



**CONSTRUCTION SEDIMENT &
EROSION CONTROL AND WATER
MANAGEMENT PLAN**

VERSION 2013-01

EAGLE GOLD PROJECT

**Prepared by:
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Abbreviations

the Plan.....	the Erosion and Sediment Control Plan
the Project.....	the Eagle Gold Project
ADR.....	adsorption, desorption and recovery
AMC.....	antecedent moisture condition
BMP.....	best management practice
DGDC.....	Dublin Gulch diversion channel
EP Pond.....	Eagle Pup pond
FNNND.....	First Nation of Na-Cho Nyäk Dun
g/t.....	grams per tonne
HKP.....	Hallam Knight Piésold
HLF.....	heap leach facility
IDF.....	Intensity-Duration-Frequency
KPL.....	Knight Piésold Ltd.
LOM.....	life of mine
Lorax.....	Lorax Environmental Services Ltd.
masl.....	meters above sea level
MAP.....	mean annual precipitation
MIW.....	mine influenced water
m ³	cubic metres
mm.....	millimetre
mm/y.....	millimetre per year
Mt.....	megatonnes (million tonnes)
Mt/y.....	megatonnes per year
MWTP.....	mine water treatment plant
PMF.....	probable maximum flood
PMP.....	probable maximum precipitation
RECP.....	rolled erosion control products
SECP.....	sediment and erosion control plan
SCP.....	sediment collection pond

TSS total suspended solids
SGC..... StrataGold Corporation
WMP.....water management plan
WRSA.....waste rock storage area

DRAFT

1 INTRODUCTION

1.1 PROJECT SUMMARY

StrataGold Corporation (SGC), a directly held wholly owned subsidiary of Victoria Gold Corporation has proposed to construct, operate, close and reclaim a gold mine in central Yukon. The Eagle Gold Project (the Project) is located 85 km from Mayo, Yukon using existing highway and access roads. The Project will involve open pit mining at a production rate of approximately 10 million tonnes per year (Mt/y) ore, at an average strip ratio (amount of waste: amount of ore) of 1.45:1.0. Gold will be extracted using a three stage crushing process, heap leaching, and a carbon adsorption, desorption, and recovery system over a 10 year mine life.

Access to the Project site is from the Silver Trail (Highway 11) onto the existing South McQuesten Road and Haggart Creek Road. Together, they comprise a 45 km road divided by the South McQuesten River. The majority of the Project site lies within the Dublin Gulch and Eagle Creek watersheds. Dublin Gulch and Eagle Creek are second order streams that are tributary to Haggart Creek, which flows to the South McQuesten River. Figure 1-1.1 provides a map of the Project location.

The Project will utilize conventional open pit mining techniques to extract ore. The open pit will be located on the south side of Dublin Gulch/Eagle Creek in an area that includes portions of three tributary gulches, namely Eagle Pup, Suttles Gulch and Platinum Gulch. Mined rock that does not contain economic ore or cannot be used for construction will be placed in one of two areas – Platinum Gulch or Eagle Pup waste rock storage areas.

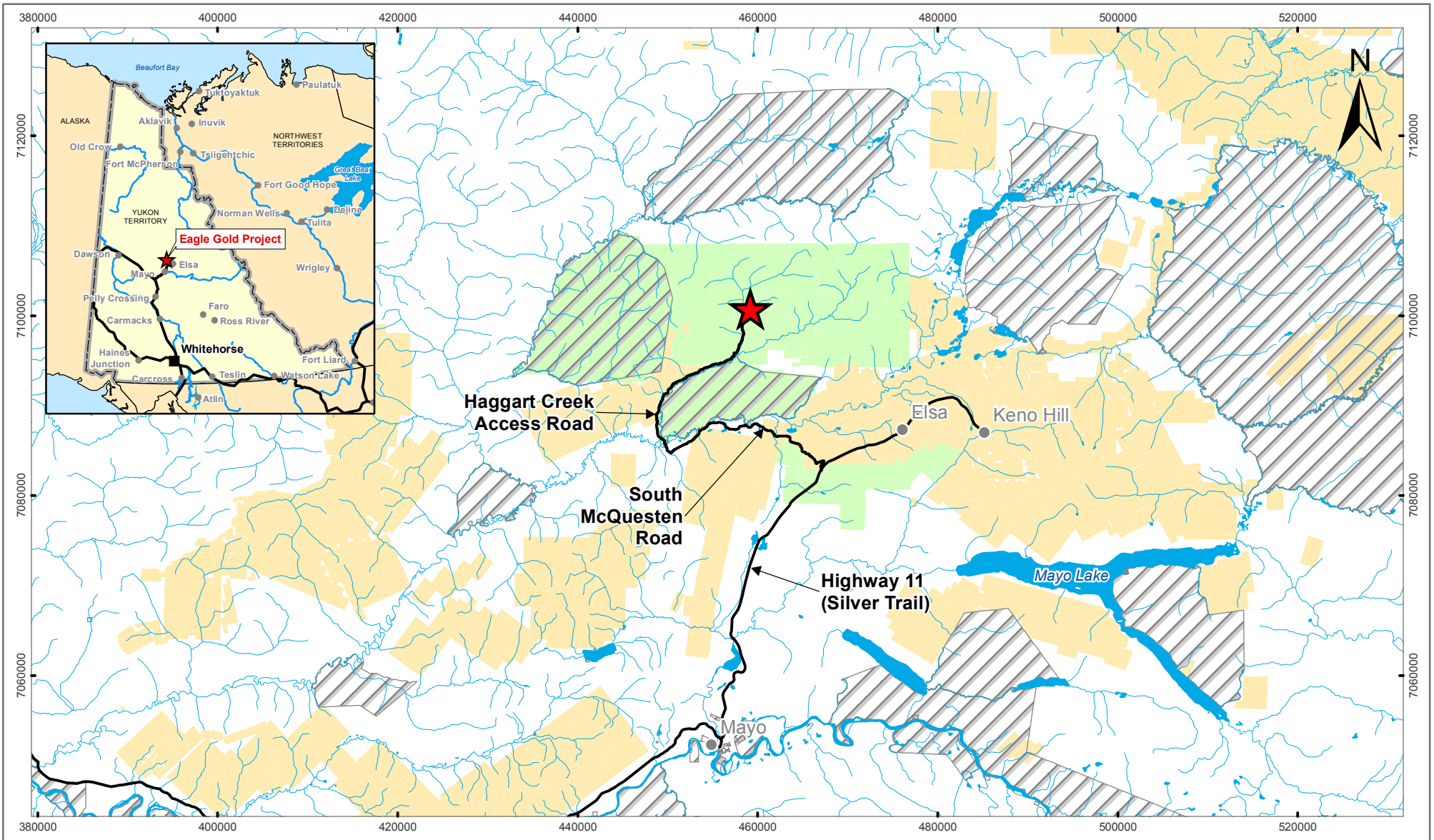
Historically, the Project site has been impacted by extensive placer mining in the Haggart Creek and Dublin Gulch watersheds. The valley floor has been significantly re-worked in the lower Dublin Gulch catchment, which has resulted in the re-routing of smaller streams within the system.

Planned infrastructure includes an open pit, three stage crushing facilities, Platinum Gulch waste rock storage area (WRSA), Eagle Pup WRSA, Ann Gulch Heap Leach Facility (HLF), Dublin Gulch diversion channel (DGDC), an ADR plant, a mine water treatment plant (MWTP), a truck shop and maintenance area, a camp, temporary (or 100-day) ore stockpile, and water management ponds. The proposed general layout of the mine and infrastructure components of the Project are presented on Figure 1.1-2 (Mine Site General Arrangement).

During operations the MWTP will be constructed downstream of the HLF to treat excess process water and other collected mine influenced water (MIW). The MWTP will discharge treated water into Haggart Creek. During the construction phase, water management ponds will be constructed for use as sediment collection ponds (SCPs) and exfiltration areas. Non-contact water will be diverted, as feasible, around disturbed areas before discharging into Haggart Creek or Dublin Gulch.

The term “contact water” is used in this Plan to describe water that has come into contact with either the WRSAs, open pit, or HLF during operations. This type of water will need to be treated at the MWTP during operations prior to discharge to the environment. Conversely, “non-contact water” is used to describe water that has not come into contact with any Project facilities. “Sediment-laden water” is used to describe water that originates from disturbed areas (e.g., roads, foundation pads, etc.) and only needs treatment for sedimentation, which is done through the management practices described in this Plan without the use of the MWTP.

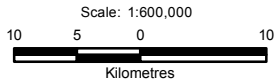
Construction activities will produce sediment-laden water only. While the ditches and culverts described in this Plan are also capable of conveying contact-water during operations, since this is a construction-specific sediment and erosion control plan, it will describe the function of best management practices (BMPs) with respect to sediment-laden and non-contact water. A comprehensive water management plan that includes a description of contact, non-contact and sediment laden water during all phases of the Project will be submitted as part of the application for a Water Use License.



LEGEND

- ★ Eagle Gold Project Site
- Victoria Gold Claims
- Other Mineral Claims
- Nacho Nyak Dun Settlement Land
- Town / Village
- Road
- ~ Watercourse
- Waterbody

NOTES
 1. Data Sources: Government of Canada, Victoria Gold Corp, Yukon Geomatics.



PROJECTION UTM Zone 8	DATUM NAD83
FILE NO. V23201707	
CLIENT 	

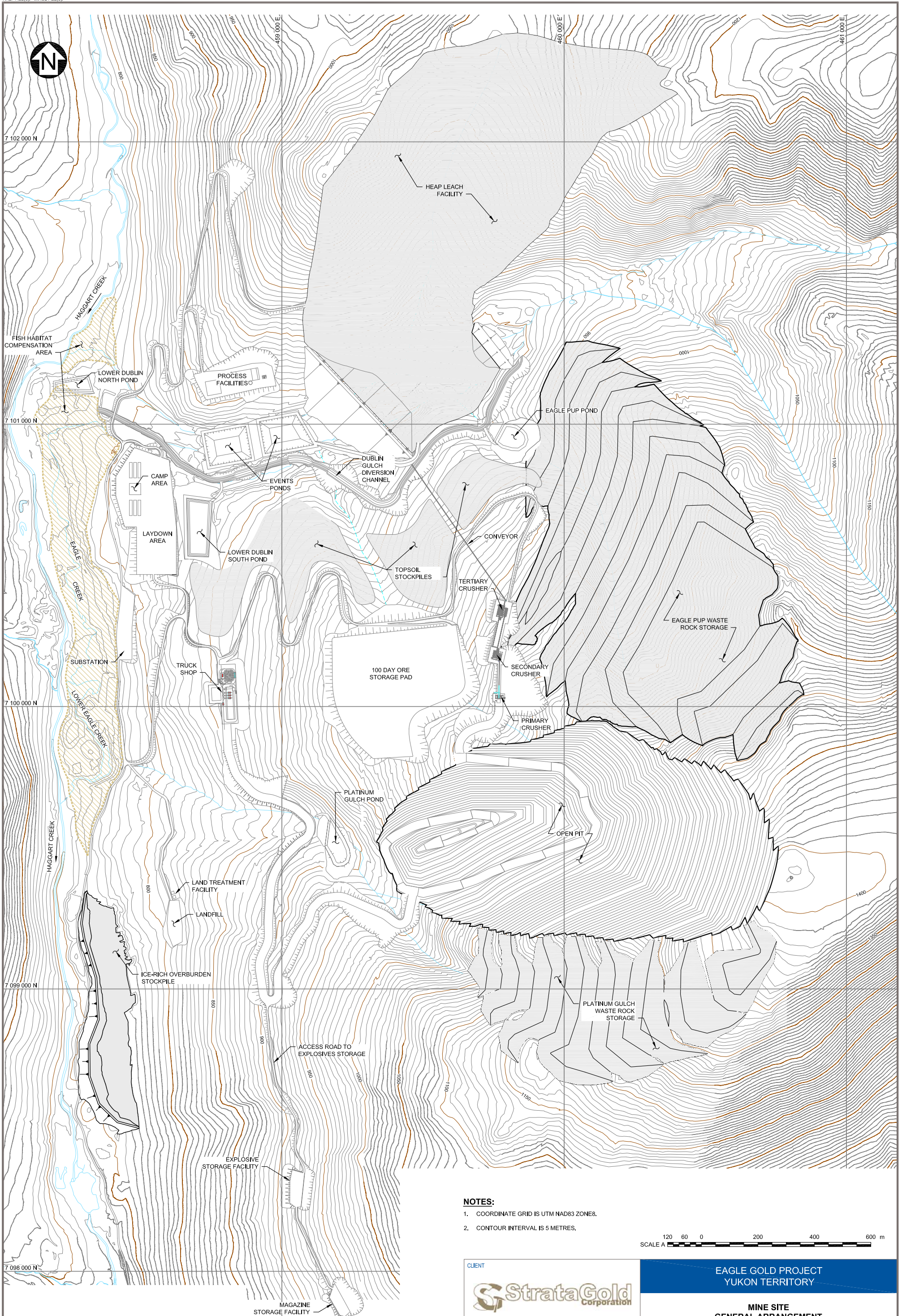
**EAGLE GOLD PROJECT
YUKON TERRITORY**

Property Location Map

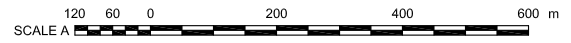
PROJECT Eagle Gold	DWN SL	CKD IS	APVD IS	REV 0
OFFICE EBA_VANC	DATE March 25, 2013			

Figure 1.1-1

STATUS
ISSUED FOR REVIEW



- NOTES:**
1. COORDINATE GRID IS UTM NAD83 ZONE8.
 2. CONTOUR INTERVAL IS 5 METRES.



CLIENT 	EAGLE GOLD PROJECT YUKON TERRITORY			
	MINE SITE GENERAL ARRANGEMENT			
	FILE NO. VA101-290/6	DWN JT/WAL	CKD BB	REV 0
	OFFICE KPL-VANC	DATE July 18, 2013		
				Figure 1.1-2

1.2 SCOPE OF PLAN

This construction sediment and erosion control and water management plan (the Plan) has been developed to proactively manage water, erosion and sedimentation throughout the construction of the Project. Construction of the mine is planned to occur over two years pending issuance of required licenses and permits. The construction phase has been divided into two stages to accommodate permitting assumptions and seasonal constraints. Stage 1 Construction includes site preparation allowable prior to receipt of a Water Use License. Stage 2 Construction includes facility construction after receipt of a Water Use License. These stages are defined in Sections 5.2 and 5.3 – Stage 1 Construction and Stage 2 Construction, respectively. The scope of this Plan includes sediment and erosion control for both construction stages.

The Plan has two functional components:

- A water management plan (WMP)
- A sediment and erosion control plan (SECP)

The WMP describes the capability of the site water management infrastructure to contain, control and convey short duration extreme rainfall events (i.e., 1 in 10 year rainfall, 1 in 100 year rainfall, or the Probable Maximum Precipitation). Water management facilities are designed with two specific operating modes: 1) service conditions, which include day-to-day operations and 2) ultimate limit conditions, which include provisions for safely handling extreme peak runoff events.

The SECP provides the best management practices (BMPs) that will be implemented on site and detailed site-specific plans that address the construction objectives of the Project.

The contents of the Plan are as follows:

- Site Conditions
- Construction Water Management Approach
- Water Management Plan Implementation
- Sediment and Erosion Control Plan Implementation

The primary emphasis of the Plan corresponds to the construction phases of the Project.

This Plan provides strategies and design objectives with appropriate flexibility to allow the design elements to be field-fit to suit the conditions encountered during construction (i.e., adaptive management approach).

2 SITE CONDITIONS

Baseline conditions have been addressed in the *Eagle Gold Project Proposal* (Stantec 2011a), subsequent updates to environmental baseline data reports (Stantec 2012a, 2012b, 2012c and 2012d), and the *Eagle Gold Project Hydrometeorology Report* (Knight Piésold 2013a). Baseline data reports and analysis contain background data that are integral to the design and implementation of the Plan. Parameters such as precipitation, runoff coefficients, soil types, and physiography are used to develop techniques and design of the sediment and erosion control and water management plan.

2.1 HYDROMETEOROLOGY

Updated and detailed hydrometeorology baseline data for the Eagle Gold site are presented in the *Eagle Gold Project Hydrometeorology Report* (Knight Piésold 2013a). The key findings of the study have been summarized in the following sections.

2.1.1 Intensity-Duration-Frequency Data

Knight Piésold (2013a) developed annual extreme rainfall values in the form of Intensity-Duration-Frequency (IDF) data. The estimated 2-year and 10-year 24-hour rainfalls are 31.0 mm and 49.1 mm, as presented in Table 2.1-1. Comparison with the measured site rainfall data suggests that the 24-hr rainfall estimates are reasonably conservative.

Table 2.1-1: Intensity-Duration-Frequency Values

Return Period (years)	24-Hour Rainfall (mm)
2	31.0
10	49.1
100	71.6
200	78.3
1000	93.7

2.2 SOILS

The most recent soil samples were collected in October 2012 at the Project site by Lorax Environmental Services Ltd. (Lorax) and submitted for grain size analysis. Four samples were collected – three from the Eagle Creek bluffs and one from a temporary sediment pond in the Suttles Gulch area. The particle size distributions for the samples from the Eagle Creek bluffs indicate that 11-16% of the particles are smaller than 0.005 mm, which is the smallest suspended sediment particle that practically can be removed by standard sedimentation practices. If the pond's surface area is big enough, 0.005 mm particles can be settled out as per the *Guidelines for Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining* (BC MOELP 1996). Comparatively, 4% of the Suttles Gulch sample contained particles smaller than 0.005 mm. The median grain size for the three samples from the Eagle Creek bluffs was 0.1 mm, 0.3 mm, and 0.02 mm. The median grain size for the sample from Suttles Gulch was 0.03 mm.

Frozen ground, when observed, is generally encountered immediately below the organic cover. Ground temperatures were measured in thermistors installed on site by Knight Piésold (Knight Piésold 1996). The measured ground temperatures showed the frozen ground to be relatively warm when observed, typically between 0°C and -1°C.

The term “ice-rich” is used to describe a soil where ice occupies a larger pore space in the soil than water in an unfrozen state. When this ice thaws, the water content exceeds the water holding capacity of the soil and excess water will be present. Frozen ground with excess ice, hereafter called ice-rich, may become unstable upon thawing, and will therefore generally need to be excavated to prescribed depths within the footprint of planned facilities. These materials, which could potentially be useful in closure activities (e.g. as cover for reclamation) once thawed and drained, require management during construction and operation of the mine. Ice-rich soils can be problematic as they begin to thaw. The exposed soils become wet, muddy, and unable to support loading as the frost melts. Additionally, disposal of ice-rich soils requires gentle slopes and low stockpile heights or confining berms for containment.

Throughout the construction stages, it has been estimated that approximately 620,000 m³ of ice-rich overburden will need to be managed. Using the current construction plan, the majority of this ice-rich material, up to approximately 489,000 m³, will be encountered within the first year of construction. Where these zones are relatively thin (e.g., less than 0.5 m thick), the area will be exposed and allowed to thaw and drain to temporary sediment basins (see Table 3.4-1). Where thicker zones are encountered, the ice-rich materials will be excavated, transported and placed in an existing containment area. The containment area will be designed to allow the thawing ice to drain. Ice-rich materials will be hauled from their source areas to the management area by haul truck and placed while still frozen to the extent possible. Accessible stored materials, where feasible once thawed and drained, will be used in reclamation activities elsewhere on site at mine closure, and in closure of the ice-rich overburden storage area. The site selected for the ice-rich material storage area is in existing depressions within placer tailings along Haggart Creek. A detailed description of ice-rich material management including preliminary design of the storage area is provided in the *Ice-Rich Materials Management Plan* (BGC 2013).

3 CONSTRUCTION WATER MANAGEMENT APPROACH

3.1 OBJECTIVES

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 (e.g., Dublin Gulch, Haggart Creek, and Eagle Creek).

3.2 STRATEGIES

Water management during construction will include diversion of non-contact water to reduce the total volume of sediment laden water to manage via ditches, construction of sediment control ponds, construction of an exfiltration pond, stabilization of disturbed land surfaces, and re-establishing vegetative cover. Where final slopes are created, native vegetation will be planted as per the *Decommissioning and Reclamation Plan* (Knight Piésold 2013b). Sediment laden water during construction will be collected in exfiltration areas or sediment basins and then released to the ground surface or watercourses after suspended solids have settled.

3.3 DESIGN

For the purpose of the WMP, the Project area has been subdivided into a number of hydrologic catchments, as shown on Figure 3.3-1. The catchment boundaries are based on end of mine footprint. However, the SCPs are designed to contain the maximum volume of runoff from catchment areas, which, depending on the catchment, may not necessarily correspond to the end of mine footprint. During construction and particularly prior to installation of diversion ditches, some of the catchment areas reporting to the SCPs are larger than the areas shown on Figure 3.3-1. Therefore, to ensure that the SCPs are capable of storing runoff during the entire life of the Project, they were sized to store the 1 in 10 year 24-hour return period storm from their largest respective contributing area.

The implementation of water management infrastructure is described in Section 4.0.

3.3.1 Storm Water Design Criteria

A risk-based approach is used to select appropriate design storm events for water management facilities. This approach weighs the likelihood of failure, versus the consequence of failure, on a

case-specific basis. Design storm events are developed by assessing the annual recurrence of precipitation events of a given magnitude, as described in Section 2.1.1.

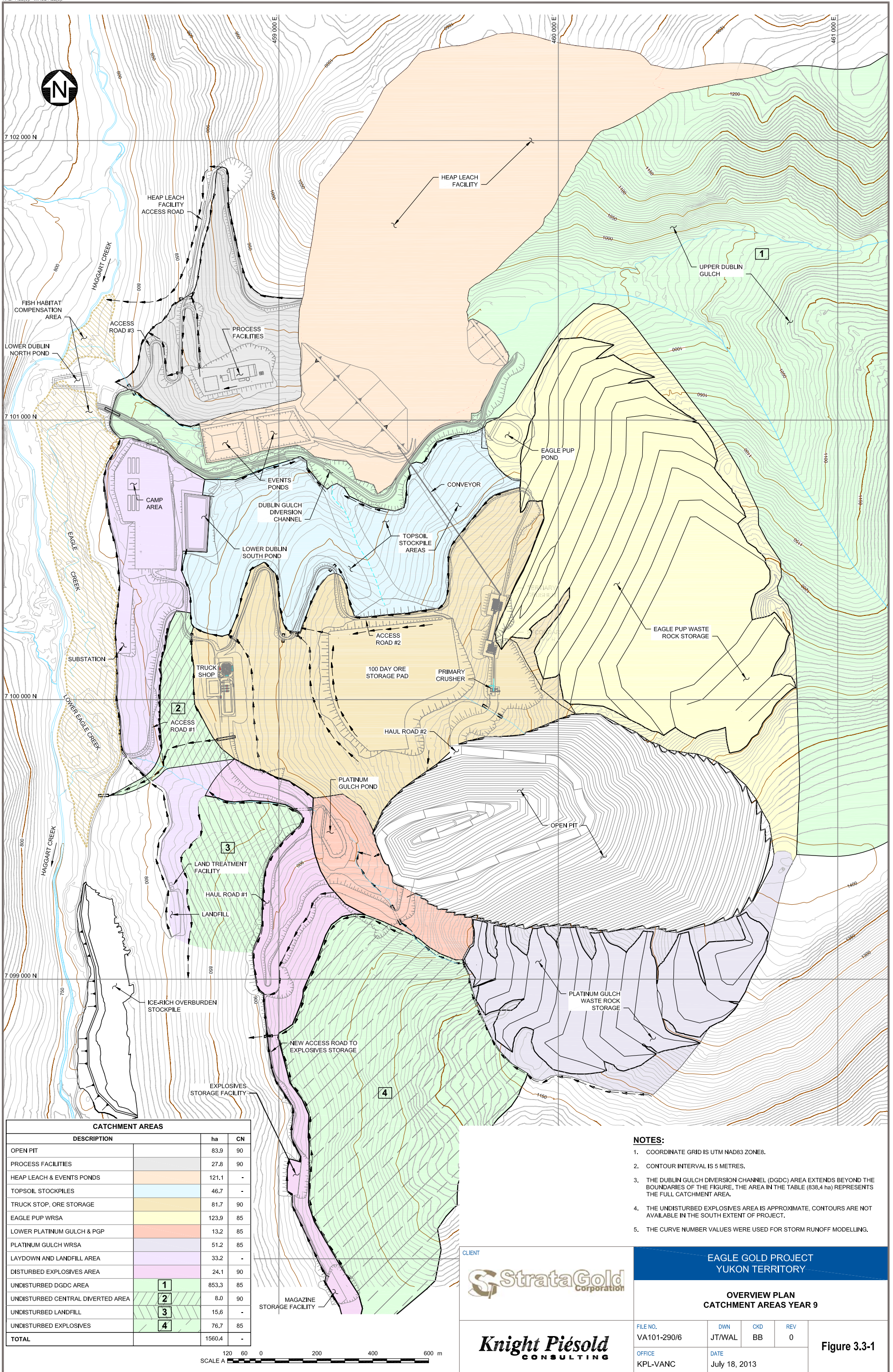
Design storm events are used as input parameters in most rainfall-runoff type storm water models (e.g., HEC-HMS, HydroCAD, TR-55). This is the approach followed in Knight Piésold (2013c), and the design criteria from that report for various design elements are listed in Table 3.3-1 below.

Table 3.3-1: Design Criteria

Design Element	Design Criteria	Anticipated Exposure Time
Diversion Ditches Upslope of Key Mine Infrastructure	1 in 100 year return period 24-hour storm with a >0.2 m freeboard	Life of Mine
Collection Ditches Upslope of Key Mine Infrastructure	1 in 100 year return period 24-hour storm with a >0.2 m freeboard	Life of Mine
General Diversion Ditches	1 in 10 year return period 24-hour storm with a >0.2 m freeboard	Life of Mine
General Collection Ditches	1 in 10 year return period 24-hour storm with a >0.2 m freeboard	Life of Mine
Corrugated Metal Half-Pipe	1 in 10 year return period 24-hour storm with a >0.2 m freeboard	Life of Mine
Sediment Control Ponds (storage)	1 in 10 year return period 24-hour storm with a 0.5 m freeboard	Construction
Sediment Control Pond Spillways	1 in 200 year return period 24-hour storm with a >0.5 m freeboard	Construction
Exfiltration Areas	1 in 10 year return period 24-hour storm with a > 0.5 m freeboard	Construction
Culverts	1 in 100 year return period 24-hour storm	Life of Mine

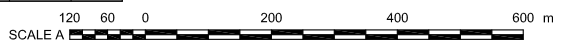
NOTES:

1. A diversion ditch is used to intercept and divert clean water prior to contact with disturbed areas.
2. A collection ditch is used to convey sediment-laden water to treatment facilities (i.e. sediment basins, sediment ponds).



CATCHMENT AREAS

DESCRIPTION	ha	CN
OPEN PIT	83.9	90
PROCESS FACILITIES	27.8	90
HEAP LEACH & EVENTS PONDS	121.1	-
TOPSOIL STOCKPILES	46.7	-
TRUCK STOP, ORE STORAGE	81.7	90
EAGLE PUP WRSA	123.9	85
LOWER PLATINUM GULCH & PGP	13.2	85
PLATINUM GULCH WRSA	51.2	85
LAYDOWN AND LANDFILL AREA	33.2	-
DISTURBED EXPLOSIVES AREA	24.1	90
UNDISTURBED DGDC AREA	853.3	85
UNDISTURBED CENTRAL DIVERTED AREA	8.0	90
UNDISTURBED LANDFILL	15.6	-
UNDISTURBED EXPLOSIVES	76.7	85
TOTAL	1560.4	-



NOTES:

- COORDINATE GRID IS UTM NAD83 ZONE8.
- CONTOUR INTERVAL IS 5 METRES.
- THE DUBLIN GULCH DIVERSION CHANNEL (DGDC) AREA EXTENDS BEYOND THE BOUNDARIES OF THE FIGURE. THE AREA IN THE TABLE (838.4 ha) REPRESENTS THE FULL CATCHMENT AREA.
- THE UNDISTURBED EXPLOSIVES AREA IS APPROXIMATE, CONTOURS ARE NOT AVAILABLE IN THE SOUTH EXTENT OF PROJECT.
- THE CURVE NUMBER VALUES WERE USED FOR STORM RUNOFF MODELLING.



**EAGLE GOLD PROJECT
YUKON TERRITORY**

**OVERVIEW PLAN
CATCHMENT AREAS YEAR 9**

FILE NO. VA101-290/6	DWN JT/WAL	CKD BB	REV 0
OFFICE KPL-VANC	DATE July 18, 2013		

Figure 3.3-1

3.4 SEDIMENT AND EROSION CONTROL

Sediment and erosion control measures will be implemented and maintained to prevent the discharge of sediment laden water to the receiving environment. The BMPs described below are shown on Figures 3.4-1 to 3.4-3 and will be required during construction. Implementation of BMPs is described in Section 5.0.

3.4.1 Sediment and Erosion Sources

Construction activities that have the potential to result in erosion and sedimentation include:

- Vegetation clearing and topsoil stripping,
- Excavation, grading and filling,
- Stockpiling of topsoil,
- Management of ice-rich material, and
- Construction of roads and infrastructure.

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.

The Plan addresses the above potential hazards to ensure effective management of surface water and sediment laden runoff during both Construction Stages 1 and 2. Sediment mobilization and erosion will be minimized by:

- Limiting the extent of land disturbance to the practical minimum
- Reducing water velocities across the ground using soil bioengineering, surface roughening, and re-contouring, particularly on exposed surfaces and in areas where water concentrates
- Progressively rehabilitating disturbed land and constructing drainage controls to improve the stability of rehabilitated land
- Protecting natural drainages and watercourses by constructing appropriate sediment control devices such as collection and diversion ditches, sediment traps, in-channel rock energy dissipaters, and sediment basins
- Installing rock riprap, channel lining, sediment filters or other suitable measures in ditches on steep gradients, as required
- Restricting access to rehabilitated areas
- Constructing collection and diversion ditches to intercept surface runoff

- Directing all sediment-laden runoff to the appropriate sediment basin
- Constructing appropriate temporary BMP measures (e.g., silt fences, hay bales) downslope of disturbed sites (where more permanent sediment control measures are not appropriate, or in combination with more permanent measures)
- Implementing soil bioengineering techniques to contain sediment and enable disturbed surfaces to recover

Installation of temporary erosion and sediment control features or “Best Management Practices” (BMPs) will be the first step towards controlling erosion and sedimentation during construction. All temporary sediment and erosion control features will require regular maintenance and inspection after each significant rainfall. These temporary features will be reclaimed after achieving soil and sediment stabilization. Typical sediment and erosion design elements and BMPs are described in Section 3.4.2 below.

3.4.2 Best Management Practices

Erosion control Best Management Practices (BMPs) reduce erosion by stabilizing exposed soil or reducing surface runoff flow velocity. There are generally two types of erosion control BMPs:

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

Erosion control BMPs will be implemented prior to and during construction to minimize erosion and sediment discharge into surrounding areas

Descriptions of the planned BMPs are provided below:

Vegetation Management and Re-vegetation

Natural vegetation is one of the best and most cost effective methods of reducing the potential for erosion and sedimentation. Vegetation keeps soil secure and leaves and ground cover reduce raindrop velocities. In order to preserve vegetation, it is recommended to maintain “no-entry” vegetation buffers to prevent excess clearing, particularly around water bodies, prior to clearing vegetation from surrounding areas. If preserving natural vegetation is not a viable option, cleared areas that will not include infrastructure will be re-vegetated as soon as practical after construction activities have ended in the area accounting for seasonal constraints.

Soil Bioengineering

Soil bioengineering is the use of plant materials to perform engineering functions such as bank protection, erosion protection, drainage, and slope stabilization (Polster 2002). Some typical techniques include:

- Wattle fences
- Live bank protection

- Live palisades

Wattle fences are used on over-steepened slopes where the incline prevents successful growth of vegetation. Live cuttings are placed in the slopes to create terraces, which hold soil in place and encourage the cuttings to grow.

Live bank protection is generally used in streams for habitat restoration, but the technique can be transferred to constructed ditches. Wattle fences using cut plugs and live cuttings are installed on the banks of the ditch, which become stabilized once the live cuttings sprout and grow.

The live palisades technique involves installing large cottonwood (poplar) posts in trenches adjacent to eroding stream beds where the natural vegetation has been compromised. The cottonwood will root along its entire buried length producing a dense cylinder of roots.

These techniques prevent the creation of smooth, hard surfaces, which tend to encourage increased velocities and thus increased erosion potential. The *USDA Engineering Field Handbook Chapter 18 – Soil Bioengineering for Upland Slope Protection and Erosion Reduction* provides useful application and construction guidelines for various bioengineering techniques.

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 also helps hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, while reducing the need for watering.

Mulching may be utilized in areas that have been seeded either for temporary or permanent covers. There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches may 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 stand-alone mulch, except in cases where temporary dust and/or erosion control is required.

Hydroseeding, sometimes referred to as hydromulching, consists of mixing a tackifier, specified organic mulch, seed, water, and fertilizer together in a hydrosurry and spraying a layer of the mixture onto a surface or slope with hydraulic application equipment. The choice of materials for mulching will be based on soil conditions, season, type of vegetation, and the size of the area.

Rolled Erosion Control Products

Rolled erosion control products (RECP) are geosynthetic or organic materials composed of two layers of coarse mesh that contain a central layer of permeable fibres in between. These products take the form of flexible sheet materials that are often composed of organic materials that decompose over time. When intended for long-term use, RECPs are made from UV-stable synthetics such as polypropylene. RECPs are used to cover un-vegetated cut or fill slopes in order to provide erosion control when seeding or mulching alone is unsuccessful. RECP sheets must be anchored with special stakes or rocks and must be in direct, tight contact with the soil surface in order to perform effectively.

Surface Roughening

Cut and fill slopes will be roughened with tracked machinery or by other means, to reduce runoff velocity, increase infiltration, reduce erosion, and to aid in the establishment of vegetative cover with seed. Roughening will typically be carried out by a tracked machine moving up and down the slope, creating undulations on the soil surface. This procedure is simple, inexpensive and provides immediate short-term erosion control for bare soil, where vegetative cover is not yet established. Compared to hard, compacted smooth surfaces a rough soil surface provides more favorable moisture conditions, which will aid in seed germination. Surface roughening works best on flat and moderately sloped areas.

Re-contouring

Re-contouring the soil surface can also reduce the effect of erosion by shortening the length of the accumulation and movement of water as well as decreasing its slope. Creating undulations or troughs will also reduce overland water movement velocity. These types of improvements are beneficial as they are easily planned and constructed on site. However, both surface roughening and re-contouring are only semi-permanent erosion control methods and more permanent structures are needed over time.

Silt Fencing

Silt fencing is a perimeter control used to intercept sheet flow runoff and used in conjunction with other BMPs. Typical silt fencing comprises a geotextile fabric anchored to posts driven into the ground. Silt fencing promotes sediment control by filtering water that passes through the fabric and increases short term detention time, allowing suspended sediments to settle. A typical silt fence installation is shown on Figure 3.4-2.

Silt fences will be placed parallel to slope contours in order to maximize ponding efficiency. Barrier locations are informally chosen based on site features and conditions (e.g., soil types, 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 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 fencing will be installed in backfilled trenches to ensure that it is properly anchored.

All silt fences should be inspected and maintained following major rainfall events. Proper installation and frequent maintenance is required for effective sediment control.

Temporary Sediment Traps and Sediment Basins

A sediment trap/basin is a temporary structure that is used to detain runoff from small drainage areas (generally less than 2 ha) to allow sediment to settle out. Sediment traps/basins are generally used for relatively small drainage areas and will be located in areas where access can be maintained for sediment removal and proper disposal. A sediment trap/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 trap/basin via ditches, slope drains, or diversion dikes. The trap/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.

Temporary sediment traps and sediment basins will be constructed at the end of collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out. The size of the temporary sediment trap/basin is dependent on the ditch design flows. The exact locations and final geometry of each trap will be field fitted to integrate with the terrain to minimize disturbance. The engineer of record or construction manager shall review and approve the sizing and location of these basins prior to construction. The sediment traps/basins will be checked regularly for sediment cleanout; if the sediment trap/basin has accumulated sediment and/or debris, the trap will be removed and cleaned, or replaced.

Two sizes of sediment basins designated SB1 and SB2 have been developed for the site and will be used for different size drainage areas. The sizing and dimensions of the two sediment basins are summarized as follows:

Table 3.4-1: Temporary Sediment Basin Design Specifications

	Sediment Basin size 1	Sediment Basin size 2
Drainage Area (hectares)	<1	1 - 2
Width (m)	10	12
Length (m)	20	25
Depth of Wet Storage (m)	1	1
Minimum Spillway Weir Length (m)	2	4

The width and length dimensions correspond to the top of the wet storage area, at the base of the outlet structure. Typical details are shown on Figure 3.4-3. These designs are based on techniques outlined in the *Alaska Storm Water Pollution Prevention Plan* (ADTPF 2011).

Filter Bags and Geotubes

Filter bags, shown on Figure 3.4-3, are generally constructed from a sturdy non-woven geotextile capable of filtering particles larger than 150 microns. Filter bags are typically installed at the discharge end of pumped diversions, via fabric flange fittings, to remove fine grained materials before discharging to the environment.

If necessary for fine grained materials, filter bags shall 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 lined areas (i.e. rock aprons, rip rap, etc.) to reduce water velocity and 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 to the environment.

Filter bags shall be maintained in the following manner:

- Inspected daily for defects, rips, tears, sediment accumulation, and erosion of the surrounding area.
- When sediment fills one half of the volume of the filter bag, the filter bag shall be removed from service and replaced.

Spare bags shall be kept nearby to minimize time required to recommence pumping activities. Once the used bag is fully drained, the bag and its contents can be deposited in reclamation material storage areas for use as cover materials during mine closure, or disposed of in the on-site landfill.

Geotubes can be used as part of a dewatering system to separate and contain solids in sediment-laden water. The system is composed of a geosynthetic tube, which is available in various sizes, and an injection port. The sediment-laden water is pumped or directed via gravity into the geotube until full. Clean water drains through the pores of the engineered textile, which allows the solids to consolidate inside the geotube. The apparatus can be filled multiple times and once it is full of solids, it can be disposed of at a landfill or the solids can be removed and used on site.

Flocculants

The term flocculation is used to describe the aggregation of small particles clumping together and settling out of suspension. In sediment and erosion control applications, flocculation achieved with the use of chemical or natural additives (e.g. corn starch, chitosan, guar gum, etc.). A flocculent dosing system is typically installed at the inlet to a sedimentation pond, which allows the flocculation process to begin immediately upon discharge to the pond. The flocculants accelerate the natural settling process as the sediment-laden water flows through the pond, and therefore the required pond detention time is reduced. Additionally, flocculants can be added at specific points along collection ditches to initiate the settling process prior to arrival at the water management pond. This system may be required in steep topographic areas where:

- The calculated surface area for the design particle size is not practical; and
- Where the clay component is high, as clay soil types have a lower settling velocity than other particles.

Ditches

Strategically placed ditches and runoff collection structures can help direct water movement, which in turn limits erosion. Cut and fill slopes created during construction leave long runs of exposed soils that are prone to erosion. A ditch placed above the cut slope will intercept water and direct it to less erosion prone areas. Coarse rock and equipment to build ditches and dams are easily obtained on site, and require little further maintenance, making them effective improvements. Typical collection and diversion ditches (two types) are shown on Figure 3.4-1. A corrugated metal half-pipe (CMH) will be used in terrain that is steeper than 15%, as the velocities at such slopes are too high for practical riprap channel protection. An appropriate diameter of CMH is 1.0 m, as shown on Figure 3.4-3

Collection Ditches

A collection ditch intercepts sediment-laden water runoff from disturbed areas 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 the appropriate sediment control measures. General locations and conditions may include:

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

Collection ditches may be either temporary or permanent structures and will be sized to convey the runoff from a 1 in 10 year 24-hour return period storm event assuming that the entire footprint area has been disturbed and contributes sediment-laden runoff to the seepage collection and recycle ponds. Ditches located upslope of key mine infrastructure (i.e. HLF, WRSAs, events ponds) will be sized to convey the runoff from a 1 in 100 year 24-hour return period storm event, as per the *YESAB Screening Report and Recommendation* (YESAB 2013).

The ditch designs will be based on steady, uniform flow analysis.

Diversion Ditches

Diversion ditches will be constructed up-gradient of disturbed areas to intercept clean surface water runoff. A diversion ditch is a channel lined with vegetation, riprap, or other flexible, erosion resistant material. The main design considerations are the design flow and velocity of the water expected in the channel. All diversion ditches have been designed to carry the appropriate peak flow. All diversion ditches will discharge through a stabilized outlet designed to handle the expected runoff velocities and flows from the ditch without scouring. The selection of a type of lining has been based upon the design flow velocities.

The ditches will be sized to convey the 1 in 10 year 24-hour peak storm for the estimated catchment size. As with collection ditches, diversion ditches located upslope of key mine infrastructure will be

sized to convey the runoff from a 1 in 100 year 24-hour return period storm event. Where fine grain soils have been exposed, appropriate erosion protection materials will be installed based on the estimated magnitude of flow and the flow velocity.

Culverts

Culverts may be either temporary or permanent structures and will be sized to convey the 1 in 100 year 24-hour peak storm event for small catchments and the 1 in 200 year 24-hour peak storm event for stream crossings.

In general, while variations may occur due to site-specific conditions, it is assumed that culverts will be installed at a slope of 2% with an inflow along a smooth headwall. A small stilling basin will be constructed at the upstream end of each culvert to reduce sedimentation. The culvert will consist of corrugated metal pipe or corrugated polyethylene tubing bedded in sandy material and the backfill material will be carefully compacted around the pipe to support the pipe haunches to prevent crushing.

Exfiltration Areas

An exfiltration area is used to treat sediment laden water by detention in an area that is not lined, and which allows the sediment laden water to filter through the natural ground surface providing the terrain meets the objectives for sediment filtration. This process provides treatment for sedimentation as it filters the water only and does not allow for any additional outflows such as riser pipes and/or spillways, which are commonly used in sediment ponds/basins.

Where feasible, exfiltration areas have been designed to detain the 1 in 10 year 24-hour storm event. The hydraulic conductivity of surficial material on site ranges from 10^{-3} to 10^{-7} m/s. A value of 10^{-7} m/s is used for the design of the exfiltration areas.

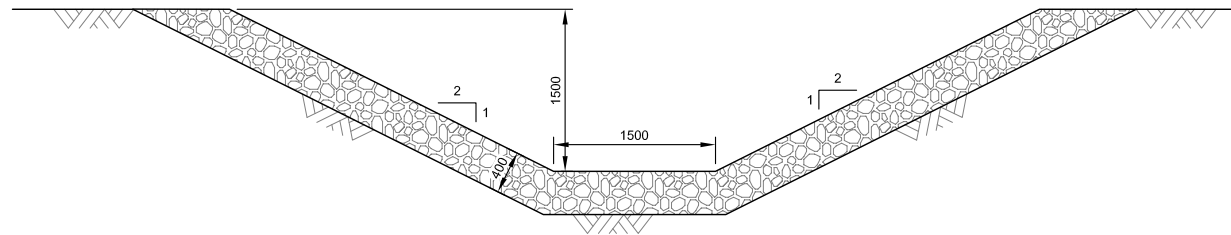
3.4.3 Monitoring Strategies

Regular monitoring of implemented BMPs will ensure success of the Plan. The contractor shall inspect all erosion control measures periodically and after each runoff-producing rainfall event. Frequent and proper maintenance will allow for prolonged use instead of allowing the measures to be destroyed and in need of full replacement.

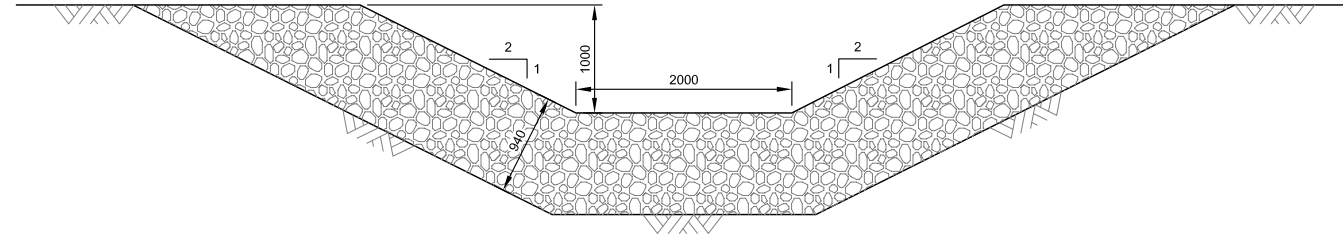
Silt fences, sediment traps/basins, ditches, culverts, exfiltration areas, and water management ponds will be visually inspected for the following:

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

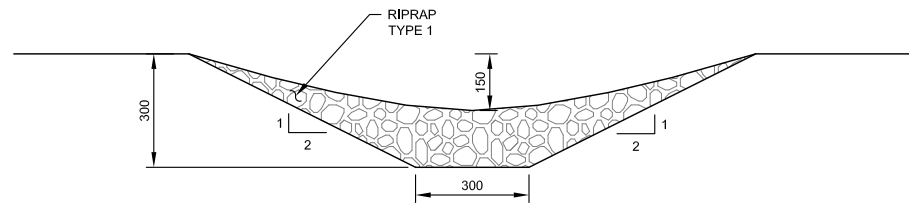
Sediment removal and proper disposal shall be done as required.



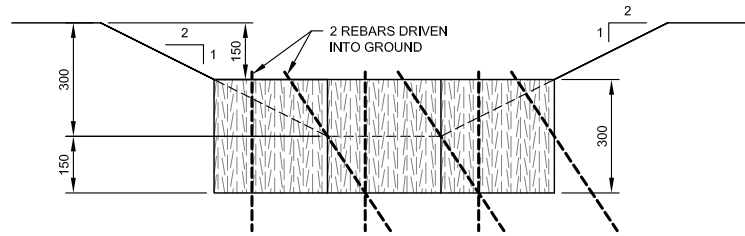
CD DD COLLECTION AND DIVERSION DITCH WITH TYPE 1 RIPRAP
NTS



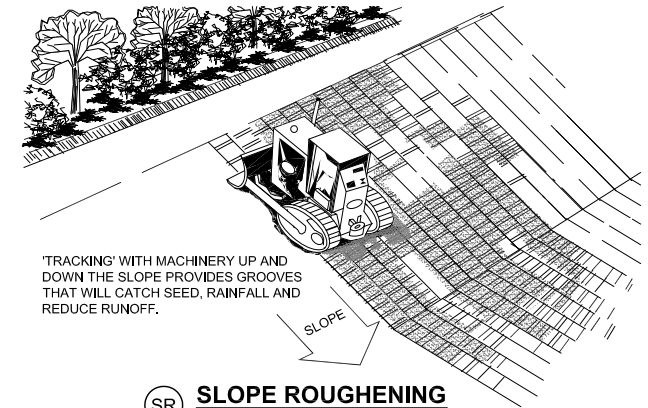
CD DD COLLECTION AND DIVERSION DITCH WITH TYPE 2 RIPRAP
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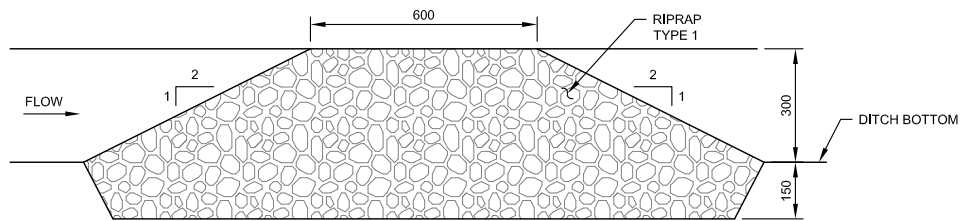
ST ROCK DAM CROSSING SECTION
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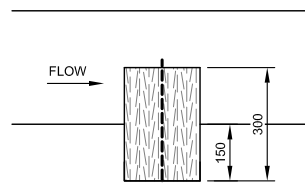
ST STRAW BALE CROSSING SECTION
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SR SLOPE ROUGHENING
NTS



ST ROCK DAM PROFILE
NTS



ST STRAW BALE PROFILE
NTS

NOTES:

1. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
2. SITE GRADING SURFACE WATER RUNOFF TO BE DIRECTED TO THE SEDIMENT TRAPS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
3. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
4. AN AREA IS CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM UNIFORM 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER TO RESIST ACCELERATED SURFACE EROSION.
5. THE SLOPE ROUGHENING DIAGRAM IS FROM THE ALASKA STORM WATER POLLUTION PREVENTION PLAN, ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES, FEBRUARY 2011.

SAVED: M:\10100290\06\AAcad\FIGS\B49_r0 (SGC) - 7/17/2013 4:19:27 PM - WLAHODA PRINTED: 7/17/2013 4:20:28 PM, Figure 3.4-1, WLAHODA XREF FILES: IMAGE FILES:

	EAGLE GOLD PROJECT YUKON TERRITORY				Figure 3.4-1
	EROSION CONTROL BMP SECTIONS AND DETAILS SHEET 1 OF 3				
	FILE NO. VA101-290/6	DWN NSD/DP	CKD BB	REV 0	
	OFFICE KPVAN	DATE July 18, 2013			