Supplementary Information Report A

to the Proposal for the Casino Project

submitted by Casino Mining Corporation

on January 3, 2014

Pursuant to the
Yukon Environmental and Socio-economic Assessment Act

March 2015

A.22C – SEDIMENT AND EROSION CONTROL MANAGEMENT PLAN

The Casino Mine Project is an approximately 22 year mine project owned and operated by Casino Mining Corporation (CMC), that will produce copper and molybdenum concentrates, and gold dore bars via flotation milling and heap leach processing, respectively. The proposed project includes a four year construction period and a 90 year post-closure period. Key project components include the open pit, tailings management facility and waste rock storage area, heap leach facility, mill and associated infrastructure, ore stockpiles, liquefied natural gas power generating infrastructure, and office and accommodation buildings. The project also requires a 120 km access road from the town of Carmacks, YT, and concentrate will be trucked to the port at Skagway, Alaska.

The objective of the Sediment and Erosion Control Management Plan (the Plan) is to control run-off, minimize erosion on exposed slopes and substrates, and prevent inputs of silt or sediment into watercourses during all phases of the Project. Erosion control measures are those designed to prevent exposed soil particles from becoming detached and transported by water or wind. Best management practices will be the primary tool used to mitigate erosion and sedimentation risks. The Plan will provide specific details on what types of erosion and sedimentation control measures will be used and where and when they will be applied. It will describe the requirements for inspection, cleaning, repair and ultimately removal of the erosion and sediment control measures.

The Plan contained herein is a preliminary draft, which will be updated as the project is refined, and has been derived from *Plan Requirement Guidance for Quartz Mining Projects*. The final Plan will provide an overview of the project, described the areas where erosion may be a concern, and provide specific monitoring and management strategies for addressing the areas of concern.

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ABBREVIATIONS

Abbreviation	Definition
BMP	Best management practices
CMC	Casino Mining Corporation
The Plan	Casino Project Sediment and Erosion Control Management Plan
TMF	Tailings management facility

REVISION SUMMARY

Version	Date	Revision notes	Revision authors
Conceptual draft	January 2014	YESAB Project Proposal Submission version	CMC
Preliminary draft	January 2015	Updated to provide more details, as requested by reviewers in the YESAB adequacy review	CMC

A.22C.1 INTRODUCTION

The Casino Mine Project is a proposed 22 year mine project owned and operated by Casino Mining Corporation (CMC), that will produce copper and molybdenum concentrates, and gold dore bars via flotation milling and heap leach processing, respectively. The proposed project includes a four year construction period and an approximately 7 year post-closure period. The location of the Project is shown on Figure A.22C.1-1. Key project components include the open pit, tailings management facility and waste rock storage area, heap leach facility, mill and associated infrastructure, ore stockpiles, liquefied natural gas power generating infrastructure, and office and accommodation buildings. The project also requires a 120 km access road from the town of Carmacks, YT, and concentrate will be trucked to the port at Skagway, Alaska.

The objective of the Sediment and Erosion Control Management Plan (the Plan) is to control run-off, minimize erosion on exposed slopes and substrates, and prevent inputs of silt or sediment into watercourses during all phases of the Project. Erosion control measures are those designed to prevent exposed soil particles from becoming detached and transported by water or wind. Sediment is comprised of soil particles resulting from erosion; sedimentation is the deposition of the transported sediment. Best management practices will be the primary tool used to mitigate erosion and sedimentation risks. The Plan will provide specific details on what types of erosion and sedimentation control measures will be used and where and when they will be applied. It will describe the requirements for inspection, cleaning, repair and ultimately removal of the erosion and sediment control measures.

The final Plan will describe the measures to be undertaken to manage erosion and sedimentation during all phases of the Project. To achieve these objectives, CMC will:

- Comply with applicable federal and territorial legislation, Project permits, licences and approvals;
- Understand the potential for erosion to occur by identifying all potential erosion and sediment sources prior to undertaking any activities that will disturb ground;
- Adopt a multi-barrier approach for erosion and sedimentation control measures; and
- Inspect and maintain sedimentation control equipment and infrastructure, and remove once work is complete.

The protection of the natural environment and management of environmental risk from erosion and sedimentation in the Yukon is governed by the *Quartz Mining Act*, *Waters Act*, *Lands Act and Territorial Lands Act,* and the *Environment Act*. Additionally, sediment and sediment laden water can be considered a deleterious substance under Section 34 of the federal *Fisheries Act*.

Guidance documents relevant to the topic include:

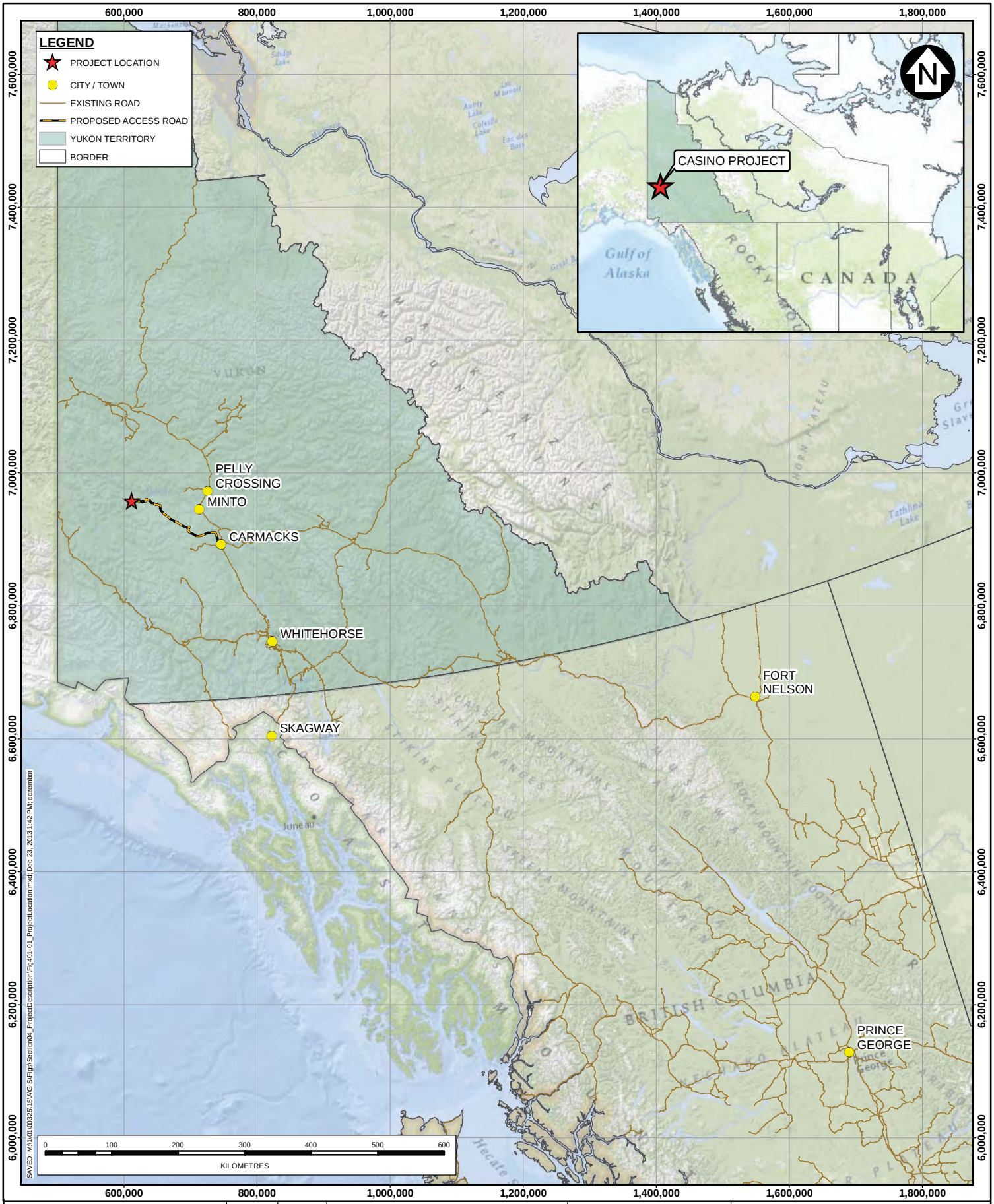
- Environmental Code of Practice for Metal Mines. Environment Canada. 2009;
- Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment (Guidelines for Canadian Drinking Water Quality, Recreational Water Quality, Protection of Aquatic Life, Agricultural Water Uses, as applicable); and
- Best Management Practices for Works Affecting Water in Yukon (Yukon Environment 2011).

Potential adverse effects from erosion and sedimentation can be minimized through project planning, following BMPs, and providing site specific controls that are commensurate with the potential risks to the natural environment. The Plan will provide a detailed description of the methods of sedimentation and

erosion prevention and control that will be used, the specific situations that they will be used in, and the implementation procedures that will be followed. The Plan will include details regarding:

- The appropriate location of control measures;
- The timing of installation, inspection and maintenance of control measures; and
- The responsible parties for implementation, operation, modification, inspection and maintenance control measures.

The Plan contained herein is a preliminary draft, which will be updated as the project is refined, and has been derived from *Plan Requirement Guidance for Quartz Mining Projects* (Government of Yukon, 2013). The final Plan will provide an overview of the project, described the areas where erosion may be a concern, and provide specific monitoring and management strategies for addressing the areas of concern. The final Plan will include a table of proponent commitments made during the environmental assessment process relevant to erosion and sedimentation management, and indicate how the Plan addresses the commitments. Terms and conditions of any applicable licences, permits and approvals required for the Project operations will also be included, once acquired.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:

1. BASE MAP: ARCGIS ONLINE NATIONAL GEOGRAPHIC MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO

CASINO PROJECT

PROJECT LOCATION

FIGURE A.22C.1-1

REF 1

P/A VA101-325/15

A.22C.2 MONITORING STRATEGIES

Monitoring of relevant water quality and sediment parameters in any receiving environment is included as a component of the *Casino Environmental Monitoring, Surveillance and Reporting Plan*. The frequency of erosion and sedimentation control monitoring and receiving environment monitoring will be established following Project permitting in consultation with regulatory agencies.

Monitoring will generally comprise of regular monitoring of key areas identified to be at high risk for erosion or sedimentation and follow up monitoring of installed mitigation measures. Periods of high flows (e.g., during spring melt/freshet periods, or high precipitation events) will also require monitoring of implemented best management practices (described in Section 4 -). Frequent and proper maintenance will allow for prolonged use instead of allowing the measures to be destroyed and in need of full replacement.

Silt fences, sediment traps/basins, ditches, culverts, exfiltration areas, and water management ponds will be visually inspected for the following:

- Excess sediment build-up;
- Structural/physical integrity; and
- Anticipated wear and tear.

Sediment removal and proper disposal shall be conducted as required.

A.22C.3 EROSION AND SEDIMENT SOURCES

While risks of erosion or sedimentation at the Project are greatest during the construction phase of the project, there are also operational considerations to be monitored to minimize the erosion and sedimentation potential of constructed infrastructure. Areas where erosion or sedimentation may be a concern during all phases of the Project are summarized in Table A.22C.3-1. Operational phases include construction (years -4 to -1), operations (years 1 to 22), post-closure (years 23 – 30) and closure (years 31+).

Generally, areas most at risk for erosion and sediment transport include steep slopes with high potential for wind and water induced erosion, exposed permafrost areas or areas where the vegetative mat has been removed resulting in thaw and fluidized movement of soils and overburden, and heavily trafficked areas.

Potential effects from the above activities in the absence of planned mitigation measures include:

- Increased surface erosion from disturbed and rehabilitated areas;
- Increased sediment load entering the natural water system; and
- Siltation or erosion of ditches and watercourses.

Table A.22C.3-1Potential Erosion and Sedimentation Sources

Erosion and Sedimentation Sources	Operational Period			
	Construction	Operations	Post-Closure	Closure
Land clearing and topsoil stripping	X	X		
Stockpiling of topsoil and ice-rick materials	X	X		
Ground disturbance to build access road	X			
Pit excavation, site grading and land filling	X	X		
Construction of roads, bridges, and culverts	X	X		
Construction of the TMF, waste rock dumps, and heap leach facility	X	X		
Ground disturbance during decommissioning of mine site infrastructure and access roads			X	
Particulate matter deposition caused by vehicle traffic within the mine site area and along the access roads	X	X	X	
Runoff from ore and topsoil stockpiles	X	X	X	

A.22C.4 EROSION AND SEDIMENT CONTROL MEASURES

Potential adverse effects from erosion and sedimentation can be minimized through project planning, following best management practices (BMPs), and providing site specific controls that are commensurate with the potential risks to the natural environment. The following BMPs will be followed:

- Ensure contractors and staff understand the objectives of the Sediment and Erosion Control Management Plan;
- Make the Sediment and Erosion Control Management Plan flexible and adaptable to different project areas, phases and risks;
- Adopt a multi-barrier approach to provide erosion and sediment control;
- Maintain a vegetated buffer between construction and any waterbodies where possible;
- Retain existing vegetation and stabilize exposed soils with vegetation where possible;
- Limit the duration of soil exposure and phase construction when possible;
- Limit the extent of disturbed areas by minimizing nonessential clearing and grading;
- Minimize slope length and gradient of disturbed areas;
- Stabilizing and re-vegetating disturbed areas following construction, as appropriate;
- Delineate areas that are susceptible to erosion (e.g., silty soils, long steep slopes);
- Stockpile topsoil away from watercourses, drainage features, and tops of steep slopes;
- Designing appropriate sediment settling ponds that conform to BC MELP (2001) guidelines;
- Designing appropriate diversion ditch systems to minimize contact water;
- Designing appropriate collection ditch systems to collect contact water;
- Assess all erosion and sedimentation control measures before and after all significant rainfall and snowmelt events to ensure they are functioning as designed;
- Monitoring of TSS and turbidity during construction to ensure compliance with regulatory guidelines (<25 mg/L increase if background levels are less than 250 mg/L, <10% increase if background levels are greater than 250 mg/L; (CCME, 2002)); and
- Using dust suppressants and enforcing traffic speed limits along all access roads.

The main methods for erosion and sedimentation control include prevention, through water management, and control, through various sediment control techniques, as discussed below.

A.22C.4.1 PREVENTION

The primary method of preventing erosion and preventing sediment laden water from entering watercourses is to limit the footprint near waterbodies and to maintain a vegetated buffer between construction activities and the watercourse. This method also protects riparian vegetation and aquatic habitat.

The water management objective during construction is to safely convey and/or detain the respective design storm event at each facility, while maintaining water quality at background levels or meeting water quality standards in the receiving environment. The primary means of achieving this objective will require the diversion of non-contact runoff, and erosion source control (i.e., minimizing total suspended sediment levels in runoff from construction areas). Water will be controlled in a manner that minimizes erosion in areas disturbed by construction activities and prevents the release of construction water which could adversely affect the quality of receiving waters.

Water will be controlled in a manner that minimizes erosion in areas disturbed by construction activities and prevents the release of sediment laden water to the receiving environment. Design criteria for the various sediment control elements will be based on industry standard guidance documents (BC MELP, 2001; BC Ministry of Energy and Mines, 1998). Sediment mobilization and erosion will be managed throughout the site by installing sediment controls (see Section 4.2) prior to construction activities, limiting the disturbance as much as possible and reducing water velocity across the ground, particularly on exposed surfaces and in areas where flow tends to concentrate. During operations, diversion ditches will be established and disturbed land surfaces will be stabilized to minimize erosion. This will be achieved by implementing progressive rehabilitation of disturbed land, construction drainage controls to improve stability, promoting infiltration, constructing appropriate sediment control devices and restricting access to rehabilitated areas.

Numerous design elements that have been included in the Project design include:

- **Maintaining vegetated buffers**: Wherever possible, vegetated buffers will be maintained between construction activities and waterbodies. Buffers may range from 10 m to 30 m, depending on the size and nature of the waterbody. The Project footprint near waterbodies will also be limited to the extent possible.
- **Coffer dams and pumping systems:** A coffer dam will be constructed with the TMF starter footprint to capture all runoff from the upstream areas and route it to the sediment pond downstream.
- **Sediment and erosion control elements and BMPs:** Typical BMPs that will be used at the project are maintaining vegetated buffers, runoff collection ditches, energy dissipaters, sediment traps, slope drains, surface roughening, filter bags, water bars, diversion structures, silt fences, sediment basins, temporary seeding, and mulching.
- **Sediment settling and water collection ponds:** Temporary sediment settling ponds will be constructed downstream of all construction activities to treat sediment laden water and discharge to existing channels via energy dissipating structures. Collection ponds will also be constructed at the toe of all stockpiles.
- **Water management pond:** This pond will collect surface runoff and seepage from the TMF embankments during operations and pump the water back to the TMF.
- **Winter seepage mitigation pond:** This pond will function as a mitigation measure at closure to store seepage from the TMF during the winter months (December to April) when there is no dilution from surface water runoff in Casino Creek.

A.22C.4.2 CONTROL

Erosion control BMPs reduce erosion potential by stabilizing exposed soil or reducing surface runoff flow velocities. There are generally two types of erosion control BMPs that are used:

- Source control BMPs for protection of exposed surfaces; and
- Conveyance BMPs for control of runoff.

Experience and adaptive management are integral to the successful selection of the appropriate BMPs and the design and implementation of an overall erosion and sediment control plan. Erosion control BMPs will be implemented prior to and during construction to minimize erosion and sediment discharge into surrounding areas. Typical BMPs that will be used at the project are:

• Runoff collection ditches	• Water bars
• Energy dissipaters	• Diversion structures
• Sediment traps	• Silt fences
• Slope drains	• Sediment basins
• Surface roughening	• Temporary seeding
• Filter bags	• Mulching

A.22C.4.2.1 Collection Ditches

A runoff collection ditch intercepts construction water runoff and diverts it to a stabilized area where it can be effectively managed. Collection ditches are used within construction areas to collect runoff and convey it to appropriate sediment control measures. General locations and conditions may include:

- Below disturbed slopes to divert sediment-laden water to control facilities;
- At or near the perimeter of the construction area to prevent sediment-laden runoff from leaving the site; and
- Below disturbed areas to prevent erosion before stabilization is achieved.

Collection ditches may be either temporary or permanent structures. Temporary collection ditches for construction will be sized to convey the runoff from a 10 year return period 24-hour storm event assuming that the entire footprint area has been disturbed and contributes sediment laden runoff to the sediment control and water management ponds. Collection ditches will be inspected and maintained regularly to remove any blockages to flow (accumulated sediment, debris, etc.) that may occur.

A.22C.4.2.2 Energy Dissipators

Energy dissipators are typically riprap lined plunge pools used to dissipate the energy of fast flowing water and prevent erosion of natural stream channels downstream. These structures are used in conjunction with diversion and collection ditches, and are typically located upstream of the receiving waterbody (e.g. stream, pond, lake, etc.). Energy dissipators will be inspected and maintained regularly to remove any blockages to flow (accumulated sediment, debris, etc.) that may occur.

A.22C.4.2.3 Sediment Traps

Sediment traps are typically constructed within collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out. The exact locations and final geometry of each trap will be field fitted to integrate with the terrain to minimize disturbance. Water from sediment traps will flow to holding ponds, sediment basins or other BMP structures. The sediment traps will be inspected regularly for sediment accumulation. Maintenance will include the removal of sediment if the sediment trap has accumulated sediment to one half of the wet storage. If the sediment trap is clogged by sediment and/or debris, the trap will be removed and cleaned, or replaced.

A.22C.4.2.4 Slope Drains

Slope drains consist of flexible tubing or conduit and are required to convey concentrated runoff into the appropriate BMP structure when ditches are deemed impractical. Slope drains shall be sized according to estimates of peak flows, which are dependent on contributing drainage area. Slope drains will be inspected and maintained regularly and any blocked or damaged parts will be cleaned, repaired, or removed and replaced.

A.22C.4.2.5 Surface Roughening

Cut and fill slopes will be roughened with tracked machinery where appropriate to reduce runoff velocity and erosion, increase infiltration, and aid in the establishment of vegetative cover with seeding. The roughening will be carried out by a tracked machine moving up and down the slope surfaces, creating undulations on the soil surface. This procedure is simple and inexpensive, and it provides immediate short-term erosion control for bare soil where vegetative cover is not yet established. A rough soil surface provides favorable moisture conditions that will aid in seed germination.

A.22C.4.2.6 Filter Bags

Filter bags are generally constructed from a sturdy non-woven geotextile capable of filtering particles larger than 150 microns. Filter bags are to be installed at the discharge end of pumped diversion pipelines, via fabric flange fittings, to remove fine grained materials such as silt before discharging water to the environment. Filter bags should be installed on flat, stable, non-erodible foundations, or in well vegetated areas. The pumping rate shall be no greater than specified by the manufacturer. Discharge from filter bags will be routed to minimize erosion. A smaller variety of filter bags, referred to as filter socks, can be installed on the discharge ends of gravity flow pipes, such as slope drains, to filter silt particles before discharging water to the environment.

A.22C.4.2.7 Waterbars

Waterbars serve to reduce sheet flow and surface erosion of areas of exposed soil and/or roads by diverting runoff towards a stable vegetated area or collection ditch. Spacing of waterbars will be field fitted based on the slope grade and general erodibility of the surface. Waterbars must not direct runoff into a ditch that will channel water toward the watercourse unless the ditch is adequately prepared with check dams and armouring, where appropriate. Waterbars may require regular maintenance when subjected to frequent traffic crossings.

A.22C.4.2.8 Diversion Structures

A temporary diversion structure consists of sandbags stacked in a pyramid formation with a polyethylene sheet placed diagonally in between the bags. Temporary diversion structures are useful for diverting concentrated overland flows to an appropriate sediment basin or other BMP structure where it can be effectively managed.

A.22C.4.2.9 Silt Fences

Silt fences are typically sheets of geotextile material installed downslope of erosion-susceptible terrain to prevent sediment-laden sheet flow from entering receiving waters. Drainage pools that form along the uphill side of the fence promote sediment settling. Drainage in contact with the fence is filtered through the geotextile. The small pores of the silt fence will filter coarse particles and restrict water exfiltration rates. Barrier locations are informally chosen based on site features and conditions (e.g. soil types, climate, terrain features, sensitive areas, etc.), design plans, existing and anticipated drainage courses, and other available erosion and sediment controls. Typical barrier sites are catch points beyond the toe of fill material, or on side slopes above waterways or drainage channels. Silt fences are not recommended for wide low-flow, low-velocity drainage ways, for concentrated flows, in continuous flow streams, for flow diversion, or as check dams. Silt fences should be inspected for damage, tears, clogging, or erosion of the surrounding areas. Damaged sections will be repaired or replaced to maintain functionality.

A.22C.4.2.10 Sediment Basins

A sediment basin is a temporary structure that is used to detain runoff from small drainage areas so that sediment can settle out. Sediment basins are generally located in areas where access can be maintained for sediment removal and proper disposal. Sediment basins are typically constructed at the end of collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out. A sediment basin can be created by excavating a basin, utilizing an existing depression, or constructing a dam on a slight slope downward from the work area. Sediment-laden runoff from the disturbed site is conveyed to the basin via ditches, slope drains, or diversion structures. The basin is a temporary measure, with a nominal design life of approximately six months, and is to be maintained until the site is permanently protected against erosion by vegetation and/or structures. The size of the temporary sediment basin is dependent on the size of the drainage area. The exact location and final geometry of each basin should be field fitted to integrate with the terrain to minimize disturbance.

A.22C.4.2.11 Temporary Seeding

Exposed slopes and other disturbed areas will be seeded to establish vegetative cover utilising native grass species. The purpose of temporary seeding is to stabilize the soil and reduce damage from wind and/or water until permanent stabilization is accomplished. Seeding is applicable to areas that are exposed and subject to erosion for more than 30 days, and is usually accompanied by surface preparation, fertilizer, and mulch; however, the timing of seeding is weather and season dependent and consequently this method is not applicable at all times. Temporary seeding may be accomplished by hand or mechanical methods, or by hydraulic application (hydroseeding), which incorporates seed, water, fertilizer, and mulch into a homogeneous mixture (slurry) that is sprayed onto the soil.

A.22C.4.2.12 Mulching

Mulching is the application of a uniform protective layer of straw, wood fiber, wood chips, or other acceptable material on or incorporated into the soil surface of a seeded area to allow for the immediate protection of the seed bed. The purpose of mulching is to protect the soil surface from the forces of raindrop impact and overland flow, foster the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth. Mulching helps to hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, and reduces the need for watering. Mulching may be utilized in areas that have been seeded either for temporary or permanent cover.

There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches likely to be used include straw, hay, wood fiber, wood chips, and bark chips. This type of mulch is usually spread by hand or by machine (mulch blower) after seed, water, and fertilizer have been applied. Chemical mulches, also known as soil binders or tackifiers, are composed of a variety of synthetic materials, including emulsions or dispersions of vinyl compounds, rubber, asphalt, or plastics mixed with water. Chemical mulches are usually mixed with organic mulches as a tacking agent to aid in the stabilization process, and are not used as mulch alone, except in cases where temporary dust and erosion control is required. The choice of materials for mulching should be based on soil conditions, season, type of vegetation, and the size of the area. One example is rolled erosion control blankets woven with degradable or poly netting with straw or coconut mulch, which can be used on steep slopes to provide a permanent or semi-permanent cover.

A.22C.4.3 IMPLEMENTATION SEQUENCE

Specific implementation sequences for water management and erosion and sedimentation control activities will be detailed during detailed engineering of the Project. At that time, this plan will be updated with the sequence of activities that will conducted to minimize erosion and sedimentation of the receiving environment during construction, operations and closure phases of the Project. For example, during construction of the tailings dam, a staged surface dual-ditch system has been designed to collect surface runoff from the embankment in an upslope ditch, and a downslope ditch diverts clean surface runoff. The ditches will be lined with scour protection to prevent erosion of the ditch channels. The exact sequence of ditch construction and lining will be outlined in the updated plan. The sequence of sedimentation basin, diversion ditches, energy dissipaters, sediment traps, etc., will also be detailed in the updated plan, once the exact construction requirements are known.

A.22C.5 REFERENCES

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