of precipitation over 24 hours (12 mm rain or snow melt conditions)

The Site ESC inspector must communicate with the site owner or owner's representative if emergency repairs are required on site.

Note: Surface soils may be detached by freeze-thaw cycles, and thawing surface soils quickly become saturated in spring. Thus, there is high erosion potential on many construction sites during spring thaws or prolonged chinook conditions. All exposed areas and stockpiles must be stabilized and inspected before a site is left in an inactive or winter shutdown state.

3.6.3.3 Inspection and Maintenance Reports

Inspection reports must be prepared during or following each inspection conducted by a qualified inspector.

Inspections must be documented (at a minimum) by:

- An inspection report showing the:
 - Project name, City of Calgary file number, project owner and the name of the ESC inspector.
 - Time, date, and weather (over the past 48 hours).
 - Project location (street address and legal land description).
- Acknowledgement that all the significant ESC measures have been inspected
- A summary of all deficiencies noted and actions taken.
- An up-to-date pictorial history of the ESC measures, including:
 - Observations on damages and deficiencies.
 - The success of approved ESC practices.

- A section summarizing maintenance and repair activities.

An example inspection and maintenance form is included in Appendix A.

3.6.3.4 Maintenance Requirements

Damages and deficiencies that have the potential to cause a release must be addressed immediately. All other damages and deficiencies should be corrected as soon as possible; in no circumstances, later than 72 hours after the inspection.

3.6.4 Anticipating Storm Events

It is common for Calgary to experience short, high-intensity storm events during the late spring and summer months. Although the timing and intensity of such events is hard to predict, they should be anticipated during each summer construction period.

When significant precipitation events are forecasted, field staff should do the following:

- Inspect erosion and sediment controls and practices (if not already done)
- Undertake preventative maintenance in advance of storms
- Avoid excessive stripping of vegetation and soils when there is a high likelihood of erosive rainfall or runoff, including snowmelt

3.7 Critical Areas

Critical areas require special attention in the ESC Plan. Field staff need to be aware of the identified critical areas, and take steps so that they are properly protected.

Critical areas are identified by the ESC designer in the approved ESC Plan. Critical areas may be on the site or adjacent to the site.

Onsite critical areas may include:

- Areas of stormwater run-on where drainage could enter the site (like down a ravine from an environmental reserve or street gutter)
- Storm infrastructure (e.g., catch basins)
- Areas with erodible soils (most stripped soils in Calgary)
- Steep slopes
- Low-impact development (LID) areas like a rain garden or bioswale

Adjacent critical areas may include:

- Areas that are environmentally sensitive (e.g., environmental reserves, water bodies, natural areas)
- Storm infrastructure (e.g., City storm ponds and catch basin inlets)
- Established residential areas
- Recreational areas
- LID areas

Note: The management of the entire construction site becomes critical once the ground is frozen and susceptible to snow melt episodes. The ESC Plan must include a Winterization Plan to address how a site is to be left before construction shuts down during the winter months (November 15th – April 15th). This plan outlines what ESC measures are to be installed and maintained to protect the site from erosion and sedimentation during snowmelt events. Calgary experiences, on average, 21 freeze-thaw cycles per year that could result in major runoff.

3.7.1.1 Low-impact Developments

LIDs are critical areas that have source control practices, such as rain gardens, bioretention facilities, green roofs, permeable pavements, bioswales (Photo 1), and absorbent landscapes, among others (refer to the *Erosion and Sediment Control Guidelines* for more definitions and details).

Whether a LID practice has been in place for years or is currently under construction, it is considered a critical area and must be protected. LIDs should be installed after the upstream catchment area is stabilized wherever possible. If the LID cannot be installed after stabilization, it is imperative that the LID measure be isolated until the upstream catchment area has been fully stabilized, or sacrificial measures, such as polysheeting or sod, must be applied. If you have an LID on site refer to your ESC Plan to find out how it must be protected. If there is no information in the Plan related to the LID, an amendment is required.

LIDs typically rely on filtering stormwater runoff through a soil and vegetation complex, or storing runoff in a retention system to be used later. If proper ESC measures are not employed upstream of the LID, sediment-laden runoff can enter the LID, clogging the soil and vegetation complex, and reducing or eliminating the filtration capacity of the LID. Sediment-laden runoff entering cisterns or storage tanks could cause operational problems by overloading mechanical equipment used to discharge runoff.



Photo 1 A Bioswale

Photo 1 shows a typical LID installed at a City of Calgary site. The LID allows runoff water to flow through a layer of RECP and through mulch and shrubs, before finally entering the storage pond. Further sediment removal may occur in the pond.

3.8 Safety

Care must be taken during planning and implementation so that erosion and sediment controls and practices do not create unsafe conditions for workers and the public.

Ponds:

Ponds can attract children and animals. Areas intended to pond water or accumulate sediment should be clearly marked with survey flagging or other methods, and may need to be fenced off. Egress from ponds must be ensured.

Inlet Control:

All temporary sediment controls on storm inlets must be approved in the ESC Plan and may not cause excess ponding of water on public streets or diversion of runoff away from storm inlets.

Storm catchbasin inlet protection, when approved for use, must be limited to measures listed in the Standard Specifications for Erosion and Sediment Control. Other types of inlet protection can be a hazard to cyclists and/or motorists using the public roadway and is therefore prohibited.

3.9 Amendments to the Approved ESC Plan

Field staff are responsible for identifying site changes in a timely manner to the appropriate contact that oversees the site (often the owner or owner's representative). Both the Owner and the field staff must also verify that changes to the ESC Plan have been approved by The City ESC Inspector prior to implementing them onsite.

Approved ESC Plans must be amended to account for any changes that may occur onsite that affect the stages of work, location, or type of practices that were originally approved.

Some reasons why a Plan amendment might be required include:

- Changes in proposed ESC measures
- Steeper grades than shown in the approved ESC Plan
- Change in location or size of a soil stockpile
- Change in stripping volumes
- Change to inspection frequency

At a minimum, an amendment request must contain the:

- Project name;
- Project reference number (Development Permit, Development Agreement, Development Liaison, Airport Development or Circulation Drawing number);
- Municipal site address;
- Notification that it is an amendment for a previous ESC Approval;

- A detailed description of what is being amended;
- Applicable amended drawing and details portions of the ESC Plan.

Amendments must be submitted to the City ESC Inspector following the process outlined at the following link calgary.ca/esc.

4.0 Annual Soil Loss Evaluation for Your Site

The maximum tolerable soil loss for any slope on a construction site in Calgary is 2 tonnes per hectare per year (t/ha/y).

The ESC Plan is created and approved for the construction site using the *Revised Universal Soil Loss Equation for Application in Canada* (RUSLEFAC).

Potential soil loss is calculated using RUSLEFAC. From the RUSLEFAC results, appropriate ESC practices are selected to reduce soil loss on each slope down to less than 2 t/ha/y.

If any changes are proposed to the approved ESC Plan, then a soil loss analysis must be recalculated using RUSLEFAC to determine which practices need to be implemented to keep the soil losses on all slopes less than 2 t/ha/y. A RUSLEFAC calculation is then required for the revised drawing where the change would impact the predicted soil loss. The revised drawings and calculations must then be submitted to The City ESC Inspector as an amendment to the approved ESC Plan.

Note: 2 t/ha/y is the tolerable limit outlined by Agriculture and Agri-Food Canada for all soil contributing runoff and sediments to streams or surface water supplies; shallow soils (<10cm) over bedrock (Table 1.2, RUSLEFAC: Agriculture and Agri-Food Canada, 2002).

4.1 RUSLEFAC Calculation

ESC designers and City ESC Inspectors need a common language to discuss the effectiveness of ESC measures. The RUSLEFAC equation allows this conversation to occur.

RUSLEFAC calculations are included in ESC Plan submissions to justify that the selected erosion and sediment controls and practices are adequate to stabilize the site and protect downstream resources. The equation is:

$$A = R * K * LS * C * P$$

Where:

A: Annual estimated soil loss in t/ha/y. Mandated to be less than 2 t/ha/y of soil loss for each slope on the site.

R: Climatic information reflecting the duration and intensity of Rainfall events; for Calgary, **R =320**

K: Soil erodibility information, distinct for each soil type

LS: Topographical information defined by both how Long and how Steep the site hillsides are

C: Mitigation measures designed to Cover soil and stop erosion like mulch or blankets

P: Sediment capture measures to Prevent eroded soils from leaving the construction site, like silt fence or sediment ponds

As construction sites can typically be split into areas of different topography, it is necessary to include RUSLEFAC calculations for each catchment area.

Figure 2 shows how the RUSLEFAC equation might look in graphical form. Picture a weight scale set across a fulcrum (the green triangle). The beam is balanced at a certain point because the factors that want to pull it one way are balanced by those that want to pull it down in the opposite direction. The arrow is pointed at 2 t/ha/y, the design annual soil loss for the project.

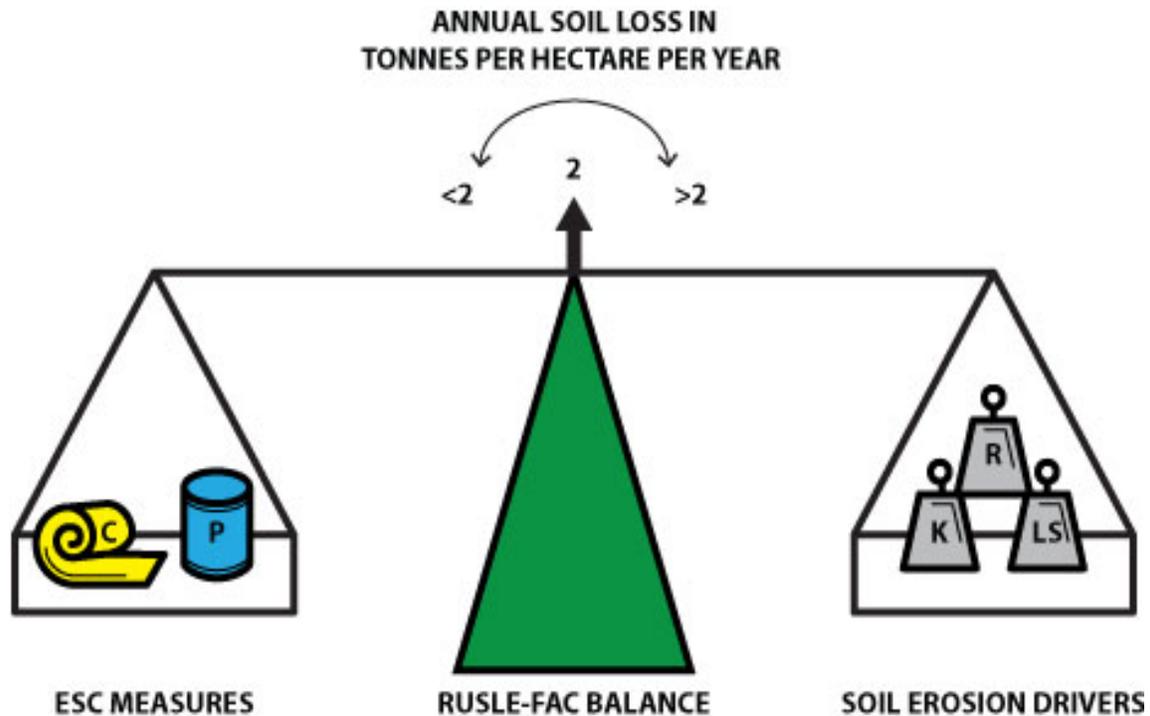


Figure 2 RUSLEFAC Diagram

R, **K**, and **LS** values are shown as lead weights that tend to cause the balance to tip to the right. They are the factors that want to drive erosion to more than 2 t/ha/y. **R**, **K**, and **LS** are shown as lead weights because they are impossible or more difficult to change and can have a big impact on soil erosion. The **R**-value is fixed for Calgary. If a more erodible soil is encountered onsite (**K**-value), or a steeper, longer slope is stripped than shown in the ESC Plan, the balance will tip further to the right, and more mitigation on the left side of the scale will be required to return balance.

On the left side of the scale are the factors that tend to mitigate soil loss. **C** is shown as rolled erosion control blanket, a common mitigation measure. **P** is shown as a drum full of water to represent a sediment pond. Having both erosion controls (**C**-value) and practices (**P**-value) onsite tends to tip the balance to the left side (with erosion controls preferred as preventative measures have higher soil conservation ‘weight’ than capture methods). Both methods require maintenance, however, so if these important tasks are left undone, the balance will tip back to the right. For example, if less hydromulch is installed than shown on the ESC Plan, or a sediment pond is not cleaned out after a rainstorm, the balance will quickly tip back to the right side.

The RUSLEFAC balance is always moving, and moving towards more soil erosion. Therefore, the field staff needs to be constantly aware of and work towards maintaining an appropriate ESC balance on the construction site.

4.1.1 More Information on RUSLEFAC

More details on RUSLEFAC and assessing site erosion potential can be found in the ***Erosion and Sediment Control Guideline***.

