APPENDIX 4
Knight Piésold Kitsault Project Reconnaissance Terrain and Terrain Stability Mapping Report

AVANTI KITSAULT MINE LTD
KITSAULT PROJECT

RECONNAISSANCE TERRAIN AND TERRAIN STABILITY MAPPING REPORT

PREPARED FOR

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VA101-343/9-2
Rev 0
July 8, 2011

Knight Piésold
CONSULTING

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AVANTI KITSAULT MINE LTD
KITSAULT PROJECT

RECONNAISSANCE TERRAIN AND TERRAIN STABILITY MAPPING REPORT
(REF. NO. VA101-343/9-2)

Rev	Description	Date	Approved
0	Issued in Finial	July 8, 2011	[signature]

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(REF. NO. VA101-343/9-2)

EXECUTIVE SUMMARY

The Kitsault Project is located on an historic molybdenum producing Mine Site that is proposed for redevelopment. This report presents the results of Reconnaissance Terrain and Terrain Stability Mapping (RTSM), undertaken for the Kitsault Project. The Study Area is divided into two parts; the Mine Site catchments and the Main Access Road corridor.

MINE SITE CATCHMENT

The Mine Site Study Area is approximately 4000 ha, and includes all water catchments surrounding the proposed mine site infrastructure and Tailings Management Facility (TMF). The RTSM for the Mine Site Study Area was conducted to Terrain Survey Intensity Level (TSIL) 'D', with approximately 16% of the Mine Site polygons being field checked. The availability of LiDAR contour base maps and recent air photography for the Mine Site facilitated the delineation of certain features of significance to the terrain stability, such as gullies and talus slopes and the current extent of anthropogenic areas. It also facilitated a higher level of resolution of the areas of 'potentially unstable' terrain. Factors detracting from the accuracy of the mapping are the difficulties of mapping through dense forest cover and the limited soil exposures away from the roads and streams.

The Mine Site Study Area is predominately hummocky bedrock that is frequently covered by a mantle or veneer of organic deposits. The gentle (6 – 26%) to moderate (27 – 49%) slopes are intermittently broken with deeply incised gullies. Thick lava flows were found directly north of the Open Pit. Rock fall talus deposits are found along the bases of the columnar jointed lava flow escarpment, which formed as a result of cliff erosion and rock falls. The tops of the lava flows are flat and generally covered with a veneer of organic deposits. A veneer of colluvium is generally found on moderate (27 – 49%) to moderately steep (50 – 70%) slopes within the Study Area. East and North-west of the open pit, a thick blanket of anthropogenic soils was side cast in the Patsy and Clary Waste Dumps during the previous mining operations.

At the Mine Site, the terrain stability mapping generally indicated a 'low' likelihood of landslide occurrence in the vicinity of the proposed Mine Site Infrastructure. There is moderately steep to steep gullied terrain adjacent to Lime and Patsy Creeks, resulting, locally, in a 'moderate' to 'high' likelihood of landslide occurrence. No mine site infrastructure is proposed in these areas. The Coarse Ore Stockpile (COS) and Conveyor are proposed to be located close to the lava flow escarpment, which has been assessed to be 'potentially unstable'.

MAIN ACCESS ROAD CORRIDOR

The Main Access Road Corridor Study Area follows approximately 64 km of established access road from the Nass Forest Service Road (FSR) turnoff to the Mine Site. The RTSM for the Main Access Road Study Area was conducted to TSIL 'E' that does not require field truthing. The 1:20,000-scale TRIM

maps with 20 m contours were available as contour base maps. The availability of ‘recent’ air photography for the Main Access Road facilitated the delineation of certain features of significance to the terrain stability, such as gullies and talus slopes and the occurrence of recent landslides on the road alignment. Factors detracting from the accuracy of the mapping are the difficulties of mapping through dense forest cover.

The Main Access Road can be divided into two sections; the Nass River Valley Section (Ch. 0 to 38+500) and the westerly section (Ch. 38+500 to 64+000). The majority of the Nass River Valley section follows gentle (6% to 26%) slopes on a thick blanket of glaciofluvial deposits and glacial moraine deposits. The westerly section follows moderate (27% to 49%) to moderately steep (50 – 70%) slopes that are intermittently broken with gullies. Bedrock typically crops out along this section of the road and is frequently covered by a veneer of colluvium, which generally becomes thicker towards the toes of the slopes.

The terrain stability mapping indicated there to be a ‘low’ likelihood of landslide occurrence along the majority of the road alignments. Along the Main Access Road alignment, several ‘unstable’ areas, associated with the sites of ‘recent’ landslides, were identified to the west of Ch. 38+500. ‘Potentially unstable’ terrain was identified between Ch. 42+500 and Ch. 47+600 of the Main Access Road alignment. It was also identified along portions of the road alignments within the mine site, in particular between Ch. 0+500 and 1+500 of the Crusher Access Road.

FURTHER WORK

Recommendations coming out of the study are provided under a separate cover: Reconnaissance Terrain and Terrain Stability Mapping Report – Recommendations for further work (Ref. No. VA11-01064, dated July 8, 2011).

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RECONNAISSANCE TERRAIN AND TERRAIN STABILITY MAPPING REPORT
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AVANTI KITSAULT MINE LTD
KITSAULT PROJECT

RECONNAISSANCE TERRAIN AND TERRAIN STABILITY MAPPING REPORT
(REF. NO. VA101-343/9-2)

SECTION 1.0 - INTRODUCTION

The Kitsault Project is located on an historic molybdenum producing Mine Site that is proposed for redevelopment. Avanti Kitsault Mine Ltd. (Avanti) acquired the Kitsault Property in October 2008 and reactivated the project. Knight Piésold Ltd. (KP) was engaged by Avanti to develop the feasibility design for the Tailings Management Facility (TMF), the water management systems and to provide geotechnical support for mine site infrastructure design and provide environmental services for the project.

Between 2009 and 2010, two site investigation programs were undertaken at the site to investigate the geotechnical, foundation and seepage conditions along the proposed tailings embankments and at the sites of the proposed mine site infrastructure, including the plant site, primary crusher, waste dumps, borrow areas and concrete aggregate sources. An Environmental Assessment for the proposed project is currently being conducted by AMEC Earth and Environmental and is anticipated to be submitted in Q2 of 2011.

SECTION 2.0 - SCOPE OF REPORT

This report presents the results of Reconnaissance Terrain and Terrain Stability Mapping (RTSM), undertaken for the Kitsault Project. The primary objective of the RTSM was to evaluate the terrain stability in relation to the proposed development. The Study Area is divided into two parts; the Mine Site catchments and the Main Access Road corridor:

- The Mine Site Study Area is approximately 4000 ha, and includes all water catchments surrounding the proposed mine site infrastructure and Tailings Management Facility (TMF). The RTSM for the Mine Site Study Area was conducted to Terrain Survey Intensity Level (TSIL) 'D', requiring between 1% and 20% of the terrain polygons to be field truthed.
- The Main Access Road Corridor Study Area follows approximately 64 km of established access road from the Nass Forest Service Road (FSR) turnoff to the Mine Site. The RTSM for the Main Access Road Study Area was conducted to TSIL 'E' that does not require field truthing. The mapping also includes corridors along the proposed road alignments within the mine site.

This report provides the findings of the RTSM for the Kitsault Mine Site and the Main Access Road Corridor study areas. It has been prepared exclusively for Avanti in relation to the Kitsault Project. No third party should rely on the information, conclusions, opinions, or any other matter contained in this report.

SECTION 3.0 - SITE AND PROJECT DESCRIPTION

3.1 SITE LOCATION

The Kitsault Project is located in north-western British Columbia within the Regional District of Kitimat-Stikine, approximately 140 km northeast of Prince Rupert and south of the head of Alice Arm, an inlet of the Pacific Coastline, as shown on Figure 3.1. The Kitsault mine site is located within NTS maps 103P 044 and 043, at approximately latitude 55º 25’ 19” N and longitude 129º 25’ 10” W and at about 600 m above sea level (masl). The project can be accessed from Terrace or Smithers via existing highways, forestry and mine access roads, and by float plane air service or boat from Prince Rupert.

3.2 THE MINE PROPERTY

The Property includes three known molybdenum deposits “Kitsault”, “Bell Moly”, and “Roundy Creek”. The ore is proposed to be hauled from the re-commissioned open pit to the Primary Crusher, and then transported to the Plant Site located on top of Widdzech Mountain via a conveyor system. Tailings will be gravity fed from the Plant Site to the Tailings Management Facility (TMF) located in the relatively flat area below Widdzech Mountain and to the east of the plant site. A NI 43-101 Feasibility Study was completed for the site in December, 2010 by AMEC. The proposed layout for the Mine Site can be seen on Figures 4.1, 4.2 and 4.3. The Main Access Road Corridor is approximately 64 km long and includes the portion of road from the turn off from the Nass FSR to the Kitsault Mine Site and is shown on Figure 3.1.

3.3 PHYSIOGRAPHY AND VEGETATION

Elevations within the study area range from 0 m at Alice Arm to 1100 m south of the open pit. Several Trachyandesite lava flows make up a rock plateau in the centre of the Mine Site, known as Widdzech Mountain. Widdzech Mountain rises to a height of 1000 m and is approximately 400 m higher than the nearby open pit site. The margins of the flows comprise staggered columnar cliffs with large talus slopes at their bases. There are swampy areas between gently rolling bedrock outcrops in the vicinity of the proposed mine site infrastructure and Tailings Management Facility (TMF). This area is covered by sparse vegetation consisting of small trees and shrubs, due to the abundant surface water in the area. Larger conifer trees grow at the lower elevations and on steeper slopes where the groundwater table is farther below ground. To the west, Patsy and Lime Creek have cut deeply incised channels as they flow northwest toward the head of Alice Arm. A ridge leading up to Hoan Peak (1990 m) makes up the southern border of the property.

The Province is divided into Biogeoclimatic Zones which are differentiated based on the Provincial Biogeoclimatic Ecosystem Classification (BEC) system. Three BEC zones occur in the study area, Mountain Hemlock (MH), Coastal Mountain Alpine (CMA) and Coastal Western Hemlock (CWH). The MH zone is a subalpine zone and represents where continuous forest transitions into patchy clumps of trees, subalpine heath and lush meadows at higher elevations. This zone is characterized by short, cool summers, and long, cool winters. The CMA zone is an alpine zone that occurs at high elevations on the Coast Mountains. The CMA represents a relatively moist environment and tends to have a deeper snowpack beginning at lower elevations than the other alpine zones. The CWH zone occupies the low to mid elevations along coastal regions of British Columbia. The climate is moderated by the proximity of the ocean and is typified by large amounts of precipitation and relatively warm temperatures.

3.4 CLIMATE

The area surrounding Alice Arm has a temperate coastal climate. Alice Arm receives an average of approximately 2 m of precipitation a year, meaning the climate verges on that of a temperate rainforest. While precipitation falls primarily as rain on Alice Arm, a large portion of annual precipitation falls as snow at the Mine Site Catchments. Climate data has been collected for the Kitsault Property from 1968 to 1972 and from 2008 to present. This limited record shows the coldest month to be January and the warmest to be July, with mean temperatures of -6 and 11.6 °C, respectively. A longer term weather station located in Prince Rupert has recorded January as being the coldest month and August as being the warmest, with average temperatures of -2.1 and 16.7 °C, respectively (Knight Piésold Ltd. Engineering Hydrometeorology Report KP Ref: 101-343-1).

SECTION 4.0 - DESKTOP STUDY

4.1 PREVIOUS RECONNAISSANCE TERRAIN MAPPING

Reconnaissance Terrain Maps which cover the Study Area were produced for the Ministry of Mines, Petroleum and Energy (MEMPR) at a scale of 1:50,000 (Kowall R. and Daykin P., 1981 and Vold T. Kowall R. and Daykin P., 1981). This data is available in digital format from the MEMPR website, and was used in this study.

4.2 TOPOGRAPHIC MAPS

Topographic maps of the Mine Site and Main Access Road Corridor were examined as part of the Desktop Study. The published 1:20,000 scale TRIM maps with 20 m contours were examined. Additionally, topographic maps with 5 m contours were produced from the project LiDAR Survey for the mine site catchments.

Slope angle maps of the Mine Site and the terrain in the vicinity of the Main Access Road were prepared using the *ArcView* Geographic Information System (GIS) software package with the '3d-Analyst' extension, and are presented on Figures 4.1, 4.2 and 4.3 for the Mine Site and Figures 4.4, 4.5, 4.6, 4.7, 4.8 and 4.9 for the Main Access Road. The Slope Angle Maps use 5 m LiDAR contours, where available, and 20 m trim contours for the remainder of the Mine Site and Main Access Road. The slope angle classes correspond with those in the Terrain Classification System for British Columbia (Howes and Kenk, 1997).

4.3 FISH HABITAT

The Fisheries and Information Summary System Database was used to obtain the locations of fish barriers in the Study Area. The fish barrier along Lime Creek was not included in the database. AMEC Earth and Environmental identified the fish barrier during the field season by field truthing the location. Fish barriers are located on Figures 8.1 to 8.3.

4.4 COMMUNITY WATERSHED SEARCH

No community watersheds are documented within approximately 25 km of the Study Area in the Land and Resource Data Warehouse (LRDW) database.

4.5 PUBLISHED GEOLOGY

The Geological Survey of Canada published a Surficial Geology Map of Nass Valley (McCuaig, S. 2003a) at a scale of 1:100,000, which covers the Mine Site Catchments and Main Access Road Corridor. The scale of the map is too coarse to facilitate a detailed interpretation of the surficial geology of the sites of the proposed facilities.

The regional bedrock geology was mapped by Steininger (1981) and Carter *et. al.* (1986) and then digitized and made available from the British Columbia Government MEMPR at a scale of 1:100,000.

The dominant bedrock in the Study Area is Upper Jurassic to Lower Cretaceous Bowser Lake Group. The Bowser Lake Group typically consists of interbedded greywacke and argillite with minor conglomerate and limestone, metamorphosed to greenschist facies. Individual beds vary in thickness from a few centimetres to upwards of 15 m with a ratio of roughly 80% greywacke, 19% argillite and 1% limestone and conglomerate. Regionally, the Bowser Lake Group has a northwest strike and a steep northeast dip, but numerous variations to this trend are interrupted by small scale folding. The sedimentary rocks have undergone intense intrusive activity related to the Coast Range Crystalline Complex located approximately two kilometres away from the Mine Site. This intrusive activity includes the Alice Arm Intrusives that are associated with the Kitsault Molybdenum deposit along with other economic deposits in the Alice Arm area and swarms of northeast striking lamprophyre dykes.

The intrusives were emplaced from 50 to 55 Million years ago in the Bowser Lake Group sedimentary rocks surrounding Alice Arm (Carter 1982). Many of these Alice Arm Intrusives are associated with Molybdenum mineralisation. The Kitsault Property contains three known Molybdenum deposits: "Kitsault", "Bell Moly", and "Roundy Creek". The "Kitsault" deposit is within the Lime Creek Intrusive Complex that consists of quartz diorite, grandiorite and decreased amounts of quartz monzonite. Mineralisation within the deposit is related to the last two phases of the Lime Creek Complex, the Central Stock (granodiorite) and the Northeast Porphyry (porphyritic granodiorite). Hornfels aureoles in the host sedimentary rocks were likely produced in reaction to intrusions along the eastern boarder of the Coast Plutonic Formation. Swarms of northeast striking lamprophyre dykes were later intruded into the sedimentary rocks between 34 to 36 Million years ago (Carter, 1964 and 1982). These swarms consist of several hundred dykes per kilometre and range in thickness from a few centimetres to 15 m.

Northeast of the deposit are 0.6 to 1.6 million-year-old olivine basalt lava flows (Carter, 1964). These plateau-type lava flows are flat lying to gently dipping and extend over considerable distances. Horizontal contraction characteristically develops vertical columnar jointing as the lava rapidly cools. These lava flows are displayed as well-developed columnar jointed cliff faces over 100 m high with talus deposited at the cliff base.

4.6 PUBLISHED GEOMORPHOLOGY

The Kitsault Project area has undergone extensive glaciation, and at the height of the Pleistocene glacial period, thick ice covered the entire region. Pre-glacial valleys on the western side of the Coast Mountains offered an easier route for ice flowing westward to the sea. The Kitsault River valley (identified on Figure 3.1) was incised before the Pleistocene period served as a main drainage path for the westward flow of glacial ice and was deepened by the passage of ice through it. Strongly developed lineations displayed by drift forms and sculptured bedrock provides an indication of the direction of Pleistocene ice movement.

The sea level during the Pleistocene glaciation was much higher due to the weight of glacial ice causing isostatic depression. This phenomenon is evidenced in the Kitsault area by the presence of glaciomarine deposits at elevations of up to 30 m above the present sea level. These deposits still remain in river deltas such as at Roundy Creek. Interbedded gravels, sands and silts were deposited sub-aqueously in ice-proximal glaciomarine environments. These glaciofluvial materials were deposited in a series of terraces associated with different sea levels at the mouths of rivers and creeks. Eventually the valley glaciers retreated and sea levels dropped leaving extensive meltwater braided stream plains. These stream plains terminated in marine water forming large glaciofluvial deltas (McCuaig, S. 2003a).

SECTION 5.0 - AIR PHOTO INTERPRETATION

5.1 MINE SITE

Air Photo Interpretation (API) was undertaken using 1:25,000 scale colour air photos, taken in 2008 as detailed below:

- 15BCC08006, photos 195 to 200 and 234 to 240 (2008), 1:25,000 scale, and
- 15BCC08011, photos 003 to 008 (2008), 1:25,000 scale.

Historical air photos were also examined, as detailed below:

- A12265, photos 358 to 368 (1949), 1:34,000 scale
- BC2178, photos 55 to 58 (1956), 1:43,000 scale, and
- BC5620, photos 223 to 224 (1974), 1:80,000 scale.

5.2 MAIN ACCESS ROAD

API for the Main Access Road was undertaken using 1:30,000 scale black and white air photos, taken in 2001, as detailed below:

- 15BCB01005, photos 192 to 205 (2001), 1:30,000 scale, and
- 15BCB01006, Line 5 photos 170 to 173, Line 2 192 to 199, and Line 4 photos 187 to 201 (2001), 1:30:000 scale.

The following historical air photos were examined:

- A12265, photos 358 to 368 (1949), 1:40,000 scale
- A15316, photos 118 to 124 (1956), 1:65,000 scale
- BC5620, photos 173 to 179 and 220 to 224 (1974), 1:70,000 scale, and
- BC85048, photos 16 to 18 (1985), 1:30,000 scale.

SECTION 6.0 - FIELDWORK

6.1 FIELD TRUTHING

Fieldwork around the Mine Site was conducted during summer field seasons in 2009 and 2010 (23 to 25 July, 2009 and 17 to 22 June, 2010). The geotechnical site investigation drilling program provided additional opportunities for field truthing. A total of 240 polygons were identified during the Mine Site Catchment mapping process. Forty polygons, a total of 16% of the polygons identified, were field checked during the fieldwork programs consistent with a Terrain Survey Intensity level D (TSIL). Descriptions of the observations at the field truthing sites are presented in Table 6.1 and photographs are presented in Appendix A. The locations of field truthing sites are displayed on Figures 8.1, 8.2 and 8.3. The Terrain and Terrain Stability Mapping for the Main Access Road Corridor was conducted to TSIL Level E that does not require field truthing.

6.2 GEOTECHNICAL SITE INVESTIGATION PROGRAM

Between 2009 and 2010 two site investigation programs were undertaken to investigate the geotechnical foundation and seepage conditions along the proposed tailings embankments and at the sites of the proposed mine site infrastructure, including the plant site, primary crusher, waste dumps, borrow areas and concrete aggregate sources. Groundwater monitoring wells were installed for long term monitoring to support environmental baseline studies. The site investigation programs consisted of site reconnaissance, drillholes, in-situ hydraulic conductivity testing, monitoring well installations, well development, test pits, vibracore drillholes and collection of rock and overburden materials for laboratory testing.

The 2009 geotechnical site investigation program was conducted from June 10 to September 26, 2009 and included 22 geotechnical drillholes (K09-01GT to K09-22GT) and nineteen test pit excavations (TP09-01 to TP09-19). The 2010 geotechnical site investigation program was conducted from July 1 to August 23, 2010, and included 25 geotechnical drillholes (KP10-01GT to KP10-25GT), seventy vibracore drillholes (VC10-01 to VC10-70) and four test pit excavations (TP10-01 to TP10-04). The locations of drillholes, test pits and vibracore locations sites are displayed on Figures 8.1, 8.2 and 8.3.

SECTION 7.0 - SITE HISTORY

The Kitsault deposit was first staked in 1911 and early stage investigations focused on a polymetallic vein, located to the southeast of the current Molybdenum deposit. Exploration continued on the Project in the 1920s and early 1930s. In 1964 Kennco Exploration (Western) Limited (KEL) discovered an ore body containing 36 million tonnes averaging 0.138% Mo (0.23% MoS_2). Construction of the Kitsault Mine began soon after. KEL commenced mining the property in 1968 and approximately 9.3 million tonnes of ore was produced with about 22.9 million pounds of Molybdenum being recovered until mining ceased in 1972 due to low metal prices. Climax Molybdenum Company of British Columbia purchased the property in 1973 and recommenced production in 1981. Mining was again halted because of low metal prices in 1982. Approximately 30 million lbs of Molybdenum were produced during these two periods of mining (BC MINFILE Report number 103P 120, Natural Resources Canada). Avanti Kitsault Mine Ltd. (Avanti) acquired the Kitsault Property in October 2008 and re-activated engineering and environmental work for the Project.

The historical mine workings at the Kitsault deposit in the 1970s to early 1980s have left behind an open pit shell, the Patsy and Clary waste dumps, an abandoned town (Kitsault Townsite) and mine access roads and trails. All other mining infrastructure was removed upon decommissioning and the site was partially reclaimed. During the initial mining period between 1967 and 1972, a transmission line was built to provide power to the Mine Site. The Kitsault Townsite was constructed during the later mining operation; the townsite is currently abandoned except for caretakers. The Main Access Road was built between 1980 and 1982 during the second period of mining.

Air Photo Interpretation (API) of the site has not revealed any significant logging of the area. All land disruption has been the result of past mining activities.

SECTION 8.0 - RECONNAISSANCE TERRAIN AND TERRAIN STABILITY MAPS

8.1 TERRAIN MAPS

The terrain maps were prepared in accordance with the Terrain Classification System for British Columbia, as detailed in Howes and Kenk (1997). The maps were developed from the API with the aid of the slope angle map, supplemented by the findings of the fieldwork. The terrain units were identified based upon the morphology, the presence and nature of soil or rock exposures, as well as vegetation associations. Landslides are described as either 'recent' or 'ancient'. The former are assessed to have occurred during the time frame of the air photo record and the latter were assessed to pre-date it.

Reconnaissance Terrain and Terrain Stability Maps (RTSM) were prepared for the Mine Site Catchments at a scale of 1:15,000, incorporating field truthing to Terrain Survey Intensity Level 'D', according to *MATS*, 1999. In the fieldwork, approximately 16% of the polygons were ground-checked. Terrain Maps for the Mine Site are presented on Figures 8.1, 8.2 and 8.3.

Reconnaissance Terrain and Terrain Stability Maps for the Main Access Road Corridor were prepared at a scale of 1:25,000, incorporating mapping to Terrain Survey Intensity Level 'E' according to *MATS*, 1999. The published terrain mapping by Kowall R. and Daykin P., 1981 and Vold T. Kowall R. and Daykin P., 1981 was used as a starting point. These polygons were refined and additional polygons were added during the API assessment; no field truthing was undertaken. Terrain Maps for the Main Access Road are presented on Figures 8.4 through 8.9.

8.2 TERRAIN STABILITY MAPS

Terrain stability refers to the likelihood of a landslide initiating in a terrain polygon following road construction activities and timber harvesting. Terrain stability class criteria were developed for the Study Area.

Three terrain stability classes were used:

- *Stable* (S) – Identified as terrain with a 'negligible' to 'low' likelihood of landslide initiation following road construction and timber harvesting
- *Potentially unstable* (P) – Expected to contain areas with a 'moderate' likelihood of landslide initiation following road construction and timber harvesting, and
- *Unstable* (U) – Expected to contain areas where there is a 'high' likelihood of landslide initiation following road construction and timber harvesting.

A 'moderate' likelihood of landslide occurrence is representative of approximately a 10% to 30% annual probability along a one km-long section of road alignment, assuming side-cast construction practices. A 'high' likelihood translates to an annual probability in excess of 30%.

Terrain stability was evaluated based on the slope angle map, the surficial geology classification and the presence of gullied terrain. A table of terrain stability classification criteria is presented in Table 8.1. A large proportion of the mine site is mapped as anthropogenic material from previous mine workings and has not therefore been considered as part of the terrain stability mapping.

SECTION 9.0 - FINDINGS

9.1 GEOLOGICAL MODEL

The field truthing and geotechnical site investigation programs confirmed that the bedrock in the Mine Site Catchments and along the Main Access Road Corridor generally comprises the Bowser Lake Group greywacke and argillite sedimentary rocks overlain in places by trachyandesite lava flows.

The surficial deposits and present day geomorphology at the site were influenced by a series of glaciations, which occurred during the Pleistocene Epoch. An ice sheet completely covered the area during this epoch, resulting in the formation of concave slope profiles. The sea level was 200 m higher than present, leaving little glacial deposits behind. Deglaciation, and the subsequent decay of plant material, led to the development of organic swamps on gently sloping areas near the heads of drainage lines. Colluvium accumulated on the mountain slopes as a result of gravity-induced slope movement, in the form of rock fall and debris slides. Fluvial deposits, predominantly comprising sands, gravels and cobbles, are found along the active fluvial channels.

9.2 RECONNAISSANCE TERRAIN MAPPING

9.2.1 Mine Site

The Terrain Maps for the Mine Site Study Area are presented on Figures 8.1, 8.2 and 8.3, photographs are provided in Appendix A.

The field truthing and geotechnical drilling investigations generally confirmed the published geology for the area. Bedrock outcrops are common throughout the study area. There is a veneer or blanket of organic deposits overlying hummocky bedrock in many areas (Photos 1 and 4). Slope gradients within the Mine Site are predominantly gentle (6 - 26%) to moderately inclined slopes (27 – 49%). These slopes are commonly broken by moderately steep (50 – 70%) slopes. The hummocky topography with small swamp covered benches is intermittently broken by deeply incised gullies. Patsy and Lime Creeks have cut steep sided gullies into the basement bedrock. Several rock slides have been identified on the steep slopes adjacent to Lime Creek (Photos 12, 13 and 14).

The organic swamps commonly consist of the accumulated remains of mosses, sedges and other vegetation. These swamp deposits are generally saturated and poorly drained forming shallow ponds and lakes (Photo 4). Thicker organic deposits were found in vibracore drillholes along the North-eastern Tailings embankment alignment and test pits east (upslope) of the Clary Waste Dump (Photos 2 and 3).

Field truthing and drilling also confirmed the presence of a thick plateau of trachyandesite lava flows directly north of the Open Pit (Photo 15). Rock fall talus deposits are found along the base of the columnar jointed cliff faces and were formed as a result of cliff erosion and rock falls (Photos 16 and 19). The tops of the lava flows are on gently inclined slopes (6 – 26%) and covered with a veneer of organic deposits (Photos 17 and 18).

A veneer of colluvium is often found on moderate (27 – 49%) to moderately steep (50 – 70%) slopes, particularly around the margins of the lava plateau, and generally becomes thicker towards the toes of slopes (Photos 5, 6 and 7). The colluvium is expected to be very thin or absent on the hillside spurs and on the upper hill slopes (Photo 9).

Fluvial deposits found along the active fluvial channels predominantly comprise of sands, gravels, and cobbles (Photo 11).

East and north-west of the existing open pit, thick blankets of anthropogenic mine waste were encountered during field truthing and investigated further during the drilling programs (Photos 28, 29, 30, 31 and 32). Waste rock from mine workings has been side cast in Patsy and Clary Waste Dumps forming tall steep slopes beside the open pit and upstream along Patsy Creek (Photo 29). Debris slides in this anthropogenic mine waste rock material are common in the steep side slopes along Patsy Creek due to creek undercutting at the toes of the slopes.

9.2.1.1 Tailings Management Facility (TMF)

The South and Northeast TMF Embankments are strategically located to optimize the natural topography. The South TMF Embankment foundation conditions are characterized by a veneer of colluvium on moderately steep (50 – 70%) to steep (>70%) side slopes in a deeply incised V-shaped valley. The end of the anthropogenic Patsy Waste Dump is located on the right (north) abutment of the proposed TMF embankment close to the valley bottom. The waste rock is anticipated to be approximately 10 m thick based on drillholes K10-05GT, K10-04GT and K09-15GT. Fluvial deposits were mapped on the valley floor in the vicinity of the proposed eastern toe of the embankment.

The proposed area for tailings deposition is also characterized by a veneer to blanket of organic deposits overlying an undulating bedrock surface with plain (0 - 5%) to gentle (6 - 26%) slopes. On the eastern side of the TMF area is a deeply incised drainage line that connects with Patsy Creek. This area is characterized by moderate (27 - 49%) to moderately steep (50 - 70%) slopes with a colluvial veneer overlying bedrock.

The site is characterized by a veneer to blanket of organic deposits overlying an undulating bedrock surface with plain (0 - 5%) to gentle (6 - 26%) slopes. The thickness of the organic peat deposits was investigated during the site investigation program using a portable vibracore drilling technique. The organic deposits were found to be between 1 and 13 m thick. Drillholes K10-18GT, K10-17GT, K10-16GT and K10-15A, which were drilled along the TMF embankment alignment, found 0 to 5 m thick organic deposits overlying bedrock. Trachyandesite lava flows are located downstream at the western end of the embankment. The contact between the lava flow and the underlying basement bedrock was investigated in drillhole K10-14GT and found to be at 46 m depth (elevation 830 m). Rock falls from the lava flow cliffs have deposited talus at the toe of the slope (Photo 16).

9.2.1.2 Waste Rock Management Facility

The Waste Rock Management Facility (WRMF) is to be located between the South Embankment of the TMF and the Open Pit. This location also overlies the existing historic Patsy Waste Dump in an incised valley. Drillholes K10-05GT and K10-06GT encountered loose to compact anthropogenic waste rock to between 10 m and 20 m depth, thickening down slope towards the Open Pit. Debris slides in this loose anthropogenic mine waste rock material have occurred in the steep side slopes along Patsy Waste Dump due to stream undercutting.

9.2.1.3 Primary Crusher

The proposed Primary Crusher site is located on the historic Clary Waste Dump at the north end of the existing Open Pit. There is approximately 10 m of loose anthropogenic rockfill (found in drillhole K10-01GT) overlying competent basement bedrock at the site.

9.2.1.4 Truckshop, Warehouse and Fuel Storage

The proposed Truckshop, Warehouse and Fuel Storage areas are sited on gentle (6 - 26%) slopes on the existing historic Clary Waste Dump. The surficial cover is predominantly waste rock overlying organic deposits. Some swamps and bogs are located in depressions and poorly drained areas. The contact between the waste rock and the underlying basement bedrock was investigated in Drillholes K09-06GT, K10-02GT, K10-03GT, K10-08GT, K10-10GT, K10-11GT and K10-12GT and was found to be up to 26 m deep.

9.2.1.5 Coarse Ore Stockpile and Conveyor

The Coarse Ore Stockpile (COS) is to be located west of the Plant Site on thick columnar trachyandesite lava flows. The site is characterized by a thin veneer of organic deposits overlying a relatively flat bedrock surface. The bedrock is columnar jointed lava. The columnar joints typically have a spacing of approximately 0.5 to 1 m. The COS is to be situated close to the edge of the lava flow plateau. A Conveyor will transport the ore from the Primary Crusher to the COS. The conveyor is proposed to travel approximately 1.4 km with a 290 m elevation change up the sub-vertical cliff face of the lava flow. The columnar jointed cliff has a significant talus slope at its toe, which provides evidence of past rock falls.

9.2.1.6 Low Grade Stockpile

The Low Grade Stockpile (LGS) site is located north of the Truckshop and Warehouse. The surficial geology in the vicinity of the site was predominantly mapped as a veneer of organic deposits overlying plain (0 - 5%) bedrock slopes. Several vibracore drillholes were conducted in this area, and encountered up to 2.4 m of organic deposits. The south-east part of the proposed footprint includes some steep slopes at the margin of the lava flows.

9.2.1.7 Plant Site and Permanent Camp

The Plant Site is located on plains (0 - 5%) and gentle (6 - 26%) slopes. The site is characterized by a veneer of organic deposits overlying the bedrock surface. The bedrock comprises thick columnar jointed lava flows. Drillhole K10-12GT encountered the base of the lava flow at a depth of 118 m.

9.2.2 Main Access Road

The Terrain Maps for the main access road are presented on Figures 8.4 through 8.9, photographs are provided in Appendix A. The Main Access Road from the Nass FSR turnoff to the Mine Site is approximately 64 km long.

The majority of the Main Access Road Corridor follows the Nass River Valley heading north from Nass FSR turnoff (Ch. 0) to approximately Ch. 14+500 at the Nass River Bridge. The road changes to a southerly direction after the bridge, following the Nass River Valley on the east side of the river from approximately Ch. 14+500 to 38+500. The road traverses plains (0 - 5%) and gently inclined slopes (6 – 27%) in this section. The Nass River Valley has undergone extensive glaciation, and at the height of the Pleistocene glacial period thick compact glacial moraine blanket (up to 50 m thick, McCuaig, S. 2003a) was deposited in the deeply carved Nass valley (Photos 35, 36 and 37). The sea level dropped and extensive glaciofluvial meltwater deposits were laid down following the retreat of glacial ice.

The road turns north-west at Kwinatahl Camp and follows the Kwinatahl River along the northern bank, climbing from an elevation of 150 m to an elevation of 850 m. From Ch. 38+500 to 51+000 the road transverses moderate (27 – 49%) to moderately steeply (50 – 70%) inclined slopes, dissected occasionally by gullies. Bedrock typically crops out along the road (Photos 40 and 41) and is frequently covered by a veneer of colluvium, which generally becomes thicker towards the toes of the slopes (Photos 38 and 39).

Once the road crosses the catchment divide, the terrain is characterized by gentle (6 - 26%) to moderately (27 – 49%) inclined slopes (approximately Ch. 51+000 to 64+000). Bedrock typically crops out in road cuts and is frequently covered by a veneer of organic deposits (Photo 42). The road meanders between a series of thick lava flow columnar jointed cliffs. Rock fall talus deposits are found occasionally along the bases of these cliff faces.

9.2.2.1 Plant Site Access Road

The Plant Site Access Road is part of the new road system that will extend from the main access road at approximately 58+300 in a south-westerly direction for 3.5 km to the Plant Site and Permanent Camp located on top of the Trachyandesite lava flow of Widdzech Mountain. The road is located on gentle (6 - 26%) slopes with a veneer of organic material overlying basement bedrock from Ch. 0 to Ch. 1+600. The access road climbs the trachyandesite lava flow and talus deposits on moderately steep (50 – 70%) to steep slopes (>70%) from Ch. 1+600 to Ch. 2+000. The road continues over top of the lava flows to the Plant Site on gentle (6 – 26%) to moderate (27 – 49%) slopes with an organic veneer overlying trachyandesite bedrock.

9.2.2.2 South Tailings Pipeline Road

The South Tailings Pipeline Road leaves the Plant Site to access the TMF and South TMF embankment. The road is approximately 1.0 km long. The first 0.5 km of this road alignment is shared with the Crusher Access Road, on gentle (6 - 26%) to moderately steeply inclined (50 to 70%) slopes. The gentle slopes generally have a veneer of organic soils and the moderately steep slopes have a veneer of colluvium.

9.2.2.3 Crusher Access Road

The Crusher Access Road braches from the South Tailings Pipeline Road at Ch. 0+500, heading in a westerly direction to connect the Plant Site to the Primary Crusher. The slopes along the alignment are predominately moderate (27 – 49%) to moderately steep (50 – 70%) with several small sections where the gradient changes to steep (>70%). The surficial geology in the vicinity of the road alignment was predominantly mapped as a blanket of colluvium deposits overlying bedrock.

9.2.3 Snow Avalanche Hazards

The mapping did not highlight any significant snow avalanche paths within the Study Area. Kitsault receives a large amount of snowfall annually, however the topography of the Study Area is not particularly conducive to avalanche formation. Snow avalanches generally occur on terrain with slope angles of 27 to 40 degrees. The predominant slope angle class within the Study Area is gentle (0 – 26% or 4° -15° slope angles) to moderately inclined slopes (27 – 49% or 16° – 26° slope angles). Additionally, the moderately steep inclined slopes (50 - 70% or 27° – 35° slope angles) in the Study Area do not typically have enough length to develop avalanche paths.

9.3 TERRAIN STABILITY MAPPING

9.3.1 Previous Landslides

The majority of the landslides mapped within the Study Area initiated in natural terrain; exceptions to this are slides in anthropogenic waste rock slopes within the area of the previous mine workings and slides in fill slopes at Ch. 40+500, 50+400 and 50+500 of the Main Access Road. A recent debris flow, which initiated on a man-made slope, was mapped just down slope from the current access road to the Clary Waste Dump.

Terrain stability analysis of the anthropogenic soils within the areas of previous mining was not included in this study. This area has been subject to significant changes that are not reflected in the topographic data or indicated on the available air photos.

The natural terrain landslides mapped generally comprised either rock slides in steep gully side slopes or debris flows, which initiated in topographically confined settings and travelled along drainage lines. A ‘recent’ slide was mapped immediately upslope from Ch. 39+300 of the Main Access Road alignment. An ancient debris flow was identified to have crossed the road alignment at Ch. 46+700. Sheet erosion was identified in a gully at Ch. 47+500 along the road alignment. Several rock slides were mapped on the steep side slopes of Lime Creek and one rock slide was mapped in the steep slopes, adjacent to an unnamed drainage line, in the area to the east of the TMF.

There is also a rock fall hazard along the steep cliffs that form the margins of the lava plateau. Mapping of the bedrock cliffs that form the margins of the lava plateau to identify areas of adverse jointing was not included as part of this study. Talus slopes have developed at the toes of the lava flow rock cliffs as a result of rock falls. These talus deposits tend to accumulate at the angle of repose so any undermining of the toe of the slope due to construction could cause instability.

9.3.2 Terrain Stability Classification Scheme

The Terrain Stability Classification Scheme for the Mine Site and Main Access Road corridors is presented in Table 8.1. The terrain stability classification scheme applies to the likelihood of landslide initiation in road slopes, assuming conventional side-cast excavation practice; and to the likelihood of landslides in areas of natural terrain, once stripped of vegetation. It is anticipated that shallow debris slides will be the primary concern due to the relatively shallow depth of overburden on the majority of the site.

The terrain attributes used to identify the ‘potentially unstable’ areas in relation to road construction and timber harvesting is detailed in Table 8.1. The slopes considered least susceptible to instability are generally those proposed in areas of bedrock exposure. The slopes considered most susceptible to landsliding are those in areas of gullied terrain and areas of glacial moraine deposits. A lower-bound natural slope angle of 49% was adopted for ‘potentially unstable’ terrain in these areas. Gullied terrain is particularly susceptible to landslides because there tends to be concentrations of both surface and sub-surface water. The glacial moraine deposits along the Nass valley were laboratory tested in the 2009 site investigation programs. Typical Atterberg limits from laboratory testing found Liquid Limits of between 30 to 50% and Plasticity Limits of 15 to 30%. All of these results plot above the ‘A-line’, establishing the samples to be clays of intermediate plasticity. The stability of such soils can be sensitive to changes in moisture content; to account for this, a lower-bound natural slope angle of 49% was adopted for ‘potentially unstable’ terrain in areas of glacial moraine deposits.

The ‘unstable’ areas in relation to road construction and timber harvesting comprise the sites of recent landslides, as well as steep gully side slopes, either with or without any recent instability.

9.3.3 Mine Site

The Terrain Stability Maps for the Mine Site are presented on Drawings B0001, B0002 and B0003.

9.3.3.1 Tailings Management Facility (TMF)

Part of the South TMF Embankment is proposed to be located in an area of anthropogenic soils, which forms part of the former Patsy Waste Dump. Analysis of the stability of anthropogenic areas is outside the scope of this study. ‘Potentially unstable’ areas were inferred, upslope from the area of anthropogenic soils, as shown on Drawing

B0003. These areas have steep bedrock controlled slopes, locally with a veneer of colluvium.

Minor 'potentially unstable' areas were identified in the proposed footprint for the Northeast TMF Embankment. Larger 'potentially unstable' areas were identified in the steep side slopes of a north-east trending drainage line within the TMF outline. A 'recent' rock slide was observed in the API and mapped as 'unstable' terrain at the furthest eastern section of this gully.

9.3.3.2 Waste Rock Management Facility (WRMF)

The WRMF is located at the southern toe of the South TMF Embankment in an area of anthropogenic soils, which forms part of the former Patsy Waste Dump. Debris slides in anthropogenic mine waste were identified in the steep side slopes of the Patsy Waste Dump. Stream undercutting at meander bends may have been a contributory cause of these landslides. Analysis of the stability of these anthropogenic areas is outside the scope of this study. It is understood that some of the waste material is proposed to be removed prior to construction of the WRMF. 'Potentially unstable' areas were inferred, upslope from the area of anthropogenic soils, as shown on Drawing B0003. These areas have steep bedrock controlled slopes, locally, with a veneer of colluvium.

9.3.3.3 Primary Crusher

The proposed Primary Crusher site is located in an area of anthropogenic soils.

9.3.3.4 Truckshop, Warehouse and Fuel Storage

The proposed Truckshop, Warehouse and Fuel Storage sites are located in an area of anthropogenic soils.

9.3.3.5 Coarse Ore Stockpile (COS) and Conveyor

The COS is to be situated close to the edge of the lava flow plateau. The conveyor is proposed to travel up the cliff face of the lava flow. A section of the conveyor crosses an identified 'potentially unstable' area on the columnar jointed cliff face escarpment and a significant accumulation of talus was identified at the toe of the slope. The talus deposits tend to accumulate at the angle of repose so any undermining of the toe of the slope due to construction could cause instability.

9.3.3.6 Low Grade Stockpile (LGS)

The majority of the LGS is mapped as 'stable'. 'Potentially unstable' areas were identified on the steep side slopes of the columnar jointed cliff face.

9.3.3.7 Plant Site and Permanent Camp

The mapping did not identify any 'potentially unstable' areas in the vicinity of the Plant Site and Permanent Camp.

9.3.4 Main Access Road

The Terrain Stability Maps for the Main Access Road are presented on Drawings B0004, B0005, B0006, B0007, B0008 and B0009. The majority of the access road alignment is located on plain to moderately inclined terrain, which is classified as 'stable' according to the terrain classification scheme. No 'potentially unstable' or 'unstable' areas were identified along the section of the road alignment between the Nass FSR turnoff at Ch. 0 and the Kwinatahl Camp at Ch. 38+500.

The road alignment follows a fluvial plain of a tributary channel of the Nass River between Ch. 0 and Ch. 38+500. This flat lying area may be susceptible to flooding. Analysis of the possible flood hazard in this area is outside the scope of this report.

The road alignment climbs from an elevation of 150 m at Kwinatahl Camp to approximately 850 m at Ch. 50+500. An ancient debris flow was identified to have crossed the road alignment at Ch. 46+700. 'Unstable' areas associated with fill slope failures along the outside of the road were identified at approximately Ch. 40+500, 50+400 and 50+500. 'Unstable' areas were also mapped in a gully with identified sheet erosion at Ch. 47+500 and at Ch. 39+300, where a 'recent' slide was identified immediately upslope from the road. Additionally, several 'potentially unstable' areas were identified in the mapping between Ch. 42+500 and Ch. 47+500, where the road alignment traverses moderately steep side slopes of colluvium.

From Ch. 50+500 to the proposed turnoff at Ch. 58+300 one section of 'potentially unstable' terrain was identified between Ch. 56+100 and 56+400, in an area where the road follows the base of a trachyandesite lava flow. The old access road continues from Ch. 58+300 to Ch. 63+400 and crosses some 'potentiality unstable' areas associated with steep bedrock slopes. An ancient rockfall was identified in the lava flow escarpment on the upslope side of the road alignment at Ch. 59+500. In addition, evidence of some ground displacement has been identified along the road surface in this area. This section of the road will not be in use by the mine once the Plant Site Access Road is complete.

9.3.4.1 Plant Site Access Road

Small sections of 'potentially unstable' terrain were identified between Ch. 1+600 and 2+000 and Ch. 2+500 and 3+100 as the road climbs to the lava flow plateau. No 'unstable' areas were identified.

9.3.4.2 South Tailings Pipeline Road

Only small 'potentially unstable' areas were identified along the South Tailings Pipeline Road. No 'unstable' areas were identified.

9.3.4.3 Crusher Access Road

The terrain along the Crusher Access Road alignment predominately comprises moderate to moderately steep slopes of colluvium with several small sections where the gradient changes to steep. The majority of the road is mapped as 'potentially unstable' from Ch. 0+500 to 1+500.

SECTION 10.0 - CONCLUSIONS AND RECOMMENDATIONS

10.1 GENERAL

Reconnaissance Terrain and Terrain Stability Mapping (RSTM) have been undertaken for the catchment areas of the proposed mine infrastructure and the Main Access Road for the Kitsault Project.

The Mine Site is predominately hummocky bedrock that is frequently covered by a mantle or veneer of organic deposits. The gentle to moderate slopes are intermittently broken with deeply incised gullies. Thick lava flows were found directly north of the Open Pit. Rock fall talus deposits are found along the base of the columnar jointed lava flow escarpment, which formed as a result of cliff erosion and rock falls. The tops of the lava flows are flat and generally covered with a veneer of organic deposits. A veneer of colluvium is generally found on moderate (27 – 49%) to moderately steep (50 – 70%) slopes within the Study Area. East and North-west of the open pit, a thick blanket of anthropogenic soils was side cast in the Patsy and Clary Waste Dumps during the previous mining operations.

The Main Access Road Corridor can be divided into two sections; the Nass River Valley Section (Ch. 0 to 38+500) and the westerly section (Ch. 38+500 to 64+000). The majority of the Nass River Valley section follows gentle (6% to 26%) slopes on a thick blanket of glaciofluvial deposits and glacial moraine deposits. The westerly section follows moderate (27% to 49%) to moderately steep (50 – 70%) slopes that are intermittently broken with gullies. Bedrock typically crops out along this section of the road and is frequently covered by a veneer of colluvium, which generally becomes thicker towards the toes of the slopes.

The mapping did not highlight any significant snow avalanche paths within the Study Area.

10.2 MINE SITE TERRAIN STABILITY MAPPING

The Mine Site was mapped to a TSIL 'D' with approximately 16% of the Mine Site polygons being field checked. The availability of LiDAR contour base maps and recent air photography for the Mine Site facilitated the delineation of certain features of significance to the terrain stability, such as gullies and talus slopes and the current extent of anthropogenic areas. It also facilitated a higher level of resolution of the areas of 'potentially unstable' terrain. Factors detracting from the accuracy of the mapping are the difficulties of mapping through dense forest cover and the limited soil exposures away from the roads and streams.

The terrain stability mapping generally indicated a 'low' likelihood of landslide occurrence at the Mine Site and in the vicinity of the proposed Mine Site Infrastructure. There is moderately steep to steep gullied terrain adjacent to Lime and Patsy Creeks, resulting, locally, in a 'moderate' to 'high' likelihood of landslide occurrence. No mine site infrastructure is proposed in these areas. The COS and Conveyor are proposed to be located close to the lava flow escarpment, which has been assessed to be 'potentially unstable'.

10.3 ACCESS ROAD TERRAIN STABILITY MAPPING

The Main Access Road was mapped to TSIL 'E' without field proofing of the polygons. The 1:20,000-scale TRIM maps with 20 m contours were available as contour base maps. The availability of 'recent' air photography for the Main Access Road facilitated the delineation of certain features of significance to the terrain stability, such as gullies and talus slopes and the occurrence of recent landslides on the road alignment. Factors detracting from the accuracy of the mapping are the difficulties of mapping through dense forest cover, and the relatively 'coarse' nature to the topographic base maps, with 20 m contours.

The terrain stability mapping indicated there to be a 'low' likelihood of landslide occurrence along the majority of the road alignments. Along the Main Access Road alignment, several 'unstable' areas, associated with the sites of 'recent' landslides, were identified to the west of Ch. 38+500. 'Potentially unstable' terrain was identified between Ch. 42+500 and Ch. 47+600 of the Main Access Road alignment. It was also identified along portions of the road alignments within the mine site, in particular between Ch. 0+500 and 1+500 of the Crusher Access Road.

10.4 FURTHER WORK

Recommendations coming out of the study are provided under a separate cover: Reconnaissance Terrain and Terrain Stability Mapping Report – Recommendations for further work (Ref. No. VA11-01064, dated July 8, 2011).

SECTION 11.0 - REFERENCES

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SECTION 12.0 - CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

Prepared: Speed

Josie Speed, M.Sc
Project Geotechnical Specialist

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TABLE 6.1

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

FIELD TRUTHING LOCATIONS

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Field Truthing Location	Description	Photo # Appendix A
2009 FIELD TRUTHING LOCATIONS		
7-21-001	Bowser Lake Group bedrock exposed in the gully overlaid with colluvium veneer	
7-21-002	Bowser Lake Group bedrock exposed in the steep section of slope overlaid with colluvium veneer	
7-21-003	Colluvium veneer overlying exposed Bowser Lake Group bedrock exposed in the steep section of slope	Photo 7
7-21-004	Bowser Lake Group bedrock exposed in the gully overlaid with colluvium veneer	
7-21-005	Bowser Lake Group bedrock exposed in small outcrop overlaid with a colluvium veneer	Photo 6
7-21-006	fine grained sand and gravel Glaciofluvial deposits on a plain terrace, seen in over turned tree roots	
7-21-007	fine grained sand and gravel Glaciofluvial deposits on a plain terrace, seen in over turned tree roots	
7-21-008	fine grained sand and gravel Glaciofluvial deposits on a plain terrace. Edge of deposit before it transitions into colluvium.	
7-21-009	Bowser Lake Group bedrock exposed in the gully overlaid with colluvium veneer	
7-21-010	Anthropogenic material of Kitsault township with fine grained sand and gravel Glaciofluvial deposits overlying Bowser Lake Group bedrock which occasionally outcrops in road cuts.	
7-21-011	Anthropogenic material of Kitsault township with fine grained sand and gravel Glaciofluvial deposits overlying Bowser Lake Group bedrock which occasionally outcrops in road cuts.	Photo 33
7-21-012	Anthropogenic material of Kitsault township with fine grained sand and gravel Glaciofluvial deposits overlying Bowser Lake Group bedrock which occasionally outcrops in road cuts.	
7-21-013	sand and gravel fluvial fan at coastline of Alice Arm	
7-22-014	Bowser Lake Group bedrock outcrop on shoreline of Alice Arm with fluvial fan deposits	Photo 22
7-22-015	Road cut 8 m high of finely layered sand and gravel Glaciofluvial deposits	Photo 23
7-22-016	Sand and gravel Glaciofluvial deposits on a moderately steep slope	
7-22-017	Sand and gravel Glaciofluvial deposits on a moderately steep slope	
7-22-018	Bowser Lake Group bedrock outcrop overlaid by thick sand and gravel Glaciofluvial deposits on a moderately steep slope	
7-22-019	Sand and gravel Glaciofluvial deposits on a moderately steep slope	
7-22-020	Sand and gravel Glaciofluvial deposits on a moderately steep slope	
7-22-021	fine grained sand and gravel Glaciofluvial deposits on a plain terrace, seen in over turned tree roots	Photo 26
7-22-022	fine grained sand and gravel Glaciofluvial deposits on moderately steep slope	Photo 24
7-24-023	fine grained sand and gravel Glaciofluvial deposits on a plain terrace, seen in small slope failures	Photo 27
7-24-024	fine grained sand and gravel Glaciofluvial deposits on a plain terrace, seen in small slope failures	Photo 25
7-25-025	Active fluvial creek with, fluvial sand and boulders in creek bed	
7-25-026	Rock slide along Lime Creek with Kitsault Township in background. Debris slide approx. 15 m wide x 30 m long x 1 m deep)	Photo 12
7-25-027	Rock slide, failure in sub-vertical cliff face of Bowser Lake Group bedrock (approx. 15 m wide x 30 m long x 1 m deep)	Photo 13
7-25-028	Rock slide, failure in sub-vertical cliff face of Bowser Lake Group bedrock (approx. 10 m wide x 30 m long x 1 m deep)	Photo 14
7-25-029	Sub-vertical cliff faces of Bowser Lake Group layered bedrock	
7-25-030	Debris slide, failure in sub-vertical cliff faces of Bowser Lake Group bedrock (approx. 10 m wide x 30 m long x 1 m deep)	
7-25-031	Debris slide, failure in sub-vertical cliff faces of Bowser Lake Group bedrock (approx. 10 m wide x 30 m long x 1 m deep)	
2010 FIELD TRUTHING LOCATIONS		
6-17-032	Bowser Lake Group bedrock in road cut	
6-17-033	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-17-034	Trachyandesite lava flow cliff face 10 m high	
6-17-035	Trachyandesite lava flow cliff face two benches 15 m high in total	
6-17-036	Trachyandesite lava flow cliff face 10 m high	
6-17-037	Trachyandesite lava flow cliff face 10 m high, unraveling	
6-17-038	Contact between Trachyandesite lava flow and Bowser Lake Group bedrock	
6-17-039	Contact between Trachyandesite lava flow and Bowser Lake Group bedrock	
6-18-040	Trachyandesite lava flow plateau with organic veneer	
6-18-041	Trachyandesite lava flow plateau with organic veneer, lava exposed on surface in places	Photo 18
6-18-042	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-043	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-044	Organics	
6-18-045	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-18-046	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-18-047	Organic veneer overlying hummocky Bowser Lake Group bedrock	

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TABLE 6.1

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FIELD TRUTHING LOCATIONS

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Field Truthing Location	Description	Photo # Appendix A
6-18-048	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-049	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-050	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-051	Organic veneer overlying hummocky Bowser Lake Group bedrock	Photo 8
6-18-052	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-053	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-18-054	Anthropogenic material sand and gravel in historic waste dump (Clary Waste Dump)	
6-19-055	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-056	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-057	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-058	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-059	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-060	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-061	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-062	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-063	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-064	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-065	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-066	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-067	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-068	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-069	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-19-070	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-20-071	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-20-072	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-20-073	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	Photo 16
6-20-074	Trachyandesite lava flow cliff face 10 m high with toppling failures	Photo 19
6-20-075	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-20-076	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-20-077	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-20-078	Trachyandesite lava flow cliff face 10 m high with colluvium and organics getting thicker	
6-20-079	Trachyandesite lava flow cliff face 10 m high with colluvium and organics getting thicker	
6-20-080	Trachyandesite lava flow cliff face 10 m high with colluvium and organics getting thicker	
6-20-081	Trachyandesite lava flow plateau with organic veneer getting thicker in drainage gully	
6-20-082	Trachyandesite lava flow cliff face 10 m high with colluvium and organics getting thicker	
6-20-083	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-20-084	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-20-085	Organic veneer overlying hummocky Bowser Lake Group bedrock	Photo 4
6-20-086	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-20-087	Colluvium veneer on moderately steep slopes overlying bedrock	
6-20-088	Colluvium veneer on moderately steep slopes overlying bedrock	
6-20-089	Colluvium veneer on moderately steep slopes overlying bedrock	
6-23-090	Trachyandesite lava flow plateau with organic veneer	Photo 17
6-23-091	Trachyandesite lava flow plateau with organic veneer, at 80 m cliff edge with talus deposits below	Photo 15
6-23-092	Trachyandesite lava flow cliff face >40 m high with talus deposits below the cliff face	
6-23-093	Trachyandesite lava flow cliff face 20 m high with talus deposits below the cliff face	
6-23-094	Trachyandesite lava flow cliff face 10 m high with talus deposits below the cliff face	
6-23-095	Trachyandesite lava flow cliff face 20 m high with talus deposits below the cliff face	
6-23-096	Trachyandesite lava flow cliff face 20 m high with talus deposits below the cliff face	
6-23-097	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-23-098	Layered Bowser Lake Group bedrock exposed in 20 m cliff faces in Lime Creek	
6-23-099	Layered Bowser Lake Group bedrock exposed in 20 m cliff faces in Lime Creek	
6-23-100	Layered Bowser Lake Group bedrock exposed in 20 m cliff faces in Lime Creek	
6-27-101	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-27-102	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-27-103	Bowser Lake Group exposed in cliff face 6 m high	Photo 10
6-27-104	Organic veneer overlying hummocky Bowser Lake Group bedrock	

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TABLE 6.1

AVANTI KITSAULT MINE LTD.
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FIELD TRUTHING LOCATIONS

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Field Truthing Location	Description	Photo # Appendix A
6-27-105	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-27-106	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-27-107	Organic veneer overlying hummocky Bowser Lake Group bedrock	
6-29-108	Bowser Lake Group massive greywacke in road cut	
6-29-109	Contact between Trachyandesite lava flow and Bowser Lake Group bedrock	
6-29-110	Vesicular trachyandesite lava flow that is weak and fractured causing rockslide on access road. The road has been repaired several times.	
6-29-111	Trachyandesite lava flow in road cut	
6-29-112	Trachyandesite lava flow in road cut	
6-29-113	Trachyandesite lava flow in road cut	
6-29-114	Bowser Lake Group bedrock in road cut	
6-29-115	Bowser Lake Group massive greywacke in road cut	
6-29-116	Bowser Lake Group bedrock in road cut, with colluvium veneer	
6-29-117	Bowser Lake Group bedrock in road cut, with colluvium veneer	
6-29-118	Bowser Lake Group bedrock in road cut, with colluvium veneer	
7-02-119	Blanket organic materials	Photo 1
7-02-120	Colluvium veneer in drainage gully overlying bedrock	Photo 5
7-02-121	Organic veneer overlying hummocky Bowser Lake Group bedrock	Photo 9
7-02-122	Bowser Lake Group bedrock exposed in confluence of Lime Creek and Pasty Creek	Photo 11
7-02-123	Blanket organic materials, test pit TP09-02 and TP09-03	Photos 2 + 3
7-02-124	Anthropogenic material, debris slides in waste rock material from Patsy Waste Dump at confluence of Lime Creek and Pasty Creek	Photo 29
7-02-125	Anthropogenic material of historic open pit	Photo 28
7-02-126	Anthropogenic material of historic Patsy Waste Dump	Photo 30
7-02-127	Anthropogenic material of historic Patsy Waste Dump, test pit TP10-D	Photo 31
7-02-128	Anthropogenic material of historic Clary Waste Dump	
7-02-129	Anthropogenic material of historic mine site access roads	Photo 32
7-02-130	Bowser Lake Group bedrock exposed in road cuts overlaid with colluvium veneer	
7-02-131	Bowser Lake Group bedrock exposed in road cuts overlaid with colluvium veneer	

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0	08JULY' 11	ISSUED WITH REPORT VA101-343/9-2	JS	JH	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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TABLE 8.1

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TERRAIN STABILITY CLASSES

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Terrain Stability Class	Landslide Likelihood Upon Construction	Areas
Stable	Negligible to Low	Plains of Fluvial or Glacial Lake Deposits.
		Gentle to moderate (5 to 49%) slopes comprising Morainal Deposits.
		Gentle to moderately steep (5 to 60%) well-drained slopes comprising Colluvium and glaciofluvial sand and gravel.
		Gentle to Moderately Steep (5% to 70%) Bedrock slopes.
Potentially Unstable	Moderate	Moderately Steep (> 49%), moderately well-drained slopes in Morainal Deposits.
		Moderately Steep (> 49%) Gullied Terrain.
		Steep (> 60%), well-drained hill slopes, predominantly comprising Colluvium, without Recent Landslides or Glaciofluvial sand and gravels.
		Steep (> 70%) Bedrock slopes.
Unstable	High	Sites of Recent Landslides. Steep (>70%) Gullied Terrain

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REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'11	ISSUED WITH REPORT VA101-343/9	JS	JEH	GLS