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5.4.3 Surficial Geology and Soil Cover

5.4.3.1 Introduction

The Surficial Geology and Soil Cover Valued Component (VC) and indicators were selected for inclusion in the assessment, taking into consideration the baseline study findings, inputs from local stakeholders, government agencies, and regulators. The identification and selection process involved in selecting VCs and their indicators can be found in **Section 4.2** and **Section 5.4.1**.

The approach of the assessment follows the methodology in **Section 4** and is described though the subsections below. The Introduction describes the applicable regulatory framework for the assessment of the VC (**Section 5.4.3.1.1**). The remainder of this section includes sub-sections dealing with the following: a brief summary of baseline data on the Soil Cover VC (**Section 5.4.3.2**), potential effects and mitigation measures (**Section 5.4.3.3**), residual effects and their significance (**Section 5.4.3.4**), cumulative effects (**Section 5.4.3.5**), limitations of the assessment (**Section 5.4.3.6**), and conclusions (**Section 5.4.3.7**).

Three key issues were identified through the issue identification and scoping process for the Surficial Geology and Soil Cover VC, including: removal and alteration of overburden, required to support Project development (at the construction, operations, and decommissioning / closure phases); the disturbance of soil, mainly during the construction phase; and redistribution of salvaged soil during reclamation at the close of the Project.

Removal and alteration of overburden will occur in: the construction phase, through cut-and-fill, grading, and re-sloping; the operations phase, through minor additional earthworks and development of new waste rock dumps; and the decommissioning / closure phase, through redistribution and contouring as part of site reclamation. Depending on the quality of the material, overburden may be reused as part of the earthworks for site development, or it may be salvaged and stored for use during reclamation. It is expected that overburden will be used as the primary reclamation material or growth medium for much of the mine-related landform area. This overburden will be used as a cap (minimum 30 cm) over mine waste rock and tailings.

Soil disturbance during the construction phase will occur as a result of site vegetation clearing, salvage / stripping of surface soil, site grading, and stockpiling of salvaged materials within the Project footprint. During operations, soil disturbance is expected to be limited. Salvaged material will be stockpiled in strategic locations to minimize operational disturbances.

Soil redistribution will take place during the decommissioning and closure phase, and will involve the placement of the salvaged soil as a cap (approximately 30 cm) on top of overburden material in high priority areas to facilitate the reclamation and revegetation of the site (**Section 2.6**).

Both the fresh water supply system and transmission line (including re-route options), are expected to experience the issues described above; however, they are not described in the following baseline discussion as the degree of disturbance is expected to be relatively low, and in the case of the transmission line, disturbance is expected to be point source in nature. Immediate reclamation much of the features is expected once construction is completed.

The interactions of Project with the Surficial Geology and Soil Cover VC and the physiography and topography VC are closely linked. Terrain destabilization and accelerated erosion results in removal of soil, which can also remove underlying surficial geological material. It is possible that terrain stability and accelerated erosion effects will occur alongside overburden removal effects, in response to the same Project components. However, controls will be designed into the Project Description to minimize and mitigate potential effects. Because of this close relationship, terrain stability and accelerated erosion effects on surficial geology and soil cover are not examined in this section, as they were addressed separately in **Section 5.4.2** Physiography and Topography.

5.4.3.1.1 Relevant Legislation and Legal Framework

The legislation and legal framework for the Surficial Geology and Soil Cover VC is the same as that described for the Physiography and Topography VC. Refer to **Section 5.4.2.1.1** for details.

5.4.3.2 Valued Component Baseline

5.4.3.2.1 Information Sources and Methods

The assessment of effects for the Surficial Geology and Soil Cover VC is based on site-specific baseline reporting conducted for the Project. Provincial and regional information sources were reviewed, and provided a background to support the Project-specific terrain and soil mapping completed during the baseline assessment. Project-specific information sources followed the provincial terrain mapping conventions outlined in Howes and Kenk (1997) and RIC (1996). Soil interpretations were based on SCWG (1998), and the Agriculture Canada Expert Committee on Soil Survey (ASAC) Soil Quality Relative to Disturbance and Reclamation (ASAC, 1987). Recently acquired aerial photography and detailed LiDAR-based contours and hill-shade images were used to interpret the landscape and soil conditions within the RSA and LSA of the Project.

For the Surficial Geology and Soil Cover VC, the Project footprint was superimposed on both the terrain and soils maps produced for the Soils and Terrain Baseline Report Appendix (**Appendix 5.1.3.2A**) to calculate the spatial effects on both components of the VC. This assessment considered the effect of changing, removing, and disturbing the parent material and soil. Spatial analysis using a GIS protocol was employed to determine the effect of the Project. Specifically, the interaction of the Project with parent material indicators and identified soil map units contained within the baseline maps were considered as part of the effects assessment.

5.4.3.2.2 Interaction between Surficial Geology and Soil Cover VC and other Past, Present, or Future Projects / Activities

A number of projects and human activities contain spatial overlap with the proposed features of the Project. These activities include logging, mining exploration, together with active and pending range tenures. The alteration of the surficial materials and soil cover as a result of the Project is localized within the mine site, mine access road, and airstrip LSAs and does not extend into the RSA where overlap with other activities would occur. After completion of site reclamation, during the decommissioning phase, only a negligible residual effect is expected.

5.4.3.2.3 Traditional, Ecological, or Community Knowledge

No traditional ecological or community knowledge comments regarding soils were raised in the context of the Surficial Geology and Soil Cover VC. However, during the review of the dAIR, both Aboriginal groups and public indicated the desire for effective reclamation of the Project site including proper soil salvage and replacement. Additional detail on comments and issues raised are presented in **Section 3** which contains the public and Aboriginal issues tracking tables for the Project. **Sections 14** through **Section 16** provide a summary of the Aboriginal background, rights, and interests for the Project.

5.4.3.2.4 Surficial Geology and Soil Cover Baseline

5.4.3.2.4.1 Mine Site

5.4.3.2.4.1.1 Surficial Geology

The natural landform area is a contiguous buffer surrounding the entire mine site and all associated facilities, and comprises numerous surficial materials. The majority of the natural landform area comprises morainal deposits (46%), with glaciofluvial deposits accounting for the second highest proportion of the area at 23%. Fluvial and colluvial materials are also common within the natural landform area, accounting for 15% and 11%, respectively. Minor areas of organic accumulations and bedrock outcroppings occur within the area. Anthropogenically disturbed areas and standing water each account for less than 1% of the area.

The baseline conditions within the TSF area will undergo the greatest degree of alteration of surficial materials within the Project footprint. Baseline mapping indicates that thin morainal deposits (47%), glaciofluvial sediments (21%), and fluvial deposits (16%) are the most common surficial materials mapped within the TSF footprint. Colluvial sediments and organic accumulations will also be affected by the development of the TSF.

The East and West waste rock dumps will have the second-largest combined (330 ha) effect on the baseline surficial materials. The majority of the East waste rock dump will be constructed on morainal deposits (86%), with an additional 4% constructed on organic deposits. The remaining 10% of the East waste rock dump will be built upon the existing disturbance (existing exploration facilities). The West waste rock dump, again, is predominantly morainal (62%), with the balance being colluvial (16%), glaciofluvial (12%), and organic (10%) deposits.

The majority of the open pit area is classified as morainal materials (53%). Approximately 46% of the open pit facility is classified as anthropogenic (previously disturbed, from exploration activities). No topsoil or subsoil stockpiles were observed during on-site baseline studies. The low-grade stockpile (LGS) has been mapped as morainal (51%), glaciofluvial (25%), and colluvial (20%) deposits. Localized areas of organic accumulations account for the remainder of the disturbance to this site. Prior to development of the LGS, surficial materials will be salvaged for use in reclamation during mine closure.

The remainder of the Project footprint, including associated mine facilities such as the plant site, camps, borrow areas, stockpiles, laydown areas, and haul roads, are anticipated to cause localized effects on a variety of surficial materials. To the extent feasible, high value reclamation materials from these facilities will be salvaged during construction.

To the extent possible, the Project design used existing disturbances as part of the mine development plan. This is mostly captured as existing FSRs. This inclusion of already existing disturbances acts to reduce the overall extent of new disturbances related to the Project. Approximately 2 ha of water bodies will be transformed with the development of the mine, for a net change of under 0.1% of the LSA.

To determine the change in surficial materials distribution as a result of the Project, the areas of each mapped terrain unit were calculated for both the LSA and the Project footprint. The difference between the two values represents the estimated change to each terrain unit within the LSA. The results of this analysis are presented in **Table 5.4.3-1**.

Table 5.4.3-1: Summary of Disturbances to Surficial Material within the LSA and Project Footprint

Terrain Units and Facilities	Baseline Extent		Proposed Project		Change in Baseline LSA Distribution	
	(ha)	% of LSA	(ha)	% of LSA	(ha)	% of LSA
Morainal	3,351.2	54.7	1,882.8	30.8	1,468.4	24.0
Glaciofluvial	1,259.3	20.6	718.3	11.7	541.0	8.8
Fluvial	413.6	6.8	64.0	1.0	349.6	5.7
Colluvium	641.5	10.5	343.7	5.6	297.8	4.9
Organic	261.7	4.3	123.9	2.0	137.8	2.3
Bedrock outcrops	46.1	0.8	36.8	0.6	9.3	0.2
Water	12.8	0.2	10.4	0.2	2.4	0.0
Anthropogenic	136.6	2.2	3.7	0.1	132.9	2.2
Open pit	0.0	0.0	238.0	3.9	-	-
TSF	0.0	0.0	1,115.6	18.2	-	-
East waste rock dump	0.0	0.0	158.5	2.6	-	-
West waste rock dump	-	-	171.7	2.8	-	-
LGS	0.0	0.0	76.0	1.2	-	-
Associated mine facilities	0.0	0.0	189.5	3.1	-	-
Natural Landform Area	0.0	0.0	989.9	16.2	-	-
Total	**6,122.8**	**100.0**	**6,122.8**	**100.0**	**2,939.2**	**48.0**

Note: TSF includes 250 ha of water for the ponds; ha = hectare; LSA = Local Study Area; % = percent; TSF = Tailings Storage Facility; LGS = Low-Grade Stockpile.

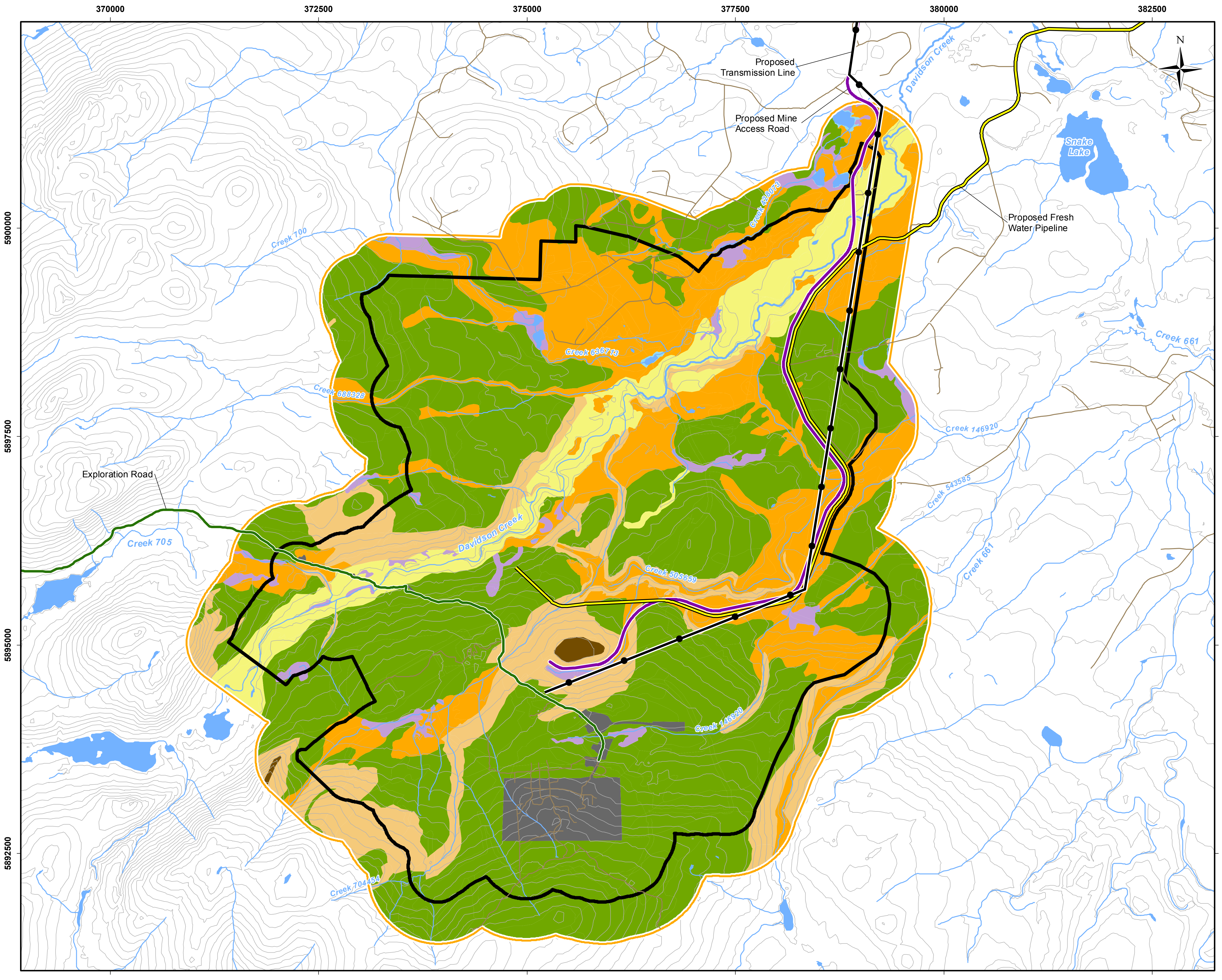
Approximately one half of the baseline surficial material units identified within the LSA are expected to undergo some degree of change as a result of the Project. Morainal, glaciofluvial, fluvial, colluvial, and organic sediments are expected to undergo the greatest amount of change. The most abundant parent material that will be altered from the construction of the Project will be morainal sediments. It is estimated that the distribution of morainal sediments within the LSA will decrease by 24% under the Project case. Glaciofluvial deposits will decrease by approximately 9%, while fluvial sediments will decrease by almost 6%. Colluvial deposits and organic accumulations are expected to decrease by 5 and 2%, respectively, in distribution throughout the LSA.

The interaction of the Project with the distribution of the baseline surficial geology is presented in **Figure 5.4.3-1**. This figure depicts the Project development overlaid on the baseline surficial geology units.

5.4.3.2.4.1.2 Soil Cover

The distribution of soil types is described in the Soils, Terrain, and Surficial Geology Baseline Report (**Appendix 5.1.3.2A**), wherein soil types were mapped as associations (groups of closely associated soil types), or complexes of associations (generally two groups of closely associated soil types that, for reasons of scale or landscape complexity, are difficult to delineate separately). Delineations (or polygons) on the soil map are based on differences in terrain conditions within which soil associations were identified in order to develop Soil Map Units (SMUs). The SMU is the basic soil entity used to describe the soil associations within this assessment of the Surficial Geology and Soil Cover VC.

The distribution of different soil types of the LSA under baseline conditions is presented in **Table 5.4.3-2**. This table also presents the expected changes in soil distribution of the Project development, which are discussed in the sections below.



Legend

Existing Road
Contour (20 m)
Stream
Waterbody

Project Components

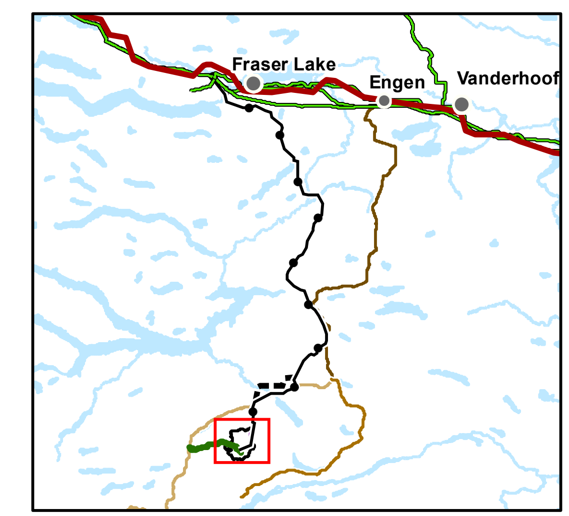
Proposed Mine Access Road
Exploration Road
Proposed Transmission Line
Proposed Fresh Water Pipeline
Proposed Mine Site

Surfical Geology

F - Fluvial
FG - Glaciofluvial
C - Colluvial
M - Morainal
O - Organic
R - Bedrock
A - Anthropogenic
LA - Lake

Terrain, Soils, and Vegetation

Local Study Area



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Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Proposed Project Development Overlaid on the Baseline Surficial Geology Units

DATE: April, 2014	ANALYST: MY	**Figure 5.4.3-1**
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Table 5.4.3-2: Summary of Disturbance to Soil Associations within the Proposed Project LSA

SMUs and Facilities	Soil Description	Baseline Extent		Proposed Project		Change in Baseline LSA Distribution	
		(ha)	% of LSA	(ha)	% of LSA	(ha)	% of LSA
AIX	Orthic Dystric Brunisol	1,259.3	20.6	718.3	11.7	541.0	8.8
BRT	Orthic Gray Luvisol	23.4	0.4	17.9	0.3	5.5	0.1
CIF	Terric Mesisol (fen)	214.3	3.5	103.4	1.7	110.9	1.8
DES	Brunisolic Gray Luvisol	1,002.7	16.4	682.4	11.1	320.3	5.2
MXY	Terric Mesisol (bog)	47.5	0.8	20.6	0.3	26.9	0.4
NIT	Orthic Dystric Brunisol	413.6	6.8	64.0	1.0	349.6	5.7
ORM	Orthic Dystric Brunisol	583.1	9.5	330.9	5.4	252.2	4.1
PIK	Orthic Eutric Brunisol	58.4	1.0	12.8	0.2	45.6	0.7
TWA	Brunisolic Gray Luvisol	2,325.1	38.0	1,182.5	19.3	1,142.6	18.7
R	Bedrock outcrops	46.1	0.8	36.8	0.6	9.3	0.2
LA	Water	12.8	0.2	10.4	0.2	2.4	0.0
DL	Disturbed Land	136.6	2.2	3.7	0.1	132.9	2.2
Open pit	-	0.0	0.0	238.0	3.9	-	-
TSF	-	0.0	0.0	1,115.6	18.2	-	-
East waste rock dump	-	0.0	0.0	158.5	2.6		
West waste rock dump	-	0.0	0.0	171.7	2.8	-	-
LGS	-	0.0	0.0	76.0	1.2	-	-
Associated mine facilities	-	0.0	0.0	189.5	3.1	-	-
Natural Landform Area	-	0.0	0.0	989.9	16.2	-	-
	Total	**6,122.8**	**100**	**6,122.8**	**100**	**2,939.1**	**48.0**

Note: The TSF includes 250 ha of water for the ponds; cm = centimetre; ha = hectare; LGS = low-grade ore stockpile; LSA = Local Study Area; m = metre; TSF = Tailings Storage Facility.

The Chief (CIF) and Moxley (MXY) map units are characterized as thick organic accumulations, generally greater than 1 m in thickness, but can occur as thinner organic accumulations. These SMUs have a limited baseline extent, comprising 260 ha (4%) of the LSA, and will undergo a 2% change in area as a result of Project development.

Twain (TWA) (morainal Brunisolic), Alix (AIX) (glaciofluvial Brunisolic), and Deserters (DES) (morainal Luvisol) soils are dominant in the LSA, representing 38%, 21%, and 16% of the LSA, respectively. These soils are interspersed throughout the Project footprint, and often have direct associations with other closely related SMUs. Uniform soil cover is not consistent throughout the area, and thin, especially in the TWA and ORM or PIK SMUs, where complex polygons can be found with colluvium or bedrock outcroppings.

The Ormond (ORM) and Pinkut (PIK) SMUs consists of thin veneers of colluvial material less than 1 m thick, and are closely associated with exposed bedrock outcrops on steeper slopes. These units combined account for 642 ha (11%) of the LSA, and will undergo a change in area of 5% in the LSA.

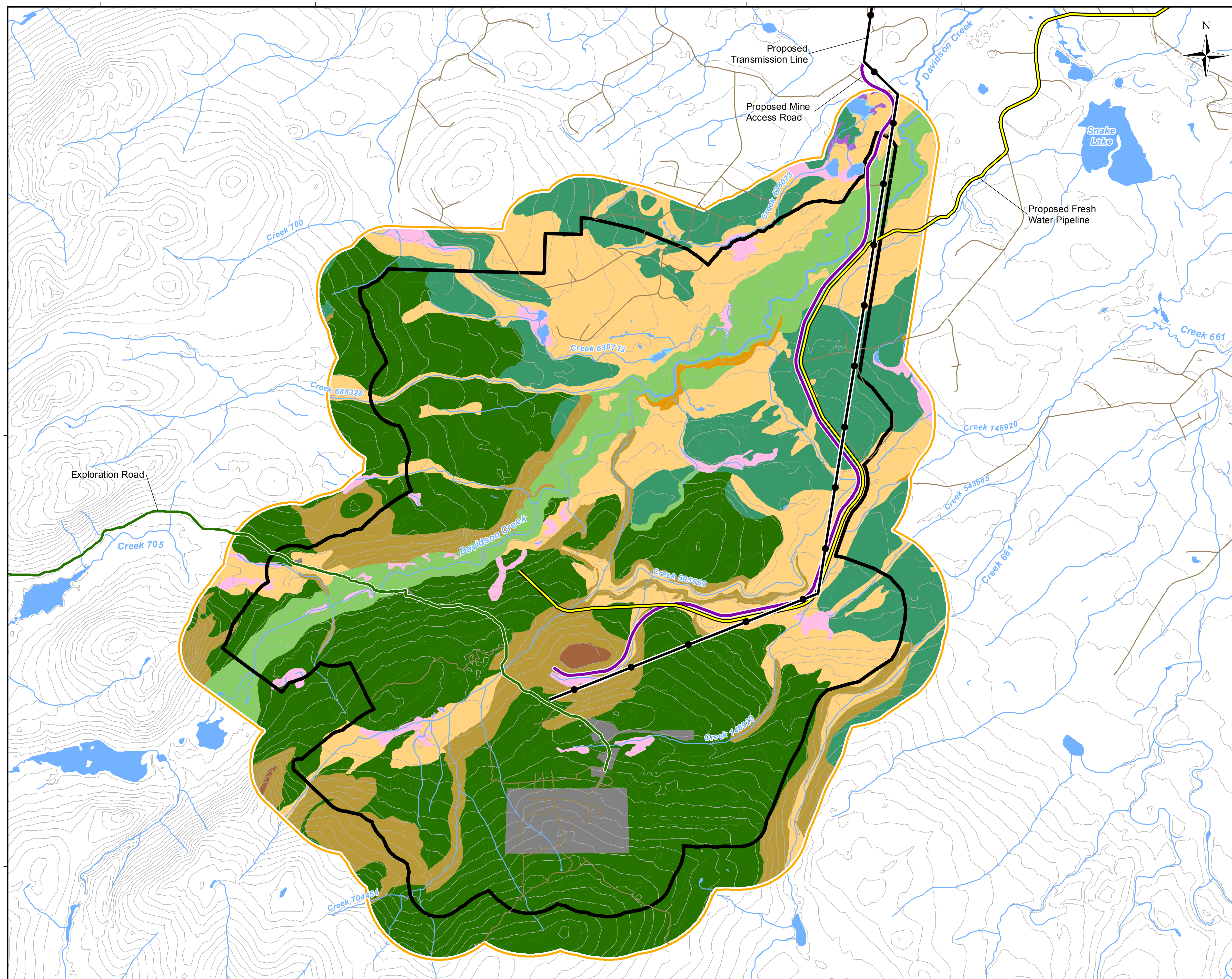
Although mapped in terms of soil units, specific units such as DL (disturbed land) and R (bedrock outcrops), are not included in the calculation of amount of soil cover based on the lack of discernible soils contained within those units. The interaction of the Project with the distribution of the baseline soils is presented in **Figure 5.4.3-2**. This figure depicts the Project development overlaid on the baseline soil map units.

5.4.3.2.4.2 Mine Site Access Road

5.4.3.2.4.2.1 Surficial Geology

The surficial materials located within the mine access road ROW will undergo permanent change through the construction of the access road. The construction and operations plan for the proposed access road involves the removal of soil cover and the levelling and grading of the overburden. These activities will result in permanent changes in the distribution of surficial sediments from the pre-disturbed baseline conditions.

The Project mine site access road feature has its own LSA, separate but adjacent to the mine site LSA. For spatial calculations, the entire area of the mine site access road LSA is considered when determining the baseline conditions.



Legend

Existing Road
Contour (20 m)

Project Components

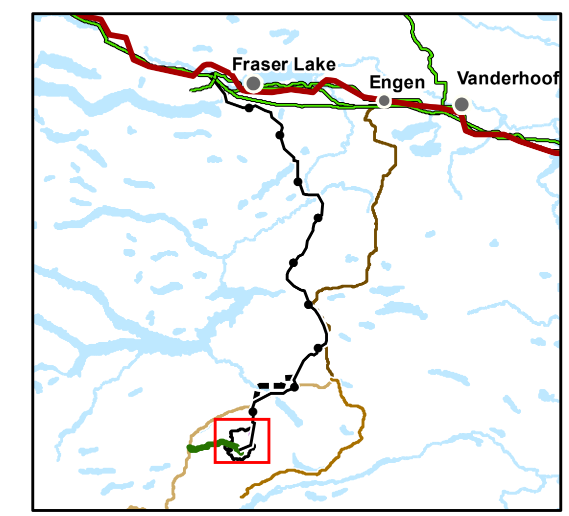
Proposed Mine Access Road
Exploration Road
Proposed Transmission Line
Proposed Fresh Water Pipeline
Proposed Mine Site

Terrain, Soils, and Vegetation

Local Study Area

Soil Map Unit (SMU)

AIX - Orthic Dystric Brunisol
CIF - Terric Mesisol (fen)
DES - Brunisolic Gray Luvisol
DL - Disturbed Land
LA - Water
MXY - Terric Mesisol (bog)
NIT - Orthic Dystric Brunisol
ORM - Orthic Dystric Brunisol
PIK - Orthic Eutric Brunisol
R - Bedrock outcrops
TWA - Brunisolic Gray Luvisol



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Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Proposed Project Development Overlaid on the Baseline SMUs

DATE: April, 2014	ANALYST: MY	**Figure 5.4.3-2**
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GIS FILE: 05-200-005_SMU_Minesite_v3.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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The Project interaction of the mine access road with the Surficial Geology and Soil Cover VC are expected to extend over the life span of the Project, but the majority of this interaction will occur during the site preparation and construction phase, and the closure of the road during the decommissioning and closure phase. The results of this analysis are presented in **Table 5.4.3-3**.

Table 5.4.3-3: Summary of Disturbances to Surficial Material within the Proposed Mine Access Road LSA

Terrain Units and Facilities	Baseline Extent		Proposed Project		Change in Baseline LSA Distribution	
	(ha)	% of LSA	(ha)	% of LSA	(ha)	% of LSA
Morainal	156.9	78.9	134.3	67.6	22.6	11.4
Glaciofluvial	26.8	13.5	24.0	12.1	2.8	1.4
Fluvial	4.7	2.4	4.7	2.4	0.0	0.0
Organic	6.3	3.2	5.9	3.0	0.4	0.2
Anthropogenic	4.0	2.0	2.5	1.3	1.5	0.8
Water	<0.1	<0.1	-	-	-	-
Mine access ROW	0.0	0.0	27.3	13.7	-	-
Total	**198.8**	**100.0**	**198.8**	**100.0**	**27.3**	**13.7**

Note: ha = hectare; LSA = Local Study Area; % = percent; ROW = right-of-way

Approximately 14% of the baseline surficial material units identified within the LSA for the mine access road are expected to undergo some degree of change as a result of the Project. Morainal and glaciofluvial sediments are expected to undergo the greatest amount of change. The most abundant parent material affected by the construction of the Project will be morainal sediments. It is estimated that the distribution of morainal sediments within the LSA will decrease by 11% under the Project case. Glaciofluvial deposits will decrease by approximately 1%. The remaining surficial materials are expected to undergo limited changes with respect to their baseline conditions.

The interaction of the Project with the distribution of the baseline surficial geology is presented in **Figure 5.4.3-3**. This figure shows the Project mine access road development overlaid on the baseline surficial geology units.

5.4.3.2.4.2.2 Soil Cover

The distribution of different soil types in the mine access road under baseline conditions is presented in **Table 5.4.3-4**. This table also presents the expected changes in soil distribution of the Project development, which is discussed in the section below.

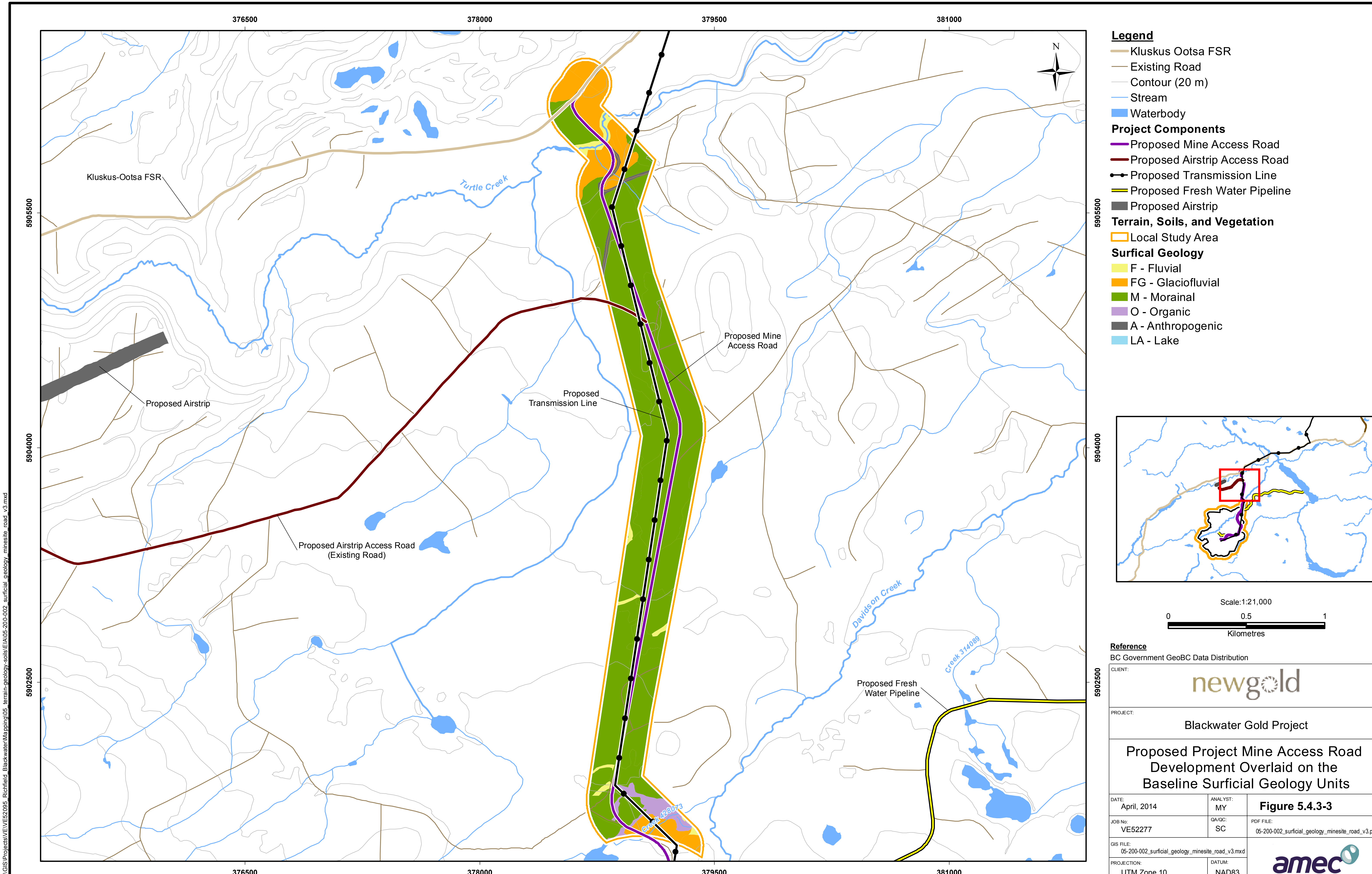
DES and AIX soils are dominant in the mine access road LSA, representing 78% and 14% of the LSA, respectively. MXY is the next most abundant, at 3% of the LSA.

Table 5.4.3-4: Summary of Disturbance to Soil Associations within the Proposed Project Mine Access Road LSA

SMUs and Facilities	Soil Description	Baseline Extent		Proposed Project		Change in Baseline LSA Distribution	
		(ha)	**% of LSA**	**(ha)**	**% of LSA**	**(ha)**	**% of LSA**
AIX	Orthic Dystric Brunisol	26.8	13.5	24.0	12.1	2.8	1.4
BRT	Orthic Gray Luvisol	1.2	0.6	1.2	0.6	0.0	0.0
CIF	Terric Mesisol (fen)	0.9	0.4	0.9	0.4	0.0	0.0
DES	Brunisolic Gray Luvisol	155.6	78.3	133.1	67.0	22.5	11.3
MXY	Terric Mesisol (bog)	5.5	2.7	5.1	2.5	0.4	0.2
NHK	Orthic Gray Luvisol	2.2	1.1	2.2	1.1	0.0	0.0
NIT	Orthic Dystric Brunisol	2.5	1.3	2.5	1.2	0.0	0.0
LA	Water	<0.1	<0.1	<0.1	<0.1	0.0	0.0
DL	Disturbed Land	4.0	2.0	2.5	1.3	1.5	0.8
Mine access ROW	-	0.0	0.0	27.3	13.7	-	-
Total		**198.8**	**100**	**198.8**	**100**	**27.3**	**13.7**

Note: ha = hectare; LSA = Local Study Area; % = percent; ROW = right-of-way

The interaction of the Project with the distribution of the baseline soils is presented in **Figure 5.4.3-4**. This figure depicts the Project development overlaid on the baseline SMUs.



376500
378000
379500
381000
5905500
5904000
5902500
N
Kluskus-Ootsa FSR
Turtle Creek
Proposed Airstrip
Proposed Mine Access Road
Proposed Transmission Line
Proposed Airstrip Access Road (Existing Road)
Davidson Creek
Creek 314089
Creek 428073
Proposed Fresh Water Pipeline
Legend
Kluskus Ootsa FSR
Existing Road
Contour (20 m)
Stream
Waterbody
Project Components
Proposed Mine Access Road
Proposed Airstrip Access Road
Proposed Transmission Line
Proposed Fresh Water Pipeline
Proposed Airstrip
Terrain, Soils, and Vegetation
Local Study Area
Surfical Geology
F - Fluvial
FG - Glaciofluvial
M - Morainal
O - Organic
A - Anthropogenic
LA - Lake
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Kilometres
Reference
BC Government GeoBC Data Distribution
CLIENT:
newgold
PROJECT:
Blackwater Gold Project
Proposed Project Mine Access Road Development Overlaid on the Baseline Surficial Geology Units
DATE:
April, 2014
ANALYST:
MY
Figure 5.4.3-3
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VE52277
QA/QC:
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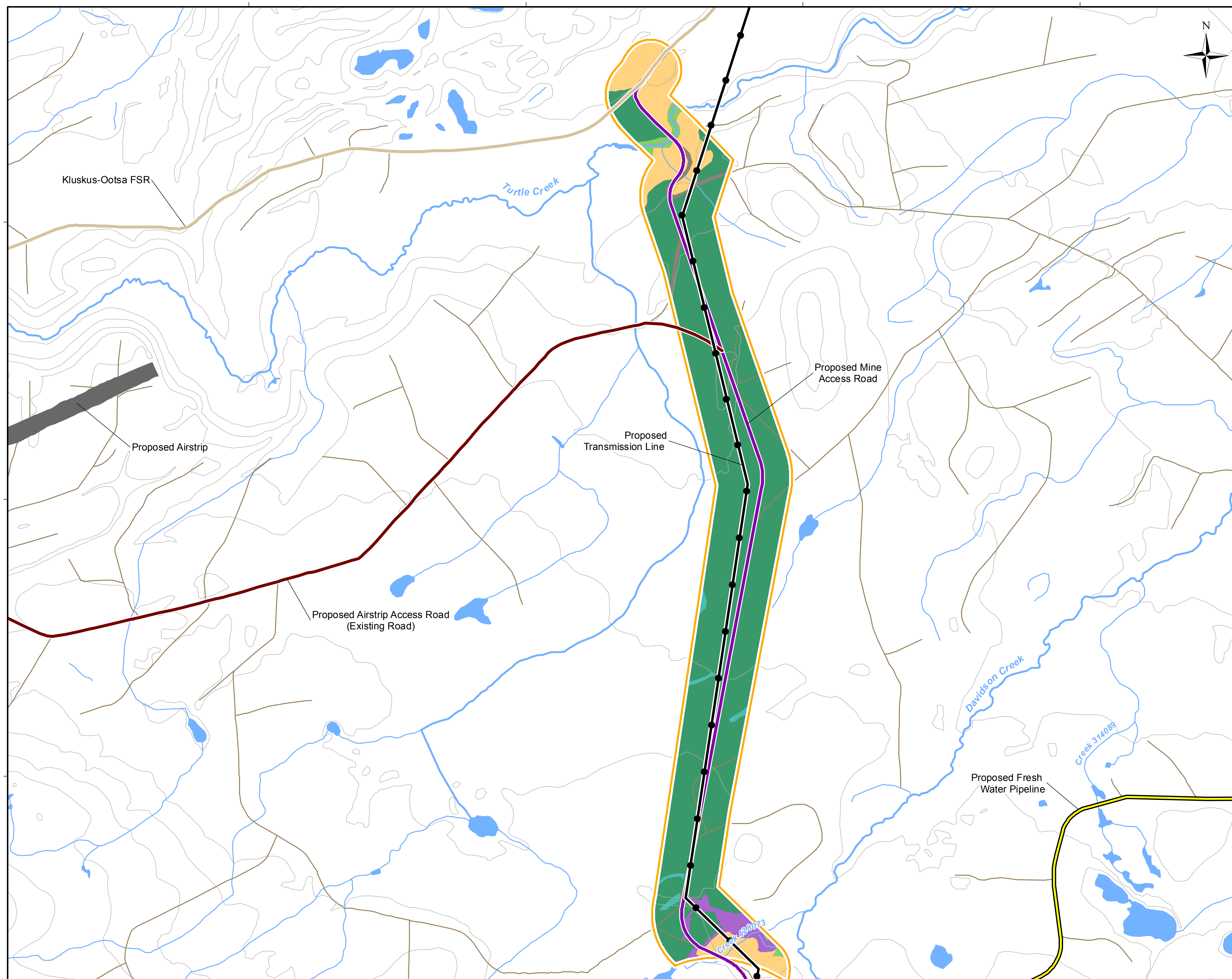


Legend

- Kluskus Ootsa FSR
- Existing Road
- Contour (20 m)
- Stream
- Waterbody

Project Components

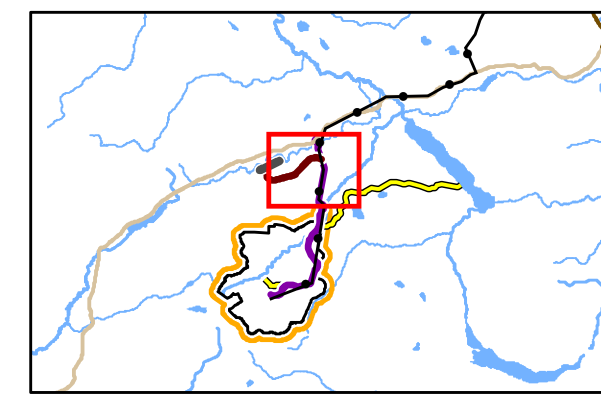
- Proposed Mine Access Road
- Proposed Airstrip Access Road
- Proposed Transmission Line
- Proposed Fresh Water Pipeline
- Proposed Airstrip

Terrain, Soils, and Vegetation

- Local Study Area

Soil Map Unit (SMU)

- AIX - Orthic Dystric Brunisol
- DES - Brunisolic Gray Luvisol
- DL - Disturbed Land
- NHK - Orthic Gray Luvisol
- NIT - Orthic Dystric Brunisol
- MXY - Terric Mesisol (bog)
- LA - Water



Scale:1:21,000

0 0.5 1

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Proposed Project
Mine Access Road Development
Overlaid on the Baseline SMUs

DATE: April, 2014	ANALYST: MY	Figure 5.4.3-4
JOB No: VE52277	QA/QC: SC	PDF FILE: 05-200-006_SMU_Minesite_road_v3.pdf
GIS FILE: 05-200-006_SMU_Minesite_road_v3.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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5.4.3.2.4.3 Airstrip

5.4.3.2.4.3.1 Surficial Geology

The surficial materials located within the airstrip landing area will undergo permanent change through the construction of the airstrip. The construction and operations plan for the proposed airstrip feature involves the removal of soil cover and the levelling and grading of the overburden. These activities will result in permanent changes in the distribution of surficial sediments from the pre-disturbed baseline conditions.

The Project interaction of the airstrip with the Surficial Geology and Soil Cover VC are expected to extend over the life span of the Project, but the majority of this interaction will occur during the site preparation and construction phase, and the closure of the airstrip during the decommissioning and closure phase.

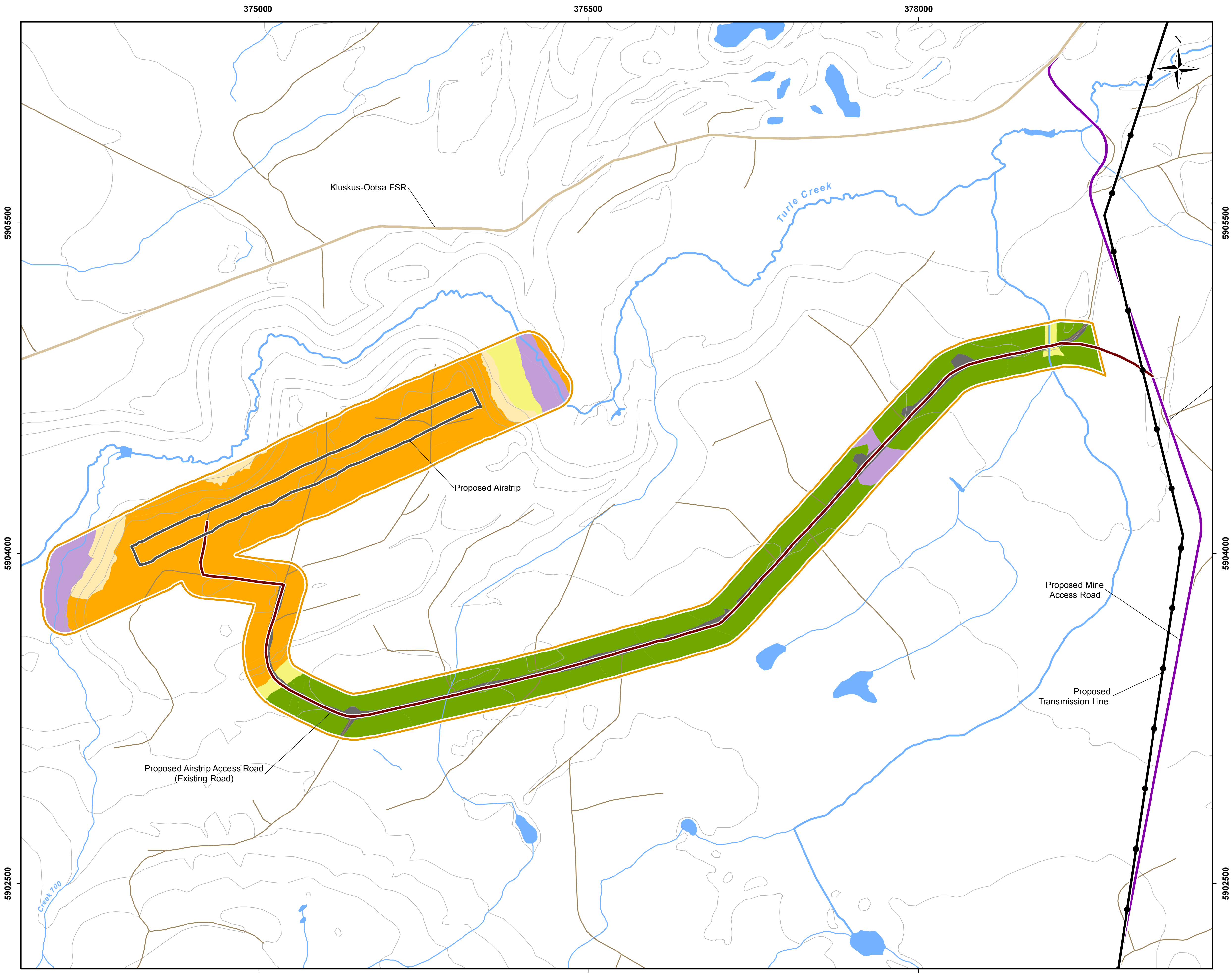
Approximately 7% of the baseline surficial material units identified within the airstrip LSA are expected to undergo some degree of change as a result of the Project. The most abundant parent material that will be altered from the construction of the Project will be glaciofluvial sediments. It is estimated that the distribution of glaciofluvial sediments within the LSA will decrease by 7% under the Project case. The remaining surficial materials are expected to undergo limited changes with respect to their baseline conditions. The results of this analysis are presented in **Table 5.4.3-5**.

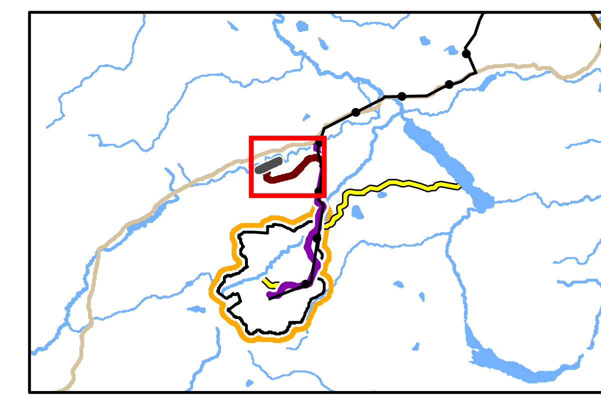
Table 5.4.3-5: Summary of Disturbances to Surficial Material within the Proposed Airstrip LSA

Terrain Units and Facilities	Baseline Extent		Proposed Project		Change in Baseline LSA Distribution	
	(ha)	% of LSA	(ha)	% of LSA	(ha)	% of LSA
Glaciofluvial	92.5	44.4	77.0	37.0	15.5	7.4
Morainal	74.0	35.5	74.0	35.5	0.0	0.0
Organics	14.1	6.8	14.1	6.8	0.0	0.0
Colluvium	7.7	3.7	7.7	3.7	0.0	0.0
Fluvial	6.7	3.2	6.7	3.2	0.0	0.0
Anthropogenic	13.3	6.4	13.3	6.4	0.0	0.0
Airstrip	0.0	0.0	15.5	7.4	-	-
Total	**208.2**	**100.0**	**208.2**	**100.0**	**15.5**	**7.4**

Note: ha = hectare; LSA = Local Study Area; % = percent

The interaction of the Project with the distribution of the baseline surficial geology is presented in **Figure 5.4.3-5**. This figure depicts the Project airstrip development overlaid on the baseline surficial geology units.





Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Proposed Project Airstrip Development Overlaid on the Baseline Surficial Geology Map

DATE: April, 2014	ANALYST: MY	**Figure 5.4.3-5**
JOB No: VE52277	QA/QC: SC	PDF FILE: 05-200-003_surficial_geology_airstrip_v3.pdf
GIS FILE: 05-200-003_surficial_geology_airstrip_v3.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

5.4.3.2.4.3.2 Soil Cover

The distribution of different soil types in the airstrip study area under baseline conditions is presented in **Table 5.4.3-6**. This table also presents the expected changes in soil distribution of the proposed airstrip Project development, which is discussed in the section below.

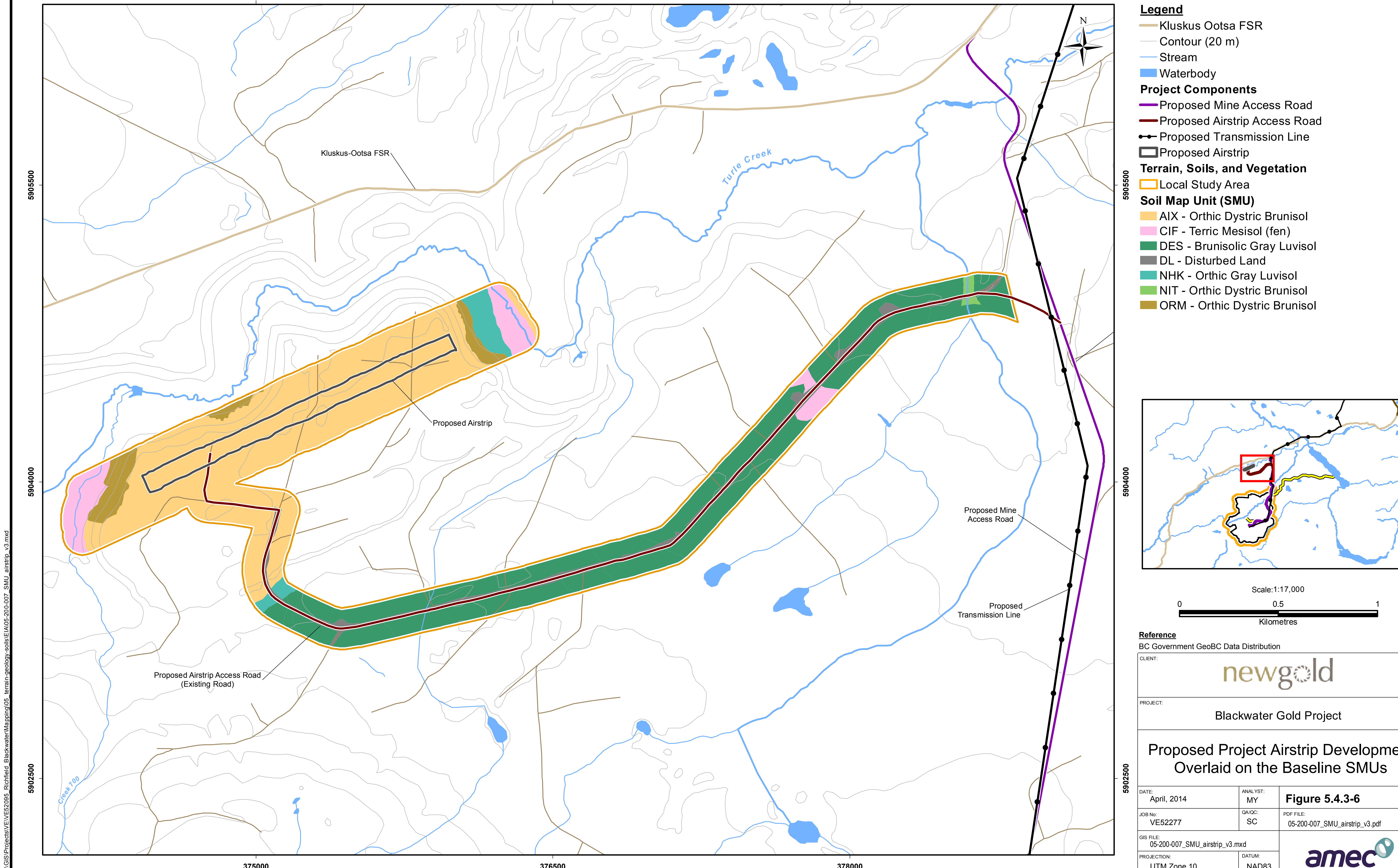
The AIX and DES soils are dominant in the airstrip LSA, representing 44% and 36% of the LSA, respectively. The CIF and ORM soils are the next most abundant, at 7% and 4% of the airstrip LSA, respectively. The airstrip is situated completely on AIX glaciofluvial soils, with no additional disturbance in other SMUs. The AIX soils will undergo a 16% reduction compared to baseline conditions.

Table 5.4.3-6: Summary of Disturbance to Soil Associations within the Proposed Project Airstrip LSA

SMUs and Facilities	Soil Description	Baseline Extent		Proposed Project		Change in Baseline LSA Distribution	
		(ha)	% of LSA	(ha)	% of LSA	(ha)	% of LSA
AIX	Orthic Dystric Brunisol	92.5	44.4	77.0	37.0	15.5	7.4
DES	Brunisolic Gray Luvisol	74.0	35.5	74.0	35.5	0.0	0.0
CIF	Terric Mesisol (fen)	13.9	6.7	13.9	6.7	0.0	0.0
ORM	Orthic Dystric Brunisol	7.7	3.7	7.7	3.7	0.0	0.0
NHK	Orthic Gray Luvisol	5.4	2.6	5.4	2.6	0.0	0.0
NIT	Orthic Dystric Brunisol	1.3	0.6	1.3	0.6	0.0	0.0
MXY	Terric Mesisol (bog)	0.2	0.1	0.2	0.1	0.0	0.0
DL	Disturbed Land	13.3	6.4	13.3	6.4	0.0	0.0
Airstrip	-	0.0	0.0	15.5	7.4	-	-
Total		**208.2**	**100**	**208.2**	**100**	**15.5**	**7.4**

Note: ha = hectare; LSA = Local Study Area; % = percent

The interaction of the Project with the distribution of the baseline soils is presented in **Figure 5.4.3-6**. This figure depicts the Project development overlaid on the baseline SMUs.



Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Proposed Project Airstrip Development Overlaid on the Baseline SMUs

DATE: April, 2014	ANALYST: MY	Figure 5.4.3-6
JOB No: VE52277	QA/QC: SC	PDF FILE: 05-200-007_SMU_airstrip_v3.pdf
GIS FILE: 05-200-007_SMU_airstrip_v3.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

5.4.3.3 Potential Effects of the Proposed Project and Proposed Mitigation

The potential effects of Project on the Surficial Geology and Soil Cover VC were identified on the basis of the information sources and regulatory requirements presented in previous sections (**Section 5.4.3.2**). The Project Description and development plans (including the RCP) were reviewed in the context of landscape and soils to determine the potential Project effects. The types of interactions that Project components and activities have in relation to the Surficial Geology and Soil Cover VC are classified as: key interactions, moderate interactions, or negligible interactions (**Table 4.3-2** Project Component and Activity Interaction Matrix for Selected VCs, **Section 4**). The focus of the effects assessment on the Surficial Geology and Soil Cover VC deal with the key interactions as there is a direct interaction between the activity and the VC. Moderate interactions, which have the potential to result in effects, are mitigated during the different Project phases and not carried forward into the residual effects assessment.

The likelihood that Project components and activities will have on the VC is determined by:

- Identifying each potential direct or indirect effect on the Surficial Geology and Soil Cover VC that may occur during each phase of the Project;
- Identifying any direct or indirect effects on the surficial geology or soil cover that may indirectly affect other VCs (e.g., Vegetation VC), including other Soil, Terrain, and Surficial Geology VCs;
- Identifying any potential direct or indirect effects on surficial geology or soil cover that are eliminated through implementation of changes to the Project design; these potential effects are not carried forward in the assessment; and
- Identifying and rating the likelihood of successful mitigation measures that would be implemented to reduce or eliminate potential direct or indirect effects on surficial geology or soil cover; potential effects where mitigation measures are determined to break the linkage between the Project component or activity and the VC are not carried forward in the assessment.

The effects of the past and present projects and activities that are present in the RSA, including mining exploration, when measurable, are captured in Soils and Terrain Baseline Summary (**Section 5.1.3.2**). As the extent of the Project's effect on the VC is local in nature, the alteration of the baseline surficial geology and soil cover condition is not expected to cause any adverse interactions with any identified historical, existing, or foreseeable future projects (**Section 4**), If the residual effects of the proposed Project on the VC is determined to be other than negligible and a potential temporal or spatial interaction with a project or activity is identified, then a cumulative effects assessment will be conducted taking into account past, present, certain and reasonably foreseeable future project or activities. The cumulative effects assessment is discussed in **Section 5.4.3.5**.

5.4.3.3.1 Potential Direct Effects on Surficial Geology and Soil Cover

The following section presents the likelihood that different Project components would have a direct effect on the Surficial Geology and Soil Cover VC. The nature of the expected effect and the likelihood of its occurrence are presented.

The removal of overburden, soil disturbance, and soil redistribution are each considered potential direct effects of Project on the Surficial Geology and Soil Cover VC. Based on the expected Project components, all three effects are likely to occur. These materials will be salvaged from specified areas within the mine-related landform area and used as capping material for reclamation activities. Removal of overburden and soil disturbance is most likely to occur during the construction phase of Project, with minimal localized disturbances occurring throughout other Project phases. The redistribution of soil is most likely to occur during the decommissioning and closure phase of Project, or during progressive reclamation during the operations phase.

Details of how the baseline landscape would be altered from Project development are provided below. Project is subdivided into six components for ease of description: the mine site (including the open pit and other associated mine facilities); mine access road; transmission line; Project access roads (Kluskus FSR); airstrip, and the freshwater supply system.

Table 5.4.3-7 presents a summary of the likelihood of direct effects occurring for the Surficial Geology and Soil Cover VC .

Table 5.4.3-7: Potential direct Project Effects on Surficial Geology and Soil Cover VC

Project Component	Project Level Interaction	Project Phase	Potential Direct Project Effect	Likelihood of Occurrence
Mine Site	Site clearing, grading, soil/overburden salvage, development of borrow pits, construction of main and ancillary facilities, water diversion / collection / treatment, storage and management of construction materials and waste. Workforce accommodation.	C, O	Removal of overburden and soil disturbance	Likely
	Decommissioning and demolition of facilities, recontouring and revegetation, reclamation of TSF, replacement of reclamation material.	D/C	Soil and overburden redistribution	Likely
Mine Access Road	Site clearing, grading and road construction, including stream crossings. Transportation of workforce and materials.	C, O, D/C	Removal of overburden and soil disturbance	Likely
Freshwater Supply System	Site clearing and grading, construction of intake and road, installation of water pipeline and freshwater reservoir.	C, O	Removal of overburden and soil disturbance	Likely
Airstrip	Site clearing and grading, construction of runway and airstrip ancillary facilities. Transportation of workforce.	C, O	Removal of overburden and soil disturbance	Likely
	Decommissioning and demolition of facilities, recontouring and revegetation.	D/C	Soil redistribution	Likely
Transmission Line	Site clearing and grading, construction of access roads and towers, and installation of cables.	C	Removal of overburden and soil disturbance	Likely
	Decommissioning and demolition of facilities, recontouring and revegetation.	D/C	Soil redistribution	Likely
Kluskus FSR	Road upgrades and transportation of workforce and materials.	C	Removal of overburden and soil disturbance	Likely

Note: C = construction; O = operations; D/C = decommissioning and closure; PC = post-closure; TSF = Tailings Storage Facility.

5.4.3.3.1.1 Mine Site Effects on Surficial Geology and Soil Cover

The Project components that will undergo the highest degree of alteration in surficial material will be the open pit, TSF, and the East and West waste rock dumps. Areas where borrow material is extracted may also incur significant changes to the baseline condition. These facilities will in turn also incur the highest degree of redistribution or alteration of surficial materials during the decommissioning and closure phase of the Project.

The construction and operations plan for the Project involves the removal of soil and overburden, quarrying of aggregate, and re-contouring of the landscape. These activities will result in both temporary and permanent changes in the distribution of surficial sediments from the pre-disturbed baseline conditions. A permanent increase of coarse-textured anthropogenic materials will be associated with the stockpiling of waste rock and the development of the TSF facility, and will correspond with an alteration in the distribution of pre-existing baseline material.

Project interactions with the Surficial Geology and Soil Cover VC are expected to extend over the life span of the Project, but the majority of this interaction will occur during the site preparation and construction phase. This will be followed by continued, limited new disturbance, or the stabilizing of altered conditions in localized areas. During the lifespan of the Project, the TSF, East and West waste rock dumps, and the open pit will continue to develop in size until Project Description specifications are met. At the end of mill operations, a portion of the overburden component of the East waste rock dump will be used for reclamation so that dump footprint will shrink during closure compared to the end of operations (**Section 2.6**).

Development of the associated facilities in the natural landform area will also affect the distribution of surficial materials, but to a lesser degree than the Project components noted above. Site preparation activities may involve some redistribution of surficial deposits, but will have limited spatial extents during construction and closure activities.

The mine site will undergo considerable overburden and soil alteration through mining operations, cut, fill, and levelling of the site in order to support mine infrastructure in the mine-related landform area, including the open pit, TSF, associated component facilities, and waste rock dumps. These facilities will undergo a permanent change from the baseline conditions. Where feasible, surficial materials (soil and overburden) from these sites will be salvaged and stored for reclamation at mine closure. Overburden collected from the open pit area will be used as an important reclamation material capping tailings and mine waste (**Section 2.6**).

The mine site footprint is 2,939 ha (including the natural landform area), and is characterized mainly by morainal materials that are associated with the Twain, Deserters, and Barrett (BRT) SMUs. As a result of Project, approximately 1,468 ha of morainal deposits will be altered, accounting for 24% of the LSA. Of this area, TWA soils will undergo the greatest degree of change, accounting for 1,143 ha. The change in DES as a result of Project will be approximately 320 ha.

Glaciofluvial sediments will undergo the second greatest change from baseline conditions within the mine site. This surficial material is associated with the AIX SMU, and will undergo a change of approximately 541 ha as a result of Project. Fluvial sediments associated with the Nithi (NIT) SMU will undergo approximately 350 ha of alteration, while colluvial sediments associated with the ORM and PIK SMUs will undergo a change of 298 ha as a result of Project. Organic accumulations will undergo 138 ha of alteration (2% of the LSA), and are associated with the CIF and MXY SMUs.

In addition to removal and relocation of materials within the mine and infrastructure area, the materials may be subjected to changes in composition through mixing of different strata, as well as physical changes involving both reduction of bulk density and increases through compaction in areas where materials need to be densified (e.g., for building foundations).

5.4.3.3.1.2 Mine Site Access Road Effects on Surficial Geology and Soil Cover

The mine access road development will require the construction of a new road segment near the mine. As a result of Project, approximately 23 ha of morainal deposits will undergo alteration. This material is associated with the DES SMU. Approximately 3 ha of glaciofluvial (AIX SMU) will be altered as a result of Project, with a minor area (0.4 ha) of organic MXY soils also being affected.

5.4.3.3.1.3 Transmission Line Effects on Surficial Geology and Soil Cover

Construction of the transmission line is not anticipated to cause major disturbances to the baseline conditions. Although it is anticipated that localized point disturbances will occur with the construction of towers and access into the line, these disturbances are expected to be negligible in size, therefore assessment of this feature is not included in the Surficial Geology and Soil Cover VC. For additional information pertaining to the transmission line access roads refer to **Section 2.2.4.4**.

5.4.3.3.1.4 Project Access Road (Kluskus FSR) Effects on Surficial Geology and Soil Cover

Project access road development will require upgrading a section of the existing FSR, specifically between KM 102 and KM 124. The FSR is scheduled to undergo limited widening to accommodate increased two-way traffic. No significant change in the baseline conditions for either surficial deposits or soil units is expected as a result of the Project access road.

5.4.3.3.1.5 Airstrip Effects on Surficial Geology and Soil Cover

The construction of the proposed airstrip will involve the alteration of baseline conditions for the airstrip and associated facilities, but not the access road. The proposed use of an existing logging road to access the airstrip area will allow for the reduction of the Project footprint, as no new construction is anticipated for the airstrip access road feature. The proposed airstrip is located entirely on glaciofluvial deposits associated with the AIX SMU. As a result of Project, approximately 16 ha of this material (7% of the LSA) will be altered from baseline conditions.

5.4.3.3.1.6 Freshwater Supply System Effects on Surficial Geology and Soil Cover

The construction of the freshwater supply system will entail the removal of topsoil and overburden to install the underground pipeline. With proper salvage and replacement techniques, minor changes are expected to the physical properties of the soil profile and surficial materials. Topsoil will be removed and stored separately from the underlying subsoil and overburden. Once the pipeline is installed, replacement of the surficial materials and topsoil where feasible will occur in reverse order. While the replaced material is not technically considered the same as the baseline, both the surficial geology material and soil should function the same as in the baseline condition. EMPs and BMPs used as part of Project should mitigate any detrimental effects of the construction and reclamation of the freshwater supply system.

5.4.3.3.2 Potential Indirect Effects of Surficial Geology and Soil Cover

The potential for effects of the Project on the Surficial Geology and Soil Cover VC to become indirect effects on other environmental components is summarized in **Table 5.4.3-8**. Based on the Project Description (**Section 2.2**), the removal of overburden, soil disturbance, and soil redistribution are all expected to have an indirect effect on other terrestrial environmental components. These include vegetation, wildlife, hydrology, and aquatic resources. As a result of this expected interaction, this effect would be carried forward into the assessment. Although terrain stability and accelerated erosion may affect other environmental components, including surface water, the unlikelihood of unmitigated occurrence suggests that it would not be carried forward.

Table 5.4.3-8: Potential indirect Project effects on other VCs

Direct Project Effect (Adverse or Positive)	Project Phase	Potential Indirect Project Effect	Carry Forward (Yes / No)	Rationale
Removal of overburden material	C	Removal may affect vegetation communities	Yes	Project design incorporates overburden replacement plan
Terrain stability and accelerated erosion	C, O, D/C, PC	Potential instability and erosion may affect vegetation and surface water conditions	No	Project design and mitigation measures in place
Drawdown of groundwater table	O	Changes may affect vegetation communities	No	Project will not affect long-term drawdown beyond natural levels (Section 5.3)
Re-contouring land surface	D/C	Changes in landscape may affect vegetation and wildlife	Yes	Alteration of topography and surficial geology may affect vegetation and wildlife
Soil disturbance	C	Removal of soil could affect vegetation in adjacent, undisturbed areas	Yes	Removed soil could affect vegetation adjacent to the Project area, due to factors such as root disturbance, change in soil microclimate, and moisture availability.
Soil redistribution	D/C	Changes in soil distribution could affect vegetation	Yes	Changes in types and areas of replaced soil would occur, which may affect the composition of vegetation after reclamation, as compared to baseline vegetation.

Note: C = construction; O = operations; D/C = decommissioning and closure; PC = post-closure

Soil disturbance refers to the removal of soil (upper 50 cm) and organic accumulations prior to preparation of the land surface for development of infrastructure and other Project facilities. The salvage of soil is a positive measure, in that it provides the reclamation material required at closure. However, once disturbed to this extent, it cannot be replaced such that the original soil profiles (i.e., sequence of soil horizons) will be restored, with the exception that soil will be replaced. Rather, the goal is to replace the soil in high value areas such that it will support equivalent and functional vegetation and other ecosystem components similar to the baseline conditions. In this regard, maintenance of soil quality is of great importance (refer to Soil Quality VC). The majority of the material used in reclamation activities will be surficial materials (overburden), collected during the construction of Project components. This material will serve as the growth medium for revegetation.

The Project Description (**Section 2.2**), the RCP, and BMPs indicate that soil from soil units rated as *Fair* and *Good* in terms of reclamation suitability, along with organic accumulations from within the Project facilities will be salvaged and stockpiled prior to development, where feasible. The salvaged material will include all organic material and the upper 50 cm of soil horizons (A, B, and/or C horizons), as defined in the *Canadian System of Soil Classification* (Soil Classification Working Group, 1998). Organic soils will be salvaged to an average depth of 1 m.

It is expected that a soil deficit will occur as a result of project development. In order to account for this deficit, the planned approach to soil salvage during construction, will be the collection and storage of the upper 50 cm of the soil profile to act as a cover soil material during reclamation. This 50 cm lift will include all surface organics (litter) and A and B horizons. In some cases, upper C horizons or overburden will also be collected. Overburden will also be collected for use as the primary reclamation material.

Soil redistribution is also a positive aspect of Project, as it is a fundamental component of landscape reclamation, intended to restore capacity to support ecosystems in the same way as at baseline. While this process is considered positive, the overall direction is assessed as neutral, as the expectation is for soil functioning to be the same after reclamation as at baseline.

Table 5.4.3-9 presents a summary of the potential effects of the proposed Project to be carried forward into the assessment for soil cover.

Table 5.4.3-9: Summary of Potential Project Effects to be Carried Forward into the Assessment for Soil Cover

Adverse Effects / Positive Effects	Project Phase	Direction
Removal and relocation of overburden material	C, O, D/C	Negative
Soil disturbance	C, O	Neutral
Soil redistribution	D/C	Neutral

Note: C = construction; O = operations; D/C = decommissioning and closure; PC = post-closure

5.4.3.3.3 Mitigation Measures

Mitigation measures to reduce or eliminate each of the potential direct or indirect effects of Project on surficial geology and soil cover are described in the sections below. Potential effects and the measures that would be employed to mitigate them are presented by Project phase where appropriate.

The following mitigation measures are identified as part of Project with regard to the removal and redistribution of surficial deposits and the disturbance and redistribution of soil:

- Minimization of the Project footprint;
- A soil salvage plan;
- Salvage and storage of overburden materials;
- Erosion control measures and maintenance of slope gradients; and
- Site reclamation following mine closure.

Table 5.4.3-10 outlines the proposed mitigation measures applicable for each Project phase with respect to the Surficial Geology and Soil Cover VC.

Table 5.4.3-10: Potential Project Effect by Project Phase on Surficial Geology and Soil Cover VC and Mitigation Measures

Project Effect	Project Phase	Mitigation / Enhancement Measure	Mitigation Success Rating
Removal of overburden material	C	Footprint minimization; salvage and storage of overburden material	Reduction
	O	Storage of overburden material	Reduction
	D/C	Site reclamation following mine closure	Reduction
Terrain stability and accelerated erosion	All phases	Erosion control measures and maintenance of slope gradients	Reduction or prevention
Re-contouring land surface	D/C	Site reclamation following mine closure	Reduction or elimination
Soil disturbance	C	Footprint minimization; soil salvage plan	Reduction
Soil redistribution	D/C	Site reclamation following mine closure	Reduction or enhancement
	PC	Soil erosion and vegetation monitoring programs	Enhancement

Note: C = construction; O = operations; D/C = decommissioning and closure; PC = post-closure

5.4.3.3.3.1 Footprint Minimization

As discussed in **Section 5.4.3.4.1**, the principal mitigation method for potential impacts to surficial deposits is minimization of disturbances. This includes minimization of the aerial extent of the Project footprint, utilizing areas of disturbance, and Project design features.

5.4.3.3.3.2 Soil Salvage Plan

The collection and storage of soil from the Project facilities is outlined in detail in the RCP (**Section 2.6**). As described in the RCP, the surface organic layers and top 50 cm of mineral soil will be salvaged for later use in reclamation where possible. This salvage will occur in areas rated as *Fair* and *Good* in terms of reclamation suitability. Many of the soils have shallow A horizons, and the soil salvage will therefore consist of the A in addition to the B (or C) horizon to a depth of 50 cm. Volume estimates of available salvageable soil and reclamation material requirements are presented in the RCP (**Section 2.6**). Salvaging organic matter for use as a soil amendment will also be included in the RCP. Due to the natural variability in soil cover at the site, stripping to a 50 cm thickness of mineral soil may not be consistently possible, due to presence of high coarse fragment content or shallow occurrence of bedrock. In addition, construction equipment will not be capable of entering all areas to collect the soils due to the nature of the topography of Project. Efforts will be made to salvage as much high value reclamation material as possible throughout the Project footprint within areas defined as containing viable soil.

5.4.3.3.3.3 Salvage and Storage of Overburden

The salvage and storage of surficial materials is vital to the RCP, in order to maintain the land at an equivalent state after mine closure. To the extent feasible, surface materials will be collected and stored in ways that will maximize their effectiveness for use during reclamation as a growth medium.

5.4.3.3.3.4 Erosion Control Measures and Maintenance of Slope Gradients

The Sediment and Erosion Control Plan (SECP) (**Section 12.2.1.18.4.1**) developed for the Project is expected to mitigate the effects that erosion may have on other terrestrial VCs, as well as on the loss of surface materials needed for reclamation. For a more detailed description of the SECP, refer to **Section 12.2.1.18.4.1**.

5.4.3.3.3.5 Site Reclamation Following Mine Closure

The Project footprint will be reclaimed during the closure and decommissioning phase of the Project. Detailed discussion with regard to the proposed closure and reclamation activities for the Project, including the mine site, mine access road, and airstrip, are presented in the Project Description, the EMS, and the RCP. BMPs and industry standards exist for mining closure and reclamation activities, and the Project currently incorporates these practices into its overall design, EMS, and RCP.

Soil reclamation refers to the redistribution of salvaged soil, and will occur during the closure phase of Project. Salvaged soil and overburden reclamation material will be redistributed over the graded and contoured surficial geological material as part of reclamation activities. The RCP indicates that overburden will be placed on re-contoured mine closure material in much of the disturbed areas and salvaged soil in high value areas. These high value areas include the LGS, mine buildings, the environmental control wetland, and the fresh water reservoir wetland (RCP **Section 2.6**) In the case of the environmental control wetland, and the fresh water reservoir wetland, salvaged organic materials will be used for reclamation. In case of the roads, the materials will be levelled, and ripped and disked, prior to topsoil application. The waste rock dumps are a special case, in which a sufficient depth of overburden material will be placed over the waste material.

Reclamation with respect to the redistribution of surficial materials and soil cover will be limited, since the removed materials will not be returned to their baseline distribution. Reclamation and closure planning has, instead, focused on measures to incorporate the redistributed surficial materials into the closure landscape features.

5.4.3.3.3.6 Effectiveness of Mitigation

Table 5.4.3-11 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on surficial geology and soil cover during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.3-11: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Surficial Geology and Soil Cover during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Removal of overburden Material	Construction	Footprint minimization	High
		Salvage and storage of overburden material	High
	Operations	Storage of overburden material	High
	Closure	Site reclamation following mine closure	High
Terrain stability and accelerated erosion	Construction, Operations, Closure, Post-closure	Erosion control measure and maintenance of slope gradients	High
Re-contouring land surface	Closure	Site reclamation following mine closure	High
Soil disturbance	Construction	Footprint minimization	High
		Soil salvage plan, surface organic layers and top 50 cm of mineral soil will be salvaged.	High
Soil redistribution	Closure	Progressive reclamation following mine closure	High
	Post-closure	Soil erosion and vegetation monitoring programs	High

When describing the effectiveness of the mitigation rating, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The effectiveness of mitigation measures for the Surficial Geology and Soil Cover VC is generally described as having a high success rating. This is because the proposed mitigation measures are techniques that are widely used in mining and other industries that have been proven effective over a long period of time. The goal is to minimize the amount of surficial and soil material being disturbed and the subsequent reclamation of the material. With proper implementation of these salvage and reclamation techniques, a high success rating is anticipated.

5.4.3.4 Residual Effects and their Significance

5.4.3.4.1 Potential Residual Effects after Mitigation

The disturbance and redistribution of surficial materials and soil is a direct consequence of Project development. Baseline surficial sediments will be re-contoured to produce a level base for some of the mine facilities, with portions, with portions salvaged and stockpiled where feasible during the various phases of Project. Waste rock will be placed in the waste pile, and at closure local overburden will be placed on the waste rock dumps to create the reclamation profile. These measures will result in development of surficial material with functioning similar to baseline conditions. Mitigation measures will minimize the overall effect that the redistribution of surficial materials will have on the landscape. Therefore, upon completion of all mitigation measures, negligible residual effects have been identified for the Surficial Geology and Soil Cover VC.

The Project footprint has been optimized in terms of its layout to avoid unnecessary development of undisturbed areas. Salvaging and stockpiling soil during construction causes direct disturbance of soils and surficial materials; however, high value soils material will be set aside to be redistributed during reclamation. Use of the salvaged surficial materials and soils as reclamation material is expected to result in cover soils which will function in a similar manner to the pre-disturbance conditions for subsequent reclamation activities.

There is a soil deficit for the Project, based on the amount of soil and organic matter that is available from salvage. Baseline surveys indicate that discontinuous cover of mineral salvage material and uneven terrain may limit the success of salvage operations in certain areas. Efforts will be made to salvage the greatest amount of high value soil material possible.

Following the application of all mitigation measures indicated above, the expectation is that no residual effects will be associated with the Surficial Geology and Soil Cover VC. Soil cover differences will exist between baseline and Project closure; however, the replacement of soil and development of growth mediums to support reclamation will serve to initiate reclamation at the site to an equivalent functioning landscape.

The redistribution of surficial materials and soils is a direct consequence of Project development. Baseline surficial sediments will be salvaged and stockpiled during the various phases of the Project. Mitigation measures will minimize the overall effect that the redistribution of surficial materials will have on the landscape. Therefore, upon completion of all mitigation measures, no residual effects have been identified for the VC.

5.4.3.4.2 Significance of Potential Residual Effects

The significance rating for the identified surficial geology and soil cover residual effects are summarized in **Table 5.4.3-12**. The ecological context of the removal and relocation of overburden, soil disturbance, and soil redistribution are all rated as *Low*, as the surficial material and soils are expected to function in a similar manner to baseline conditions. The effects are considered *Local* in geographic extent, *Reversible* in nature, and *Neutral* in direction. The likelihood for all effects on the Surficial Geology and Soil Cover VC is considered *High* throughout all phases of the Project as the residual effect is expected to occur as evident in the Project Description. The level of confidence in the significant rating is considered *High* as the VC is well understood and mitigations from previous projects have found to be effective. This Project effect on the VC is rated as *Not Significant* (Negligible) for the residual effect.

The residual effect for the alteration of baseline landscape was evaluated to be *Not Significant* (Negligible) using the criteria described in the assessment methodology (**Section 4**). Functionality of the soil types and surficial parent material is expected to be consistent with baseline conditions (with mitigations), resulting in an overall direction of *Neutral.* This rating was applied as the geographic extent is *local* (within the LSA), *Low* in context and magnitude, R*eversible* and *Chronic* in duration. Residual effect significance ratings are described in **Section 4**.

Table 5.4.3-12: Residual Effects Assessment by Project Development Phase for Surficial Geology and Soil Cover VC

Parameter	Stage of Development / Rating			
	Construction	**Operations**	**Decommissioning and Closure**	**Post-Closure**
Removal and Relocation of Overburden Material				
Effect Attribute				
Context	Low	Low	Low	n/a
Magnitude	Low	Low	Low	n/a
Geographic extent	Local	Local	Local	n/a
Duration	Chronic	Chronic	Chronic	n/a
Reversibility	Yes	Yes	Yes	n/a
Frequency	Continuous	Continuous	Continuous	n/a
Likelihood Determination	High	High	High	n/a
Level of Confidence for Likelihood	High	High	High	n/a
Significance Determination	Not significant (negligible)	Not significant (negligible)	Not significant (negligible)	n/a
Level of Confidence for Significance	High	High	High	n/a
Soil Disturbance				
Effect Attribute				
Context	Low	Low	n/a	n/a
Magnitude	Low	Low	n/a	n/a
Geographic extent	Local	Local	n/a	n/a
Duration	Chronic	Chronic	n/a	n/a
Reversibility	Yes	Yes	n/a	n/a
Frequency	Once	Intermittent	n/a	n/a
Likelihood Determination	High	High	n/a	n/a
Level of Confidence for Likelihood	High	High	n/a	n/a
Significance Determination	Not significant (negligible)	Not significant (negligible)	n/a	n/a
Level of Confidence for Significance	High	High	n/a	n/a
Soil Redistribution				
Effect Attribute				
Context	n/a	n/a	Low	n/a
Magnitude	n/a	n/a	Low	n/a
Geographic extent	n/a	n/a	Local	n/a
Duration	n/a	n/a	Chronic	n/a
Reversibility	n/a	n/a	Yes	n/a
Frequency	n/a	n/a	Once	n/a
Likelihood Determination	n/a	n/a	High	n/a
Level of Confidence for Likelihood	n/a	n/a	High	n/a
Significance Determination	n/a	n/a	Not significant (negligible)	n/a
Level of Confidence for Significance	n/a	n/a	High	n/a

Note: Each identified residual effect was subjected to nine rating criteria to determine significance; these criteria are described in **Section 4**.

5.4.3.5 Cumulative Effects

All Project related effects to surficial geology and soil cover will be addressed during the closure phase of the Project. The implementation of the RCP, along with the other identified mitigation measures (**Section 5.4.3.3.3**), will effectively mitigate any residual effects related to the Surficial Geology and Soil Cover VC. Following the successful implementation of mitigation measures, it is anticipated that no residual effects related to the Surficial Geology and Soil Cover VC will remain. As such, residual effects for the are considered to be Not Significant (Negligible) and are not carried forward as part of the assessment.

5.4.3.6 Limitations

The effects assessment for the Surficial Geology and Soil Cover VC is based on the information presented within the Project Description (**Section 2.2**) and Reclamation and Closure Plan (**Section 2.6**). Some variation in the composition of soil types in some areas may affect the results of the assessment; however, it is believed the estimates are suitable in the context of the overall assessment.

5.4.3.7 Conclusion

Direct effects of Project are expected to occur on the Surficial Geology and Soil Cover VC through the construction to decommissioning / closure phases of the Project. The salvage and storage of soil and overburden materials during the construction and operations phases, development of a compact Project footprint, and the eventual reclamation of the site will reduce the overall effect. The original distribution of baseline surficial materials and soil types will not be re-established; however, upon reclamation, a functional and equivalent landscape will be developed to support the reclamation goals. The anticipated significance of those residual effects is rated as *Not Significant* (Negligible).