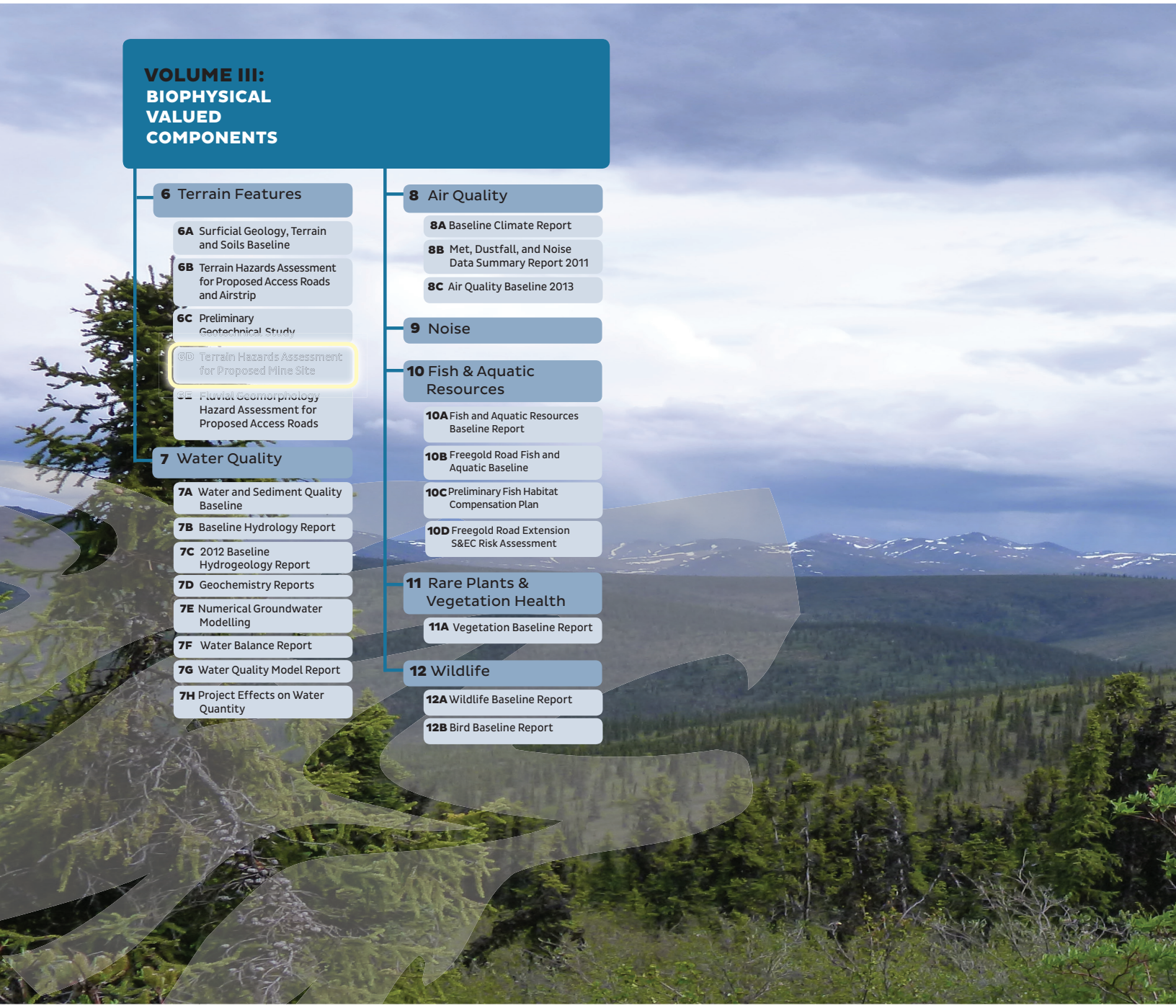
APPENDIX 6D: TERRAIN HAZARDS ASSESSMENT FOR PROPOSED MINE SITE



CASINO MINING CORPORATION
CASINO COPPER-GOLD PROJECT



TERRAIN HAZARDS ASSESSMENT FOR PROPOSED MINE SITE

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OHSAS 18001

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EXECUTIVE SUMMARY

Casino Mining Corporation (CMC) proposes to develop a copper-molybdenum-gold mine at their Casino Property, situated approximately 380 km northwest of Whitehorse, Yukon. The mine is proposed to be an open pit operation with an operating life of 23 years.

Knight Piésold Ltd. (KP) was contracted by CMC to prepare a Project Proposal for the Casino Project for submission to the Yukon Socioeconomic Assessment Board Executive Committee and to provide input to the Feasibility Study design of the project. This report presents the findings of a terrain hazards assessment for the proposed mine site. The terrain hazards assessment incorporated terrain mapping, terrain stability mapping and a preliminary assessment of potentially hazardous permafrost-related features. The report is intended to provide background information pertinent to the planning and design of the proposed mine facilities in addition to providing input to the Project Proposal.

The surficial geology at the mine site was interpreted from Air Photo Interpretation, supplemented by the findings of field truthing and the results of previous geotechnical site investigations. The proposed Plant Site is located on a hill top. A test pitting program, undertaken in this area as part of the 2011 geotechnical site investigation, indicated the bedrock surface is generally 1 to 2 m below ground level. The site of the proposed Open Pit is also in a hill top setting. The bedrock surface is expected to be at relatively shallow depth in the south and central portions of the proposed Open Pit footprint; however, bedrock was encountered significantly deeper (approximately 27 m below ground surface) in a site investigation borehole, undertaken in the north portion of the proposed footprint. The overburden encountered in the borehole comprised an approximately 15 m-thick blanket of silt-rich re-worked loess, overlying colluvium. The proposed stockpiles and Heap Leach Facility are to be sited on gently inclined, Upper Colluvial Slopes. Test pitting undertaken at the sites of the proposed waste rock stockpiles has shown the colluvial soils in these areas to be silt-rich, locally. Extensive colluvial aprons were mapped along the toes of the side slopes of the Casino Creek Valley. These deposits are interpreted to extend across approximately half the footprint area of the proposed Tailings Embankment. The colluvial apron deposits are rich in silt and organic soil. They were encountered to a maximum depth of approximately 23 m in the site investigation boreholes.

The terrain hazards assessment highlights extensive areas of permafrost terrain at the proposed mine site, with a generally shallow (within approximately 1 m of the ground surface) permafrost table. The terrain mapping identified extensive silt-rich soils at the site, in particular, the colluvial aprons at the slope toes along the Casino Creek Valley and local deposits of loess in the upland areas, including the proposed Open Pit site. These soils tend to be ice-rich and include beds of massive ground ice. Beds of massive ground ice, with a thickness of up to approximately 3 m, have been encountered in site investigation boreholes undertaken at the site of the proposed Tailings Embankment. The colluvial

slopes at the sites of the proposed Tailings Embankment, stockpiles and Heap Leach Facility have also been found to be silt and ice-rich, locally.

The colluvial apron deposits are expected to be susceptible to long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice. Significantly, there is a marked variation in the depth the permafrost table was encountered in the test pits, undertaken across the proposed downstream toe of the embankment. As the colluvial apron soils are silt-rich, it is possible that there would be an increased risk of soil piping if the permafrost degrades. There is regional evidence of permafrost degradation as well as occasional evidence within the Study Area of the extent of permafrost degradation being exacerbated by anthropogenic processes. Significant uncertainty can be expected regarding the baseline rate of permafrost degradation and the extent to which it is anticipated to be affected by anthropogenic processes.

The terrain hazards assessment highlighted the occurrence of sheetwash at the site of the proposed Heap Leach Facility and the site of the Eastern Supergene Oxide Ore Stockpile, in the north part of the site. Sheetwash is a process by which fine sediment is transported down slope by surface flow and shallow sub-surface seepage within the active layer. Natural concentrations of surface and sub-surface water flow should be expected locally in areas of sheetwash. Sheetwash may be particularly pronounced at the site of the proposed Heap Leach Facility, where it is interpreted that the presence of a broad 'swale' leads to concentrations of surface run-off and shallow sub-surface seepage flow during the summer months.

The terrain mapping highlighted the widespread occurrence of soils that are rich in silt and organic soil, as well as being ice-rich. These soils, which predominantly comprise colluvial apron and re-worked loess deposits, are expected to be especially prone to erosion and instability, upon disturbance. At the site of the proposed Tailings Embankment, a thaw flow was observed in an area where an access track had been formed on a colluvial apron with a natural slope angle of less than 25%. The erosion potential of such soils is possibly increased by the near surface presence of permafrost. A thick deposit of silt-rich and ice-rich re-worked loess was identified in the north part of the footprint area of the proposed Open Pit, which is expected to be especially prone to erosion and instability, upon disturbance.

A terrain stability classification scheme was developed for the site, incorporating relatively low threshold slope angles for 'potentially unstable' terrain in areas of ice-rich soils – 35% for the Upper and Mid Colluvial Slopes and 20% for the Colluvial Aprons. The terrain stability mapping indicates approximately 13% of the Study Area comprises 'potentially unstable' terrain and less than 0.5% 'unstable' terrain. The terrain stability mapping highlighted areas of 'potentially unstable' terrain and local areas of 'unstable' terrain at the site of the proposed Tailings Embankment, related to the interpreted presence of silt-rich and ice-rich soils. The mapping highlighted widespread areas of 'potentially unstable' terrain and local areas of 'unstable' terrain within the proposed storage area of the Tailings Management Facility. Areas of 'potentially unstable' terrain were identified, locally, at the sites of the proposed Stockpiles and Heap Leach Facility.

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SECTION 1.0 - INTRODUCTION

Casino Mining Corporation (CMC) proposes to develop a copper-molybdenum-gold mine at their Casino Property, situated approximately 380 km northwest of Whitehorse, Yukon (Figure 1). The mine is proposed to be an open pit operation with an operating life of 23 years.

Knight Piésold Ltd. (KP) was contracted by CMC to prepare a Project Proposal for the Casino Project for submission to the Yukon Socioeconomic Assessment Board Executive Committee and to provide input to the Feasibility Study design of the project. This report presents the findings of a terrain hazards assessment for the proposed mine site. The report is intended to provide background information pertinent to the planning and design of the proposed mine facilities, in addition to providing input to the Project Proposal.

The terrain hazards assessment incorporated terrain mapping, terrain stability mapping and a preliminary assessment of potentially hazardous permafrost-related features. The report builds on preliminary terrain mapping undertaken at the site by AECOM. The report has been prepared exclusively for CMC in relation to the proposed Casino Copper-Gold Project.

SECTION 2.0 - SCOPE OF WORK

A Terrain Hazards Assessment was undertaken for the proposed Casino Copper-Gold Project. The Study Area comprises the full upslope catchment areas from the sites of the proposed facilities. The scope of work included Air Photo Interpretation (API), analysing slope angle maps, undertaking field proofing and developing terrain hazards maps for the site. The mapping included terrain mapping based on the Terrain Classification System for British Columbia (Howes and Kenk, 1997), terrain stability mapping, delineation of past landslides and identification of potentially hazardous permafrost features.

The API was undertaken by inspecting 1:20,000 scale colour air photos, taken in September, 2009 with a stereoscope. A slope angle map of the Study Area was prepared from the 5 m LiDAR contours using the *ArcView* Geographic Information System (GIS) software package with the '*3d-Analyst'* extension. The slope angle classes used correspond with those in the Terrain Classification System for British Columbia (Howes and Kenk, 1997). Terrain stability mapping was undertaken by integrating the terrain mapping with the slope angle maps and the corresponding slope aspect.

SECTION 3.0 - SITE AND PROJECT DESCRIPTION

3.1 PHYSIOGRAPHY, DRAINAGE AND VEGETATION

The site is located on the north slopes of the Dawson Mountain Range, within the Klondike Plateau Physiographic Area (Matthews, 1986). As shown in Figure 2, the elevation of the terrain ranges from approximately 1400 m above sea level at the site of the proposed Open Pit, in the northwest part of the Study Area to approximately 700 m above sea level (asl) on the floor of the Casino Creek Valley, in the south part of the Study Area, where it is proposed to construct the Tailings Management Facility (TMF).

The terrain in the Study Area typically comprises broad summits, gentle upper slopes, moderate to moderately steep mid-slopes and gentle colluvial aprons at the slope toes. Regionally, the east-west trending major valleys in the North Dawson Range tend to be asymmetric, with shallower north-facing slopes being the result of enhanced sheetwash and solifluction processes on these 'sheltered' slopes. This pattern does not, however, appear to be repeated in the tributary valleys within the Study Area; in fact, some of the north-facing slopes in the tributary catchments of Casino Creek are markedly steeper than the adjacent south facing slopes, as shown in Figure 2.

The Open Pit and the Plant Site are proposed to be located on hill tops, in the north part of the Study Area, as shown in Photos 1 and 2. The slope angles at the site of the proposed Open Pit are extremely variable due to the previous mining operations. The stockpiles and the Heap Leach Facility are proposed to be sited on the adjacent gently-inclined, south and east-facing, Upper Colluvial Slopes. The Tailings Management Facility (TMF) is proposed to be located in the Casino Creek Valley, as shown in Photo 3 and Figure 2. The proposed facility includes a Saddle Dam, as well as the Main Tailings Embankment, as shown in Figure 2. The valley side slopes are generally moderately inclined with gentle colluvial aprons at the toes of the valleys. The side slopes are moderately steep locally. There is a particularly extensive area of moderately steep terrain in a tributary valley, on the east side of the proposed footprint area of the TMF, as shown in Figure 2. At the site of the proposed Tailings Embankment, the side slopes are generally moderately inclined with gentle colluvial aprons at the slope toes, although the natural slopes are moderately steep, locally, particularly on the south side of the valley.

Bedrock outcrops within the Study Area are limited in occurrence, mainly comprising residual knobs (tors) on the hill tops.

The majority of the Study Area lies within the Casino Creek Catchment. Casino Creek flows towards the south, joining Dip Creek, approximately 4 km outside the Study Area. The northwest part of the Study Area lies within the Canadian Creek catchment. Canadian Creek flows in a northerly direction, joining Britannia Creek and the Yukon River.

The Study Area lies within the Boreal Cordilera Ecozone. The terrain tends to support a thick cover of sphagnum moss. The south-facing slopes tend to be better drained than the north-facing slopes and tend to support a mixture of coniferous forest and grassland. Coniferous forests have established locally on the north-facing mid-slopes.

3.2 CLIMATE

The climate of the region is described as cold and semi-arid. The mean annual temperature is between approximately -4 and -8°C and the mean annual precipitation is 300 mm (Smith et al., 2004). The mountainous terrain of central Yukon is prone to thermal inversion (EBA, 2004). This means that the mean annual air temperature is commonly lower in the valley bottoms. This microclimate effect often results in the presence of thicker permafrost on the valley bottoms.

SECTION 4.0 - DESK STUDY

4.1 SITE HISTORY

The history of development at the site was established by undertaking an historic API. Historic air photos were obtained from the National Air Photo Library. The 1949 air photos show an access track had been established along the Britannia Creek Valley to the mine site and placer mining had been undertaken in the upper reaches of Canadian Creek. By 1961, surface exploration had commenced in the hill top area, where the proposed Open Pit is to be located. The extent of the placer mining was extending along Canadian creek towards its confluence with Britannia Creek.

4.2 PUBLISHED GEOLOGY

4.2.1 Bedrock

An extract from the Canadian Geological Survey's published bedrock geology map for the Yukon Territory (Gordey and Makepeace, 2001), is presented in Figure 3.

The bedrock within the Study Area is predominantly mapped as granites of the mid-Cretaceous 'Whitehorse Suite'. Bedrock belonging to the Late Cretaceous to Tertiary Prospector Mountain Suite is mapped locally in the vicinity of the site of the proposed Open Pit. This Formation predominantly comprises granitic rocks and related felsic dykes and locally comprises diorite, gabbro and porphyry. An area of bedrock belonging to the Devonian Nasina Formation is mapped in the proposed footprint area of the Tailings Management Facility. This Formation comprises graphite schist with interspersed marble.

There are no geological faults mapped inside the Study Area. A northeast trending fault is mapped along the Dip Creek Valley, southeast of the Study Area.

4.2.2 Surficial Deposits

Published surficial geology mapping is available for the area to the north of the Study Area (Huscroft, 2002 and Huscroft 2002a). The maps show the slopes in this area to be almost completely covered with surficial deposits with bedrock outcrops being restricted to the hill tops and ridgelines. According to the published geology maps, the mine site lies outside the limits of the previous glaciations. The published mapping shows the hill slopes to be generally covered with a veneer or blanket of colluvium. Lobes of colluvial/eolian deposits are mapped along some of the ephemeral drainage lines. These deposits, referred to as 'muck', are indicated to be primary deposits of eolian fine sand and silt that were re-sedimented and interstratified with organic silts, colluvium and alluvial fans. The published geology map indicates these deposits are more prevalent on the north-facing slopes, where they can be up to approximately 20 m-thick and commonly contain segregated bodies of ice and buried ice wedges.

4.3 PERMAFROST

The site is located within the zone of widespread discontinuous permafrost. Permafrost is 'most prevalent on north-facing slopes and in valley bottoms where thick fine-grained slope toe complexes (interbedded loess, colluvium and peat) and alluvial sediments have accumulated' (Bond and Lipovsky, 2011). In their early terrain mapping work at the mine site, AECOM inferred that permafrost is present close to ground surface within virtually all the summits and ridgelines based on the observation of cryoplanation terraces (erosional steps in bedrock), sorted stone polygons and solifluction lobes. There is an abundance of open-system pingos in the Dawson Range (Bond and Lipovsky, 2011). Most of the pingos have collapse craters, suggesting that their ice cores have thawed. AECOM identified a pingo in their preliminary mapping, which lies within the northeast part of the current Study Area, as shown in Figure 5.

4.4 PREVIOUS MAPPING AND FIELD TRUTHING

Reconnaissance terrain mapping was undertaken for the project by AECOM in 2009. The terrain mapping was undertaken in accordance with the Terrain Classification System for British Columbia (Howes and Kenk, 1997) and was undertaken to Terrain Survey Intensity Level (TSIL) 'C', with approximately 25% of the 2221 polygons being inspected in the field. This previous mapping was reviewed and developed as part of this study. The findings of the field truthing undertaken by AECOM are included in Appendix A and the locations of their field truthing sites are shown on Figure 5.

4.5 PREVIOUS SITE INVESTIGATIONS

Preliminary geotechnical site investigations were undertaken at the site of the Casino Mine Property in 1993 and 1994 (KP, 1995). Approximately one hundred machine-excavated trial trenches were undertaken in 1993, with a further 119 machine-excavated test pits being carried out at the site in 1994. Further geotechnical site investigation work was undertaken in 2010 and 2011. The findings of the 2010 and 2011 geotechnical site investigations are incorporated into the findings of this study. The locations of the test pits and boreholes, undertaken at the site of the proposed Tailings Embankment, are shown on Figure 4.

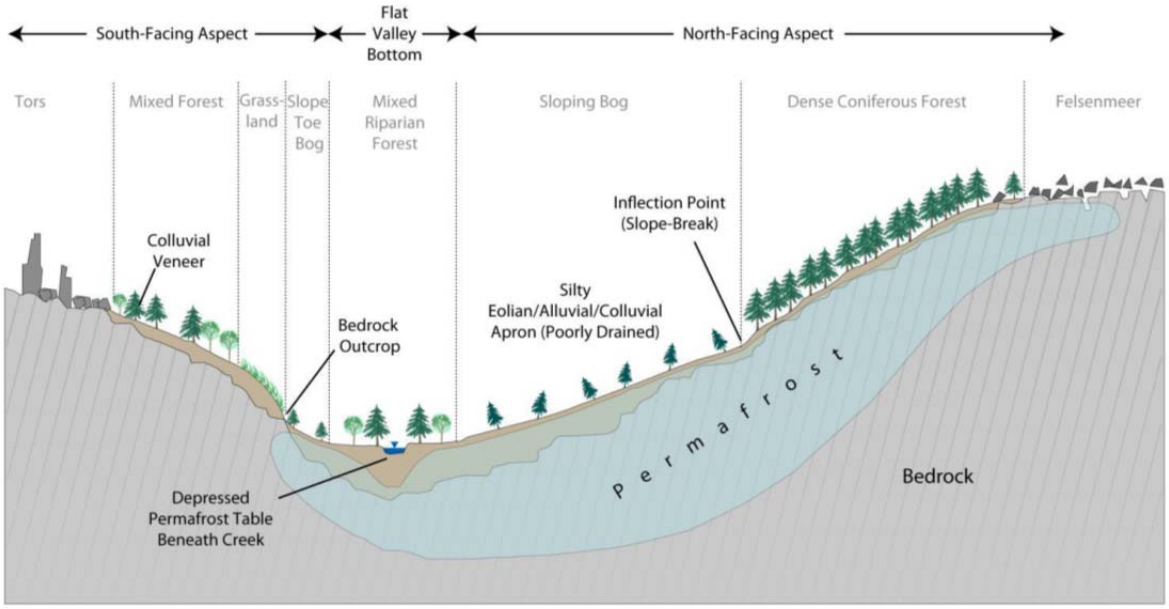
The 1993/94 site investigations indicated the bedrock to be generally overlain by a veneer or blanket of colluvium on the hill slopes and by a blanket of silt-rich colluvium in the aprons at the toes of the valley slopes. Coarse alluvium, comprising sand with some gravel, trace silt and trace cobbles was encountered to the full 5.0 m depth of Test Pit TP 94-61, undertaken adjacent to Casino Creek, at the site of the proposed Tailings Embankment. Particle size analyses indicated the colluvium predominantly comprises well-graded silty sandy gravels with some cobbles and trace clay and the alluvium predominantly comprise poorly-graded gravelly sands with trace silt.

The bedrock surface was generally encountered at depths of approximately 1 to 4 m across the site and was found to be deeper along the drainage lines. The weathering profile also tended to be thicker along the drainage lines. The presence of a deeper weathering profile along the alignment of Canadian Creek is possibly associated with the presence of an east-northeast trending fault zone, which is described in the logs for Trial Trenches 9076A, 9074B and 9063A.

Permafrost was encountered in the majority of the test pits. Permafrost was generally encountered at approximately 0.5 m to 1.5 m-depth, with the deeper areas of permafrost generally occurring in areas of coarse alluvium and at the toes of the south-facing slopes. Test pits TP94-80, 81 and 84, undertaken on gentle slopes at the toes of the valley sides, encountered ice-rich soils in silt-rich colluvial apron deposits. Test Pits TP94-81 and TP94-84 encountered a band of ice at approximately 4.0 m-depth. The band of ice encountered in TP94-81 was approximately 0.5 m-thick. Massive ground ice was also possibly encountered at the base of TP94-80. These 3 test pits were undertaken on the west side of the Casino Creek Valley, several hundred metres downstream from the proposed location of the toe of the Tailings Embankment. Ice-rich soils were also encountered in silt-rich soils in Test Pits TP94-83 and TP94-87, which were also undertaken in the vicinity of the proposed location of the Tailings Embankment. The colluvium was also found to be fine-grained, locally, in the upper part of the Casino Creek Catchment; for example, Test Pits TP94-11 and TP94-5 encountered predominantly silts or sands. These deposits were described in the logs as being 'thaw unstable'. Test Pit 94-5 was carried out close to the toe of the footprint area of one of the proposed stockpiles.

4.6 GEOLOGICAL AND GEOMORPHOLOGICAL MODEL

In their preliminary work on the project, AECOM developed the following geological/geomorphological model for the east-west trending valleys in the vicinity of the site:



This model is consistent with an 'idealized cross-section of the surficial geology across Dip Creek', presented in Bond and Lipovsky, 2011.

The key features of the model are:

- The 'sheltered' north-facing slopes have a shallow permafrost table. Sheetwash and solifluction occur during seasonal melting within the active layer in these slopes and result in colluvial soils

intermixing with organic soils and loess deposits to form poorly-drained colluvial aprons at the toes of the slopes.

- The south-facing slopes have a deeper permafrost table or are free of permafrost. Permafrost-related processes are far less prevalent on these slopes and the surficial soils tend to be better drained.
- There is a depressed permafrost table associated with the main watercourse on the valley floor.
- The valley profile is distinctly asymmetric with shallower slope angles occurring on the north-facing slopes as a result of sheetwash and solifluction.
- Down slope orientated 'stone stripes', distinguished by the presence of mature trees, occur locally on some north-facing mid-colluvial slopes. The stone stripes are characterized by relatively free-draining coarse material that accumulated as a result of periglacial processes. They were interpreted by AECOM to be preferential flow paths for water.
- Tors develop in granite bedrock outcrops on the hill tops as a result of mechanical weathering.

4.7 FISH HABITAT

Provincial watershed fish habitat suitability maps, prepared by the Yukon Placer Mining Secretariat, were examined as part of the Desk Study. The mapping indicates a 'moderate to low suitability' along Dip Creek, as far upstream as the confluence with Casino Creek and a 'Low Suitability' along Casino Creek.

An overview of fisheries values within the Dip Creek/Casino Creek Watershed was provided by Summit Environmental Inc. and is summarized below:

- Juvenile Chinook, juvenile Burbot, and Slimy Sculpin have been captured in Dip Creek with Slimy sculpin being captured 15-20 km further upstream, and
- Arctic Grayling and Slimy Sculpin have been documented in Casino Creek.

SECTION 5.0 - FIELDWORK

5.1 FIELD TRUTHING

Helicopter assisted field truthing of the Study Area was undertaken by KP between August 30 and September 1, 2011. The weather was mainly dry and seasonally mild at the time of the fieldwork. The observations from the field truthing program are summarized in Table 1. Photos from the field truthing are presented in Appendix B.

5.2 2010 AND 2011 SITE INVESTIGATIONS

A total of 40 machine-excavated test pits were undertaken at the TMF Site and Plant Site in August, 2010. The test pit depths generally ranged between 1 and 4 m due to the near surface presence of bedrock or permafrost. A total of nine KPL geotechnical drillholes (DH10-01 to DH10-06, DH10-18 to DH10-20) were undertaken in 2010.

A total of 157 machine-excavated test pits were undertaken at the sites of the proposed waste management facilities in the 2011 site investigation program, 104 in the proposed Tailings management Facility area, 43 in the Heap Leach Facility area and 10 in the Low Grade Ore Stockpiles area. The test pit depths generally ranged between 1 and 7 m due to the near surface presence of bedrock or permafrost. In 2011, a total of seven KPL geotechnical drillholes (DH11-21A, DH11-21B, DH11-22, DH11-23A, DH11-23B, DH11-24, and DH11-25) were undertaken at the Tailings Management Facility site and five drillholes (DH11-29, MW11-1A, MW11-1B, MW11-2A, and MW11-2B) at the Heap Leach Facility site.

SECTION 6.0 - RECONNAISANCE TERRAIN AND TERRAIN STABILITY MAPPING

6.1 TERRAIN MAPPING

Terrain mapping was undertaken based on 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 maps. The terrain units were identified based upon the morphology, the presence and nature of soil or rock exposures, as well as vegetation associations. The terrain mapping was refined, based on the findings of the field truthing. The mapping was conducted to TSIL 'C', requiring over 20% of the terrain polygons to be field truthed. Decile superscripts were sometimes used to describe the relative coverage of the various components in multiple component polygons. In areas of weathered bedrock (D) and colluvium (C), particularly blocky areas, where the ground surface is dominated by angular boulders, were described as subtypes D1 and D2, respectively.

Landslides are described as either 'recent' or 'ancient'. 'Recent' landslides are devoid of vegetation, partly re-vegetated or re-vegetated with pioneer species, only. 'Ancient' landslides are completely re-vegetated. The terrain mapping was refined based on the findings of the field truthing.

6.2 TERRAIN STABILITY MAPPING

The primary objective of the terrain stability mapping was to analyse the terrain stability in relation to the proposed development. 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. Terrain stability was evaluated based on the slope angle, the slope aspect, the surficial geology, the permafrost conditions and the presence of gullied terrain.

Three terrain stability classes were used:

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

SECTION 7.0 - FINDINGS

7.1 GENERAL

The findings of the mapping are presented in Figure 5. The preliminary geological/geomorphological model for the site, as described in Section 4, was developed further in the terrain hazards assessment. The key developments are highlighted below:

- The 2011 site investigation confirmed the bedrock predominantly comprises granite; however schist was encountered in Test Pits TP11-TMF 096, 097 and 099, undertaken at the site of the proposed Saddle Dam.
- It was interpreted that relatively thick deposits of loess have accumulated in local 'sheltered' settings between hill tops, in particular, in the north part of the footprint area of the proposed Open Pit, as shown in Photo 6. Ice-rich silts and sands, interpreted as loess, were encountered to a depth of approximately 15 m below ground level in Drillhole 11-39, undertaken in the 2011 site investigation.
- The silt-rich and ice-rich colluvial apron deposits at the site of the proposed Tailings Embankment were found to extent to depths of as much as 23 m below ground level (Drillhole DH10-04).
- The test pitting highlighted there to be a shallow permafrost table, locally in the south-facing colluvial mid-slopes.
- The sites investigations undertaken at the site of the proposed Tailings Embankment have shown massive ground ice to be present, locally, within the colluvial aprons.
- The site investigations highlighted the presence of a fault zone, aligned along the upper reach of Canadian Creek, which continues in an east-northeast direction across the footprint of the proposed Open Pit. Drillhole DH11-39, encountered bedrock at about 30 m depth and the deep weathering profile in this drillhole is possibly related to the presence of the fault. Trial trenches 9076-A and 9074 B, which were undertaken adjacent to Canadian Creek in the 1990's encountered a fault zone as did Trial Trench 9063-A, undertaken further to the east along the same alignment.

7.2 TERRAIN UNITS

7.2.1 Summits and Ridgelines

Summits and ridges are present in the north part of the Study Area. Patton Hill forms a prominent feature in the northwest part of the Study Area, at the southern margin of the footprint of the proposed Open Pit (Figure 5). Another hill top occurs within the footprint area of the proposed Open Pit. The Plant Site is proposed to be located on a hill top in the central portion of the Study Area.

The summits and ridgelines are generally broad and rounded. The test pits, undertaken in these areas as part of the geotechnical site investigations, indicated the bedrock surface to generally be approximately 1 to 2 m below ground level. In the test pits undertaken along the ridgeline, where it is proposed to locate the plant site, the bedrock was found to be overlain by silty sand with trace gravel and cobbles.

Tors occur locally in these settings, as shown in Photo 4. Tors are the remnants of frost-shattered bedrock. The tors are surrounded by blocky weathered bedrock, referred to as

'felsenmeer'. The 'felsenmeer' was found to be several metres-thick at WP 196, located in a road cut at the site of the proposed Open Pit (Photo 5).

7.2.2 Colluvial Slopes (Upper and Mid-slopes)

7.2.2.1 Upper Colluvial Slopes

Four stockpiles, two Non Acid Generating (NAG) Waste Storage Areas and a Heap Leach Facility are proposed to be located on the south and east-facing upper colluvial slopes, in the area to the south and east of the site of the proposed Open Pit (Figure 4). On these upper slopes, angular cobbles and boulders of weathered bedrock are broken into smaller-sized particles by weathering. Wind-blown loess deposits were identified locally on the upper slopes (WP 199, Photo 7). The loess comprises silt and fine sand. Organic soils develop from the decomposition of vegetation. The loess and organic soils are locally mixed with the weathering products through cryoturbation, forming a veneer of colluvium. As the colluvium is transported down slope, the clasts become smaller.

The test pits and trial trenches undertaken on the Upper Colluvial Slopes, at the sites of the proposed facilities, encountered predominantly silty sand with trace to some gravel, cobbles and boulders. Ice-rich sandy silts with trace to some gravel, cobbles and boulders were encountered, locally. Very coarse soils, predominantly comprising cobbles and boulders were encountered in some of the test pits undertaken at the site of the proposed Heap Leach Facility.

7.2.2.2 Mid-Colluvial slopes

The slope angles increase on the mid-slopes, reaching a maximum of approximately 35°. Mid-colluvial slopes comprise the predominant terrain unit at the footprint of the proposed TMF. There are extensive moderately steep (27° to 35°) north-facing colluvial slopes in the east part of the proposed footprint area, as shown in Figure 2. The colluvium tends to form veneers, grading to blankets. The soils tend to be strongly cryoturbated.

The colluvial soils encountered in the test pits undertaken on the valley side slopes at the site of the proposed Tailings Embankment predominantly comprised sandy silts with trace gravel. The colluvial soils on the northwest side of the Casino Creek Valley were found to be coarser in some areas, for example silty sand with some gravel, cobbles and boulders was encountered in Test Pit TP11-TMF087.

7.2.3 Colluvial Aprons (Lower Slopes)

The terrain mapping identified extensive colluvial aprons (Ca) at the toes of the Casino Creek Valley side slopes. A significant proportion of the footprint of the proposed Tailings Embankment is on colluvial apron slopes, as shown on Figure 5. The colluvial soils at the toes of the hill slopes have been intermixed with loess and organic soils. The term 'colluvial apron' is used to describe these deposits, which form a near continuous wedge of sediment at the transition from the hill slopes to the valley bottoms. A prominent concave break of slope marks the transition from the mid-slopes to the colluvial aprons.

The colluvial slopes are sometimes distinguished by streaky flow-like patterns in the air photos. These features are interpreted to be the result of sheetwash, where fine sediment is transported down slope by surface flow and shallow sub-surface seepage. The colluvial aprons consist mainly of sheetwash sediment mixed with re-transported loess and surficial organic soils that have been carried down slope by water seeping above the permafrost table. The colluvial apron soils tend to be silt-rich and ice-rich and soil drainage tends to be very poor to imperfect. The aprons vary in thickness from a few metres to tens of metres (Hushcroft, 2002).

7.2.4 Flood Plains

The first and second order streams in the Study Area tend to have narrow, discontinuous flood plains with only thin veneers of sandy to silty overbank deposits.

7.2.5 Alluvial Channels

The footprint of the proposed Tailings Embankment extends over the 'active' alluvial channel of Casino Creek. Coarse soils, typically comprising sandy gravels with some cobbles, were encountered in test pits undertaken along the alignment of the active channel.

7.2.6 Anthropogenic Soils

There are areas of waste rock from previous mining at the site of the proposed Open Pit. There are also mine tailings along the Canadian Creek/Britannia Creek watercourse from the previous placer mining. The stream gullies that were developed for placer mining have experienced enhanced erosion, resulting in considerable sediment delivery downstream. It is possible that due to the added sediment, the Canadian/Britannia Creek watercourse will be less stable and more prone to flooding and channel erosion and channel re-location.

Additional anthropogenic areas in the Study Area include the existing mine camp and Air Strip, local borrow areas used for access track/road construction and trenches that were excavated to expose bedrock for mapping as part of exploration programs.

7.3 PERMAFROST

7.3.1 Occurrence and Landforms

Permafrost is widespread but discontinuous in the northern Dawson Range (Bond and Lipovsky, 2011). The permafrost-related landforms identified in the Study Area are highlighted in Figure 5. It is interpreted that the permafrost table is generally close to ground level, within the Study Area. The main exceptions are expected to be the lower portions of the south-facing slopes and the areas in close proximity to the watercourses. In terms of the sites of the proposed facilities, the permafrost table was generally encountered at depths of approximately 0.5 to 2.5 m; the main exceptions were the colluvial slopes to the northwest of Casino Creek, where it was found, locally to be at a depth of greater than 4 m and the floor of the Casino Creek Valley, where the depth of the permafrost table was found to increase markedly in a southerly direction in the vicinity of the downstream toe area of the proposed embankment.

The sparse tree cover on the upper slopes, the north-facing slopes and the colluvial aprons is indicative of a generally shallow permafrost table. These areas tend to support a thick mat of sphagnum moss. The sphagnum moss insulates and preserves the permafrost and when it decomposes it forms poorly drained peat, which also helps ice-rich conditions persist. Trees only normally grow in areas where the active layer is thicker than about 1 m.

It is interpreted that extensive fine-grained loess deposits accumulated on some of the upland south-facing slopes in the north part of the Study Area, and were reworked over time, principally by sheetwash. The resulting colluvium in these areas tends to be silt-rich as it was derived principally from loess and is consequently susceptible to a shallow permafrost table with the possibility of massive ground ice. Ice-rich soils were encountered in Trial Trench 9063-B and Test Pit TP 94-5, which were undertaken at the site of one of the proposed stockpiles. Ice-rich soils were also encountered in Drillhole DH11-39 and Trial Trench 9076-D, undertaken at the site of the proposed Open Pit.

The regional occurrence of ice-rich soils in the colluvial aprons has been previously documented (Bond and Lipovsky, 2011). As described in Section 4 of the report, several tests pits undertaken in an earlier site investigation at the site of the proposed Tailings Embankment encountered ice-rich soils, with an approximately 0.5 m-thick band of massive ground ice being encountered at a depth of 4.0 m in Test Pit TP 94-81. Several test pits undertaken on colluvial aprons at the site of the proposed Tailings Embankment as part of the 2011 site investigation also encountered ice-rich soils/ massive ground ice, e.g. TP11-TMF075 and TMF076, TP11-TMF071 and TP11-TMF061, 062 and 063. A band of massive ground ice was encountered between 2.1 m and 5.2 m depth in Drillhole DH11-23A. The site investigations undertaken at the site of the proposed Tailings Embankment have shown the permafrost table to generally be in the range of approximately 0.5 m to 1.5 m below ground level within the colluvial aprons. Significantly, however, there seems to be a marked variation in the depth of the permafrost table across the proposed toe-line of the embankment. Test Pit TP11-TMF028 was terminated at a depth of 0.7 m in frozen silt, whereas, Test Pit TP11-TMF026, undertaken approximately 200 m to the southwest, was terminated at 4.0 m depth in unfrozen clay/silt with some sand.

Test Pit TP 94-61, undertaken adjacent to Casino Creek, at the site of the proposed Tailings Embankment, encountered un-frozen alluvium, comprising sand with some gravel, trace silt and trace cobbles to the full 5.0 m depth of the pit. It was interpreted that the permafrost table is depressed, locally, in the coarse alluvium in the vicinity of Casino Creek.

AECOM previously identified a pingo in the northeast part of the Study Area, as shown in Figure 5.

7.3.2 Permafrost Degradation

A possible thaw lake was identified in the east portion of the footprint area of the proposed Open Pit. A possible thaw flow was identified at WP 211, at the site of the proposed Tailings Embankment**,** as shown in Photo 8. The thaw flow occurred on a colluvial apron with a natural slope angle of approximately 15°. The run-out path of the thaw flow was estimated to be

approximately 500 m-long and coincided with the alignment of a temporary access track. It was interpreted that the vegetation cover had been removed during the construction of the access track, resulting in degradation of the permafrost and the development of a thaw flow. Gully erosion was evident along the run-out path, and was attributed to ongoing thermal erosion.

Extensive thermokarst features, including depressions, thaw lakes as well as possible partially thawed ice wedge polygons associated with an area of polygonal patterned ground have been identified in the vicinity of Dip Creek, several km's south of the Study Area (KP, 2012). In the area where these features were identified, there was no clear association between the degradation of the permafrost and anthropogenic processes.

7.4 SURFACE DRAINAGE

Surface drainage within the Study Area is influenced by the depth of the permafrost table as well as the texture of the surficial soils.

The summits and ridgelines tend to be well-drained. The soils in colluvial slopes tend to be imperfectly drained except on hillside spurs and in areas where the fines content is relatively low and the permafrost table relatively deep, where they tend to be moderately well drained. The colluvial aprons tend to be poorly-drained. The coarse alluvial soils along the Casino Creek watercourse are interpreted to be well-drained.

The occurrence of a shallow permafrost table in the colluvial slopes and aprons results in seasonal shallow seepage flows and overland flows. The sub-surface seepage may be concentrated along flow lines, which would only become apparent during construction when a flow line is intercepted.

7.5 LANDSLIDES

No 'recent' natural terrain landslides were identified within the Study Area. A possible solifluction lobe was identified in the footprint area of the proposed Open Pit, as shown on Figure 5. The solifluction lobe developed on a south-facing slope at an elevation of approximately 1400 m above sea level. The solifluction lobe was encountered in Trial Trenches 9053-C and 9076-D and was found to be approximately 0.35 m to 0.5 m-thick, comprising gravelly sand with some silt.

7.6 TERRAIN STABILITY

The Terrain Stability Classification Scheme for the Study Area is presented in Table 2. The terrain stability classification scheme applies to the likelihood of landslide initiation in road slopes (assuming conventional side-casting) and clear cuts. The classification scheme incorporates slope angle, slope aspect and surficial geology. These were considered to be the key attributes controlling landslide susceptibility, taking account of the findings of a broader study, undertaken for the project access roads (KP, 2012). It is emphasized that the terrain stability classification scheme applies to the likelihood of slope detachments (e.g. slides and flows) as opposed to slope displacements (i.e. soil creep), and that soil creep can be anticipated to occur, locally, at significantly shallower slope angles than slope detachments. Thermal erosion is not incorporated into the classification scheme. Thermal erosion has

been observed to occur in gently sloping ice-rich terrain that is classified as 'stable' in the terrain stability mapping.

The slopes considered least susceptible to instability are generally those proposed in areas of bedrock exposure. The ice-rich colluvial slopes are considered most susceptible to landslides. The terrain attributes for 'potentially unstable' and 'unstable' terrain were established from observations of the conditions under which slope displacements (soil creep, solifluction lobes and soil slumps) and detachments (slides, flows and falls) were observed to have occurred within the Study Area, as well as in the surrounding area (KP 2012).

The terrain stability mapping indicates that approximately 13% of the Study Area comprises 'potentially unstable' terrain and less than 0.5% 'unstable' terrain. The terrain stability mapping highlighted widespread areas of 'potentially unstable' terrain and local areas of 'unstable' terrain at the site of the proposed TMF. Local areas of 'potentially unstable' terrain were identified at the sites of the proposed Stockpiles and Heap Leach Facility. The delineation of 'potentially unstable' and 'unstable' terrain in these areas is based on the inferred presence of ice-rich soils.

7.7 OTHER HAZARDS

7.7.1 Erosion Potential

The terrain mapping highlighted the widespread occurrence of silty and organic soils at the site. These soils occur within the colluvial aprons and also, locally, within the colluvial slopes. Silt and organic soils are especially prone to erosion. Thermal erosion gullies have developed on gentle colluvial aprons, in areas where the terrain was disturbed by the construction of access tracks. The erosion potential is possibly increased by the near surface presence of permafrost and ice-rich soils.

7.7.2 Snow Avalanches

Snow avalanches generally occur on terrain with slope angles of approximately 27 to 40 degrees. The predominant slope angle classes within the Study Area are gentle slopes (6 to 26%, 4° to 15°) and moderate slopes (27% to 49%, 16° to 26°). Nonetheless, a significant proportion of the annual precipitation falls as snow, and the Study Area includes some areas of moderately steep terrain that could be susceptible to snow avalanches.

SECTION 8.0 - ENGINEERING CONSIDERATIONS

8.1 PERMAFROST DEGRADATION

The Study Area includes extensive areas of ice-rich soils, where the permafrost table is commonly within several metres of the ground surface. These areas include high elevation slopes, north-facing colluvial mid-slopes and colluvial aprons. The occurrence of ice-rich soils yields a sensitive construction environment. Permafrost is susceptible to thermal disruption and may thaw. Permafrost degradation can occur both during and after construction, resulting in the possibility of differential settlement of earthworks, slope instability and enhanced erosion and sediment delivery to watercourses. There is regional evidence of non-anthropogenic permafrost degradation (KP, 2012) as well as occasional evidence within the Study Area of the extent of permafrost degradation being exacerbated by anthropogenic processes, in particular, the construction of access tracks. The key objective in such an environment is to maintain a stable permafrost regime; however, some non-anthropogenic permafrost degradation should be anticipated and the extent to which this key objective can be achieved will partly depend upon the relative influences of non-anthropogenic and anthropogenic permafrost degradation. If it is important, therefore, to understand the non-anthropogenic as well as the anthropogenic processes that can lead to permafrost degradation.

8.1.1 Non-Anthropogenic Processes

The presence of thaw lakes, thermokarst depressions and possible partly-thawed ice wedge polygons in areas of natural terrain in the vicinity of the Study Area provide regional evidence of permafrost degradation due to non-anthropogenic processes (KP, 2012).

Some non-anthropogenic processes that could lead to permafrost degradation in the Study Area are considered to be:

- Forest fires initiated by lightning strikes
- Natural terrain landslides
- Natural stream avulsions
- Windthrow, and
- Climate change.

8.1.2 Anthropogenic processes

The presence of a thaw lake, adjacent to an access road at the site of the proposed Open Pit, provides possible local evidence of permafrost degradation due to anthropogenic processes. In addition, a thaw flow was observed on an access track where the vegetation had been stripped at the site of the proposed Tailings Embankment.

Some anthropogenic processes that could lead to permafrost degradation in the Study Area are considered to be:

- Removal of vegetation – the thick layer of sphagnum moss provides effective insulation
- Alteration to surface water drainage
- Creating standing bodies of water that are in direct thermal contact with the surficial soils

- Implementing inadequate road drainage
- Stockpiling or placement of fill
- Uncontrolled placement of Potentially Acid Generating (PAG) Waste – pyrite oxidation is an exothermic reaction
- Stream avulsions resulting from placer mining
- Man-made fires, and
- Climate change.

In all areas of known or suspected ice-rich soil, it will be important to develop design solutions and construction methodologies that mitigate possible permafrost degradation.

8.2 LANDSLIDES AND TERRAIN STABILITY

The terrain hazards assessment identified significant areas of 'potentially unstable' terrain and local areas of 'unstable terrain at the site of the proposed Tailings Embankment, all related to the interpreted presence of silt-rich and ice-rich soils. Areas of 'potentially unstable' terrain were identified, locally, at the sites of the proposed Stockpiles and Heap Leach Facility.

8.3 EROSION POTENTIAL

The terrain mapping highlighted the widespread occurrence of silty and organic soils at the site. Silt and organic soils are especially prone to erosion. The erosion potential of these soils is possibly increased by the near surface presence of permafrost. A thick deposit of silt-rich and ice-rich re-worked loess has been identified in the north part of the footprint of the proposed Open Pit. The soils in this area are expected to be especially prone to erosion and instability, upon disturbance.

8.4 WASTE AND WATER MANAGEMENT

Extensive colluvial aprons have been identified along the toes of the side slopes of the Casino Creek Valley, including a significant proportion of the footprint area of the proposed Tailings Embankment. These deposits are silt-rich and ice-rich and have been shown to contain bands of massive ground ice. The colluvial apron deposits are expected to be susceptible to long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice. Test pitting, undertaken at the sites of the proposed waste rock stockpiles, has shown the upper colluvial slopes in these areas to be silt-rich and ice-rich, locally.

As discussed in EBA (2004), the key potential impacts of thawing permafrost on dam structures and waste impoundment areas are:

- Increased pore water pressure and seepage
- Enhanced settlement with differential settlement being likely
- Increased potential for piping, and
- Increased susceptibility of liquefaction of the foundation soils during an earthquake.

The choice of tailings disposal methodology can be a particularly important consideration in permafrost areas, particularly as it can have implications in relation to permafrost degradation. Particular

consideration will need to be given to the management and encapsulation of Potentially Acid Generating (PAG) waste at the project Tailings Management Facility (TMF) since pyrite oxidation is an exothermic reaction, which could contribute to permafrost degradation.

The surface water management strategies implemented should prevent accumulations of water in the natural terrain adjacent to the proposed facilities in areas of known or suspected ice-rich soils. Ditching at the toes of embankments should be avoided in such areas.

The terrain hazards assessment highlighted the occurrence of sheetwash at the site of the proposed Heap Leach Facility and the site of the eastern Supergene Oxide Ore Stockpile, in the north part of the site. Sheetwash is a process by which fine sediment is transported down slope by surface flow and shallow sub-surface seepage within the active layer. Natural concentrations of surface and sub-surface water flow should be expected, locally, in these areas. Sheetwash may be particularly pronounced at the site of the proposed Heap Leach Facility, where the presence of a broad 'swale' leads to concentration of surface run-off and shallow sub-surface seepage flow during the summer.

An area of bedrock belonging to the Devonian Nasina Formation is mapped within the proposed footprint area of the TMF. This Formation includes interspersed marble, regionally, which, if present at the site of the proposed TSF, could be of significance in relation to seepage considerations. Marble has not been identified in any of the previous site investigation boreholes.

SECTION 9.0 - CONCLUSIONS AND DISCUSSION

A terrain hazards assessment has been undertaken for the proposed Casino Copper-Gold Project. The terrain hazards assessment incorporated terrain mapping, terrain stability mapping and a preliminary assessment of potentially hazardous permafrost-related features.

The terrain mapping was undertaken to Terrain Survey Intensity Level 'C' in relation to BC's terrain mapping scheme (MoF, 1999), with over 20% of the polygons being field truthed. The availability of LiDAR contour base maps and ortho-imagery facilitated the delineation of certain features of significance to the terrain stability such as gullies and solifluction lobes as well as 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 forest cover and the limited soil exposures away from the tracks and streams; also, only one year of air photos was examined.

The surficial geology at the mine site was interpreted from Air Photo Interpretation, supplemented by the findings of field truthing and the results of previous geotechnical site investigations. The proposed Plant Site is located on a hill top. A test pitting program, undertaken in this area as part of the 2011 geotechnical site investigation, indicated the bedrock surface is generally 1 to 2 m below ground level. The site of the proposed Open Pit is also in a hill top setting. The bedrock surface is expected to be at relatively shallow depth in the south and central portions of the proposed Open Pit footprint; however, bedrock was encountered significantly deeper (approximately 27 m below ground surface) in a site investigation borehole, undertaken in the north portion of the proposed footprint. The overburden encountered in the borehole comprised an approximately 15 m-thick blanket of silt-rich re-worked loess, overlying colluvium. The proposed stockpiles and Heap Leach Facility are to be sited on gently inclined, Upper Colluvial Slopes. Test pitting undertaken at the sites of the proposed waste rock stockpiles has shown the colluvial soils in these areas to be silt-rich, locally. Extensive colluvial aprons were mapped along the toes of the side slopes of the Casino Creek Valley. These deposits are interpreted to extend across approximately half the footprint area of the proposed Tailings Embankment. The colluvial apron deposits are rich in silt and organic soil. They were encountered to a maximum depth of approximately 23 m in the site investigation boreholes.

The terrain hazards assessment highlights extensive areas of permafrost terrain at the proposed mine site, with a generally shallow (within approximately 1 m of the ground surface) permafrost table. The terrain mapping identified extensive silt-rich soils at the site, in particular, the colluvial aprons at the slope toes along the Casino Creek Valley and local deposits of loess in the upland areas, including the proposed Open Pit site. These soils tend to be ice-rich and include beds of massive ground ice. Beds of massive ground ice, with a thickness of up to approximately 3 m, have been encountered in site investigation boreholes undertaken at the site of the proposed Tailings Embankment. The colluvial slopes at the sites of the proposed Tailings Embankment, stockpiles and Heap Leach Facility have also been found to be silt and ice-rich, locally.

The colluvial apron deposits are expected to be susceptible to long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice. Significantly, there is a marked variation in the depth the permafrost table was encountered in the test pits, undertaken across the proposed downstream toe of the embankment. As the colluvial apron soils are silt-rich, it is possible that there would be an increased risk of soil piping if the permafrost degrades. There is regional

evidence of permafrost degradation as well as occasional evidence within the Study Area of the extent of permafrost degradation being exacerbated by anthropogenic processes. Significant uncertainty can be expected regarding the baseline rate of permafrost degradation and the extent to which it is anticipated to be affected by anthropogenic processes.

The terrain hazards assessment highlighted the occurrence of sheetwash at the site of the proposed Heap Leach Facility and the site of the Eastern Supergene Oxide Ore Stockpile, in the north part of the site. Sheetwash is a process by which fine sediment is transported down slope by surface flow and shallow sub-surface seepage within the active layer. Natural concentrations of surface and sub-surface water flow should be expected locally in areas of sheetwash. Sheetwash may be particularly pronounced at the site of the proposed Heap Leach Facility, where it is interpreted that the presence of a broad 'swale' leads to concentrations of surface run-off and shallow sub-surface seepage flow during the summer months.

The terrain mapping highlighted the widespread occurrence of soils that are rich in silt and organic soil, as well as being ice-rich. These soils, which predominantly comprise colluvial apron and re-worked loess deposits, are expected to be especially prone to erosion and instability, upon disturbance. At the site of the proposed Tailings Embankment, a thaw flow was observed in an area where an access track had been formed on a colluvial apron with a natural slope angle of less than 25%. The erosion potential of such soils is possibly increased by the near surface presence of permafrost. A thick deposit of silt-rich and ice-rich re-worked loess was identified in the north part of the footprint area of the proposed Open Pit, which is expected to be especially prone to erosion and instability, upon disturbance.

A terrain stability classification scheme was developed for the site, incorporating relatively low threshold slope angles for 'potentially unstable' terrain in areas of ice-rich soils – 35% for the Upper and Mid Colluvial Slopes and 20% for the Colluvial Aprons. The terrain stability mapping indicates approximately 13% of the Study Area comprises 'potentially unstable' terrain and less than 0.5% 'unstable' terrain. The terrain stability mapping highlighted areas of 'potentially unstable' terrain and local areas of 'unstable' terrain at the site of the proposed Tailings Embankment, related to the interpreted presence of silt-rich and ice-rich soils. The mapping highlighted widespread areas of 'potentially unstable' terrain and local areas of 'unstable' terrain within the proposed storage area of the Tailings Management Facility. Areas of 'potentially unstable' terrain were identified, locally, at the sites of the proposed Stockpiles and Heap Leach Facility.

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TABLE 1

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CASINO COPPER-GOLD PROJECT

FIELD TRUTHING LOCATIONS

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Field Truthing Location	Description
WP 186	Hand dug pit: 0 to 0.1 m: moss; 0.1 to 1.0 m: very soft brown dark grey spongey fibrous Peat, saturated. Strong organic odour. Below 1.0 m..hard, frozen. Thaw Lake (approx. 20 m long x 10 m wide)
WP 187	Channel bed exposure: sandy gravel, some cobbles. Hand dug pit approx. 5 m from river bank: 0 to 0.1 m:moss; 0.1 to 0.5 m: Loose brown grey fine to medium sand, some silt (Fluvial Plain Deposit); 0.5 to 0.55 m: sand and gravel
WP 188	Hand dug pit: 0 to 0.15 m: moss; 0.15 to 0.3 m: Very soft brown dark grey spongy fibrous Peat, wet; 0.3 to 0.45 m: soft grey organic silt, trace sand, some roots; 0.45 to 0.5 m: Grey brown fine to coarse Sand, some angular to subangular gravel, trace silt, saturated.
WP 190	Hand dug pit: 0 to 0.25 m: moss; 0.25 to 0.3 m: soft grey gravelly silt, trace sand, trace subangular cobbles, some plant remains. Gravel is angular to subangular (colluvium); below 0.5m...Hard, frozen.
WP 192	Hand dug pit: 0 to 0.1 m: Topsoil; 0.1 to 0.25 m: Angular to subangular fine to coarse gravel, some subangular cobbles, some sand, trace silt (colluvium); 0.25 to 0.4 m: compact brown grey silty fine to coarse sand, trace angular to subangular fine to coarse gravel (colluvium)
WP 194	Subangular to angular bouldery Cobbles, some subangular to angular gravel, trace sand (colluvium)
WP 195	as WP 194
WP 196	5 m high Cut Slope in angular Cobbles of porphyry, some angular gravel
WP 197	Borrow Area: 0 to 1.0 m depth: Dense grey brown angular to subangular fine to coarse Gravel, some medium to coarse sand, trace subangular to angular cobbles; with some boulder sized pockets of dark grey organic gravelly silt (Colluvium); 1.0 to 1.3 m depth: very weak to weak highly weathered Porphyry; below 1.3 m depth...medium strong and moderately weathered.
WP 199	Orange brown fine sand, some silt, trace subrounded to subangular fine to coarse gravel (Reworked Loess)
WP 200	Hand dug test pit: 0 to 0.6m: Soft to very soft grey brown silt, trace subangular to angular gravel, some sand, some angular to subangular cobbles; with some gravel sized pockets of organic silt, some plant remains. (Colluvium). Below 0.6 m...frozen, includes segregated bodies of ice (at least gravel sized)
WP 211	Thaw flow and thermal erosion on old access track

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TABLE 2

CASINO MINING CORPORATION
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TERRAIN STABILITY CLASSES

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Terrain Stability Class	Landslide Likelihood Upon Construction	Areas
Stable	Negligible to Low	Alluvial plains and terraces
		Gently inclined (< 20%) colluvial aprons
		Gently to moderately inclined (< 35%) colluvial slopes
		Gentle to moderately steep (6% to 60%) slopes in weathered bedrock
Potentially Unstable	Moderate	Moderately inclined (>20%) colluvial aprons ('Ca')
		Moderately inclined (35% to 49%) colluvial slopes ('C')
		Moderately steep to steep (>60%) slopes in weathered bedrock ('D')
Unstable	High	Sites of 'recent' landslides and soliflucted slopes ('-S') .
		Moderately steep (>50%) colluvial slopes ('C')

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NOTES:

1. TERRAIN STABILITY CLASSIFICATION SCHEME DOES NOT INCORPORATE THERMAL EROSION. THERMAL EROSION HAS BEEN OBSERVED AND CAN BE EXPECTED TO OCCUR IN GENTLY SLOPING ICE-RICH TERRAIN THAT IS CLASSIFIED AS 'STABLE' IN THE TERRAIN STABILITY MAPPING.
2. TERRAIN STABILITY CLASSIFICATION SCHEME APPLIES TO THE LIKELIHOOD OF SLOPE DETACHMENTS (E.G. SLIDES AND FLOWS) AS OPPOSED TO SLOPE DISPLACEMENTS (I.E. SOIL CREEP). SOIL CREEP CAN BE EXPECTED TO OCCUR, LOCALLY, AT SIGNIFICANTLY SHALLOWER SLOPE ANGLES THAN SLOPE DETACHMENTS.

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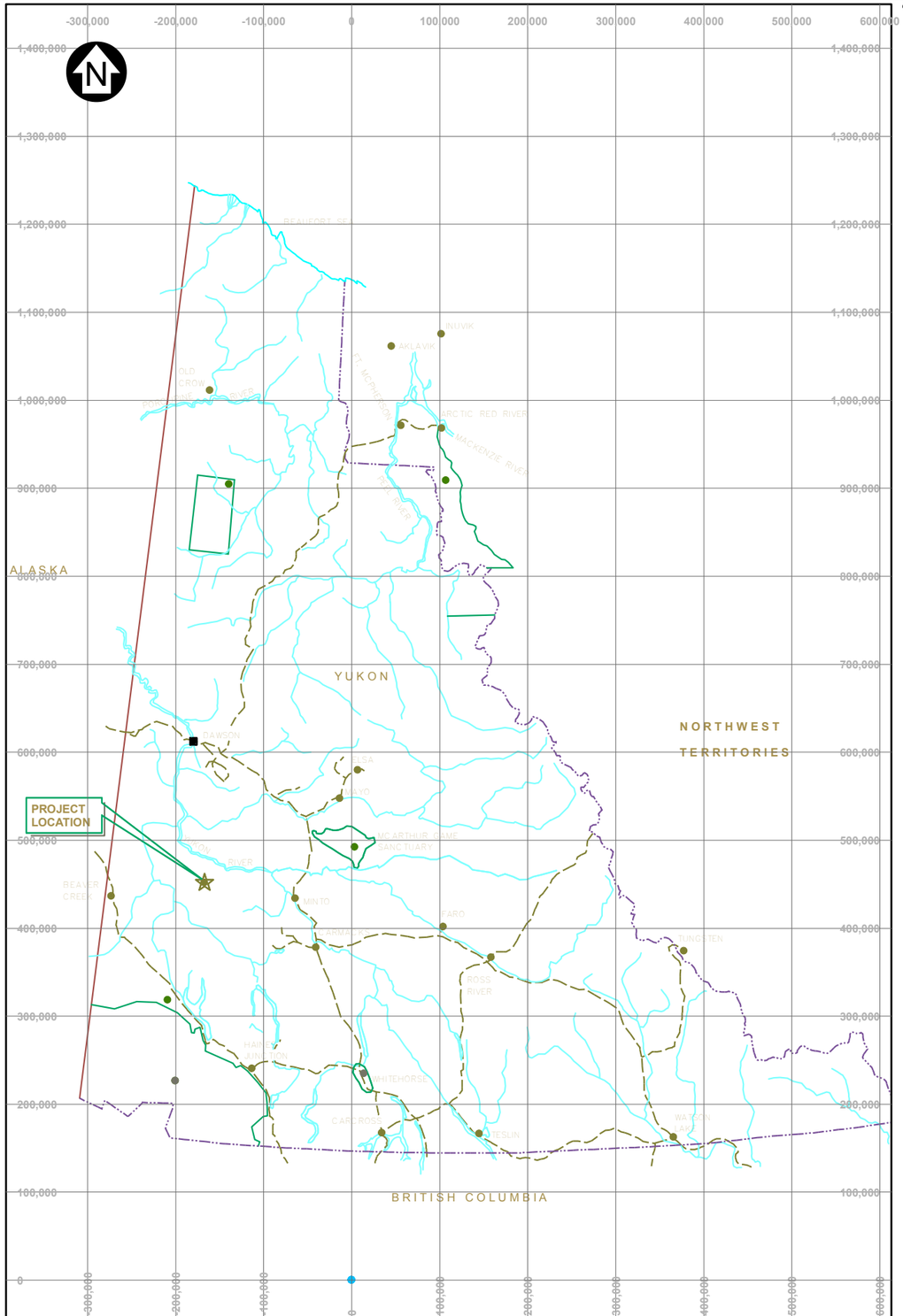

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TERRAIN UNIT MAP LEGEND

Example

proportional coverage of component (7=70%) — **7aCk - R:m**

- texture
- surficial material
- surface expression
- terrain symbol
- geomorphological process
- drainage class

TEXTURE

- a blocks (>256 mm; angular)
- b boulders (>256 mm; round)
- c clay (<0.002 mm)
- d angular and rounded particles; >2 mm
- e fibric organics
- g gravel (rounded particles, >2mm)
- h humic organics
- k cobbles (64-256 mm, rounded)
- m mud (silt and /or clay)
- p pebbles (2-64 mm, rounded)
- r rubble (2-256 mm, angular)
- s sand (0.63-2 mm)
- u mesic organics
- x 2 to 256 mm, angular
- z silt (0.002-0.63 mm)

SURFICIAL MATERIALS

- A anthropogenic material
- C colluvium
- D weathered bedrock
- E aolian sediments
- F fluvial sediments
- FG glaciofluvial sediments
- I ice
- L lacustrine sediments
- LG glacial lake sediments
- M till
- Ml ablation till
- O organic materials
- R bedrock
- U undifferentiated materials
- V volcanic sediments

Superscripts: ^A = active, ^I = inactive

SURFACE EXPRESSION

- a apron
- d moderate slope(s) (27-49%)
- b blanket
- c cone
- cl cliff
- d depression
- e plateau (no upslope catchment)
- f fan
- fp fill platform
- g gully
- h hummocky topography
- j gentle slope(s) (6-26%)
- k moderately steep slope(s) (50-70%)
- l lobe
- m rolling topography
- p plain (0-5%)
- r ridge topography
- s steep slope(s) (>70%)
- t terraced
- u undulating topography
- v veneer
- w mantle of variable thickness
- x thin veneer
- y1 topographically confined hill slope
- y2 topographically confined plain
- z1 hill top (rounded)
- z2 hill top (sharp)

GEOMORPHOLOGICAL PROCESSES

- A snow avalanches
- B braided channel
- C cryoturbation
- E glacial meltwater channels
- F slow mass movement
- G glacial processes
- H kettled
- I irregularly sinuous channel
- J anstomosing channel
- L abundant seepage
- M meandering channel
- N nivation
- O Decomposition of plant remains
- R rapid mass movement
- S solifluction
- U sheet erosion
- V gully erosion
- W weathering
- X permafrost processes
- Z general periglacial processes

GEOMORPHOLOGICAL PROCESSES: SUBCLASSES AND SUBTYPES

- F" slow mass movement, initiation zone
- Fc soil creep
- Fe slow earthflow(s)
- Fg rock creep
- Fk tension cracks
- Fr slow rockslide(s)
- Fs slow debris slide(s)
- R" rapid mass movement, initiation zone
- Ra rock avalanche
- Rb rockfall(s)
- Rd debris flow(s)
- Rr rapid rockslide(s)
- Rs rapid debris slide(s)
- Rt debris torrent(s)

PERMAFROST PROCESS SUBCLASSES

- p palsas, peat plateaus
- t thermokarst: subsidence
- e thermokarst: thermal erosion by water
- f thaw flow slides
- w ice wedge polygons
- r patterned ground
- s sheetwash
- i segregated ice

DRAINAGE CLASSES

- x wery well drained
- r rapidly drained
- w well drained
- m moderately well drained
- i imperfectly drained
- p poorly drained
- v very poorly drained

TERRAIN SYMBOLS

- . components on either side of the symbol are of approximately equal proportion
- / the component in front of the symbol is more extensive than the one that follows
- // the component in front of the symbol is considerably more extensive than the one that follows
- _ the component in front of the symbol overlays the one that follows

NOTES:

1. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 83 UTM ZONE 7N.

2. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:6,000,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION

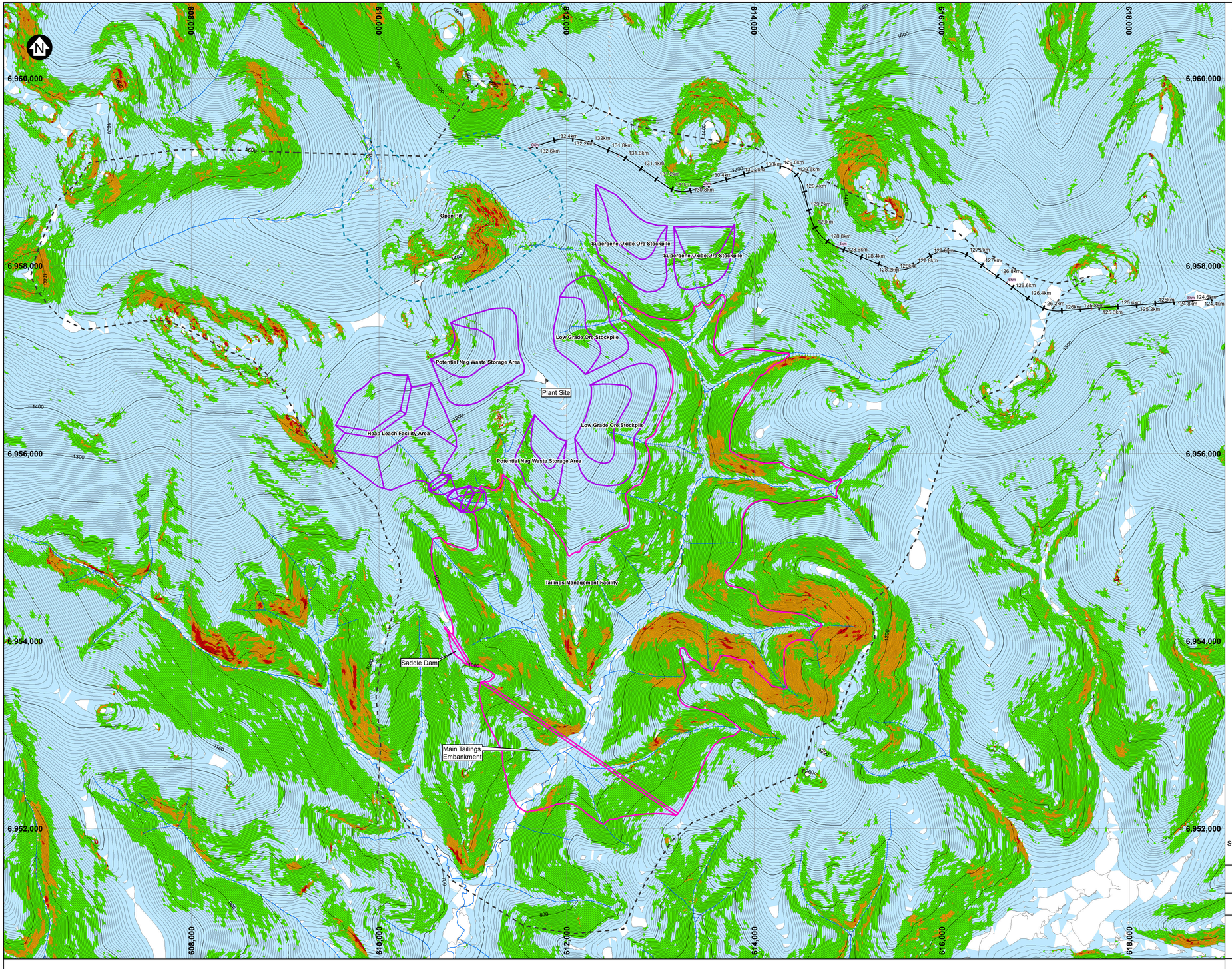
CASINO COPPER-GOLD PROJECT

SITE LOCATION MAP AND TERRAIN UNIT LEGEND

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-325/8	3

FIGURE 1 REV 0



LEGEND:

GENERAL

- 5M LIDAR CONTOUR
- 100M LIDAR CONTOUR
- RIVER
- ROAD
- STUDY AREA

SLOPE ANGLE

- 0 - 5% (PLAIN: 0 - 3 DEGREES)
- 6 - 26% (GENTLE: 4 - 15 DEGREES)
- 27 - 49% (MODERATE: 16 - 26 DEGREES)
- 50 - 70% (MODERATELY STEEP: 27 - 35 DEGREES)
- >70% (STEEP: >35 DEGREES)

NOTES:

1. BASE MAP: TIN CREATED FROM 5M CONTOURS FROM EAGLE MAPPING.

2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 83 UTM ZONE 7N.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:20,000 FOR 24x36 ("D" SIZE) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

SCALE 400 200 0 400 800 1,200 1,600 2,000 m

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

MINESITE SLOPE ANGLE MAP

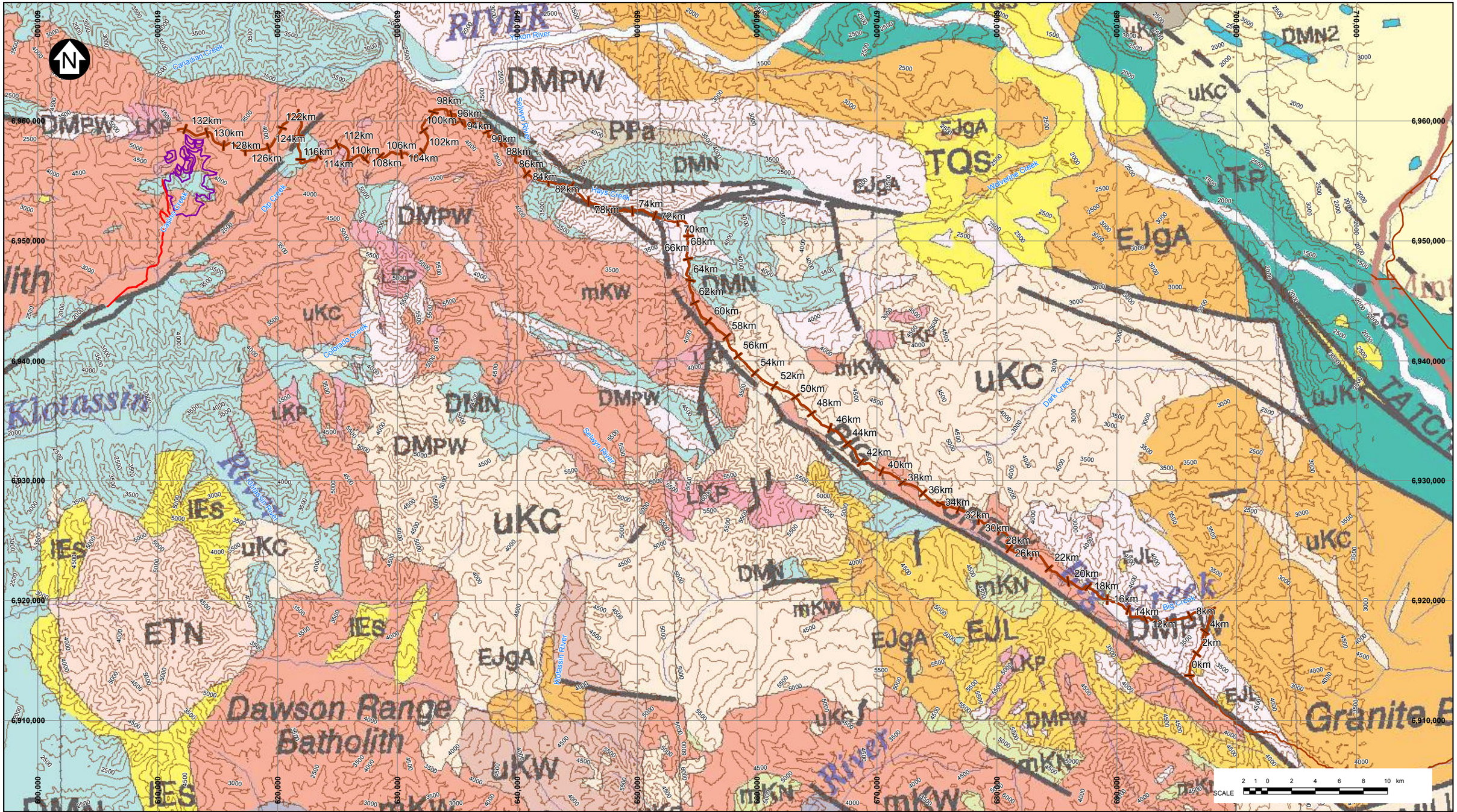
Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-325/8	3

FIGURE 2 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	30MAR'12	ISSUED WITH REPORT	KK	KK	JEH	KJB

KP FIGURE SAVED: M:\1\01\00325\08\A\GIS\Figs\MineSiteSlopeAngle(D_size).mxd; Mar 22, 2012 2:50:24 PM kkrauszova



LEGEND:

PROPOSED FEATURES

- ROAD
- AIRSTRIP
- MINE SITE

GENERAL

- 500 FT. CONTOUR

BEDROCK GEOLOGY

- IEs — LOWER EOCENE SKUKUM FORMATION: VARIABLE ASSEMBLAGE OF VOLCANIC ROCKS.
- uKC — UPPER CRETACEOUS CARMACKS FORMATION: BASALT AND BRECCIA WITH SOME CRYSTAL TUFF AND SOME SEDIMENTARY ROCKS
- mKN — MID CRETACEOUS MOUNT NANSEN FORMATION: MAINLY ANDESITE TO DACITIC LAVA FLOWS, BRECCIA AND TUFF.
- mKW — MID CRETACEOUS WHITEHORSE SUITE: GREY MEDIUM TO COARSE GRAINED GRANITE.
- EJL — EARLY JURASSIC LONG LAKE SUITE: MOSTLY GRANITIC ROCKS.
- DMN — DEVONIAN NASINA FORMATION: GRAPHITE SCHIST WITH INTERSPERSED MARBLE.
- DMPW — DEVONIAN PELLY GNEISS SUITE.

FAULT

- FAULT

NOTES:

1. BASE TOPOGRAPHY: CANVEC CONTOURS.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. EXTRACTED FROM 1:100,000 SCALE BEDROCK GEOLOGY MAP OF THE YUKON TERRITORY, PUBLISHED BY GEOLOGICAL SURVEY OF CANADA (GORDEY, S.P. AND MAKEPEACE, A.J. 2001)
4. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:300,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
5. ROAD ALIGNMENT BASED ON JUNE 6, 2011 FILE FROM ASSOCIATED ENGINEERING.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	30MAR'12	ISSUED WITH REPORT	JEH	KK	GRG	KJB

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

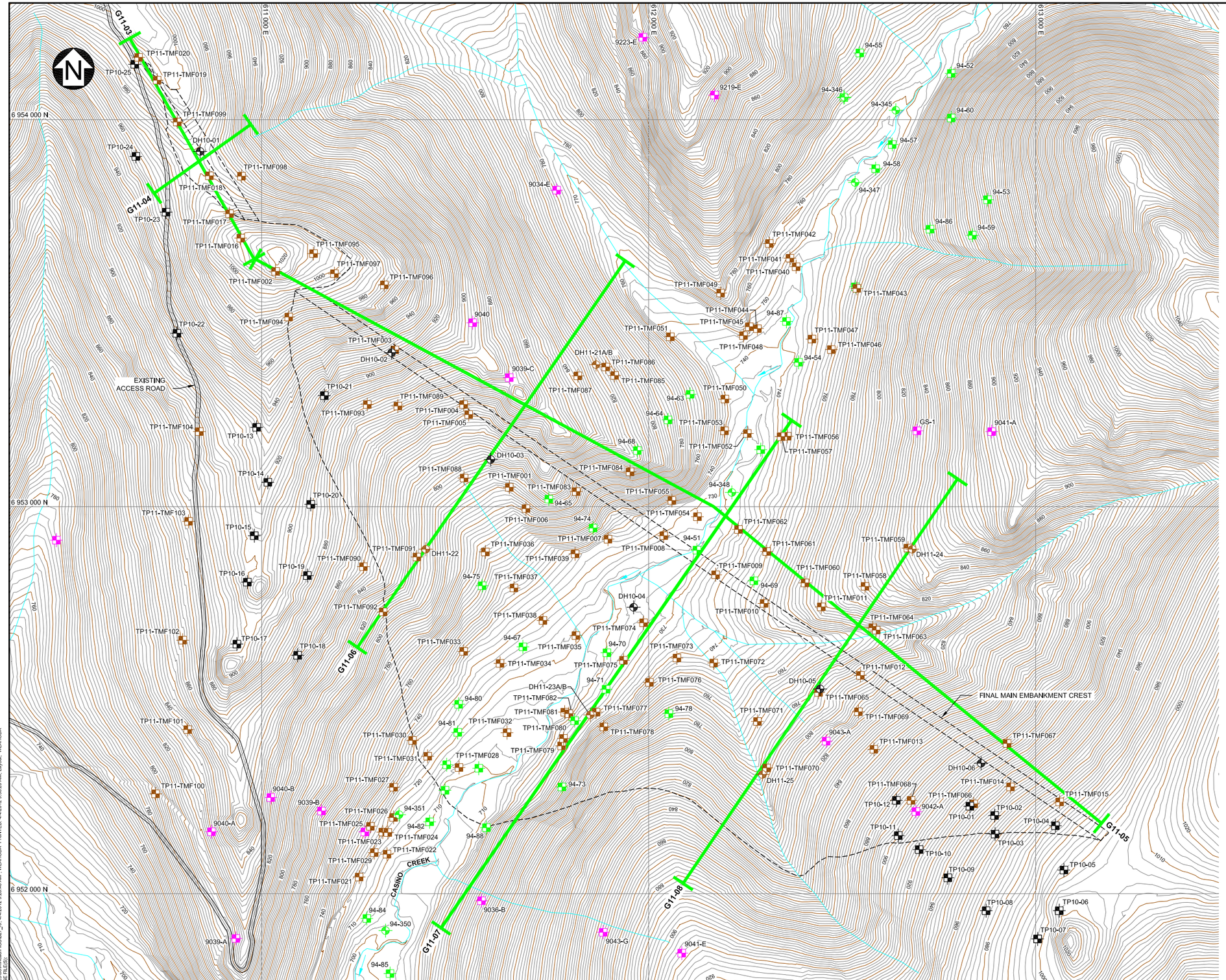
PUBLISHED BEDROCK GEOLOGY MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-325/8	3

FIGURE 3 REV 0

KP FIGURE SAVED: M:\1\01\00325\08\A\GIS\Figs\PublishedBedrockGeologyMine.mxd, Apr 03, 2012 11:08:07 AM adinca



LEGEND:

- 2011 SEISMIC REFRACTION SURVEY LINE
- 2011 TEST PIT
- 2010 TEST PIT
- 1994 TEST PIT
- 1993 TEST TRENCH
- 2011 GEOTECHNICAL DRILLHOLE
- 2010 GEOTECHNICAL DRILLHOLE
- 1994 GEOTECHNICAL DRILLHOLE WITH 50 mm DIA. WELL

NOTES:

1. COORDINATE GRID IS UTM (WGS84/NAD83) ZONE 7 (m).
2. CONTOUR INTERVAL IS 2 METRES.
3. DIMENSIONS ARE IN METRES UNLESS NOTED.

SCALE A 100 50 0 100 200 300 400 500 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	30MAR'12	ISSUED WITH REPORT	CMS	PP/WAL	JEH	KJB

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

TAILINGS MANAGEMENT FACILITY
PREVIOUS SITE INVESTIGATIONS

Knight Piésold CONSULTING

P/A NO. VA101-325/8

REF NO. 3

FIGURE 4

REV 0

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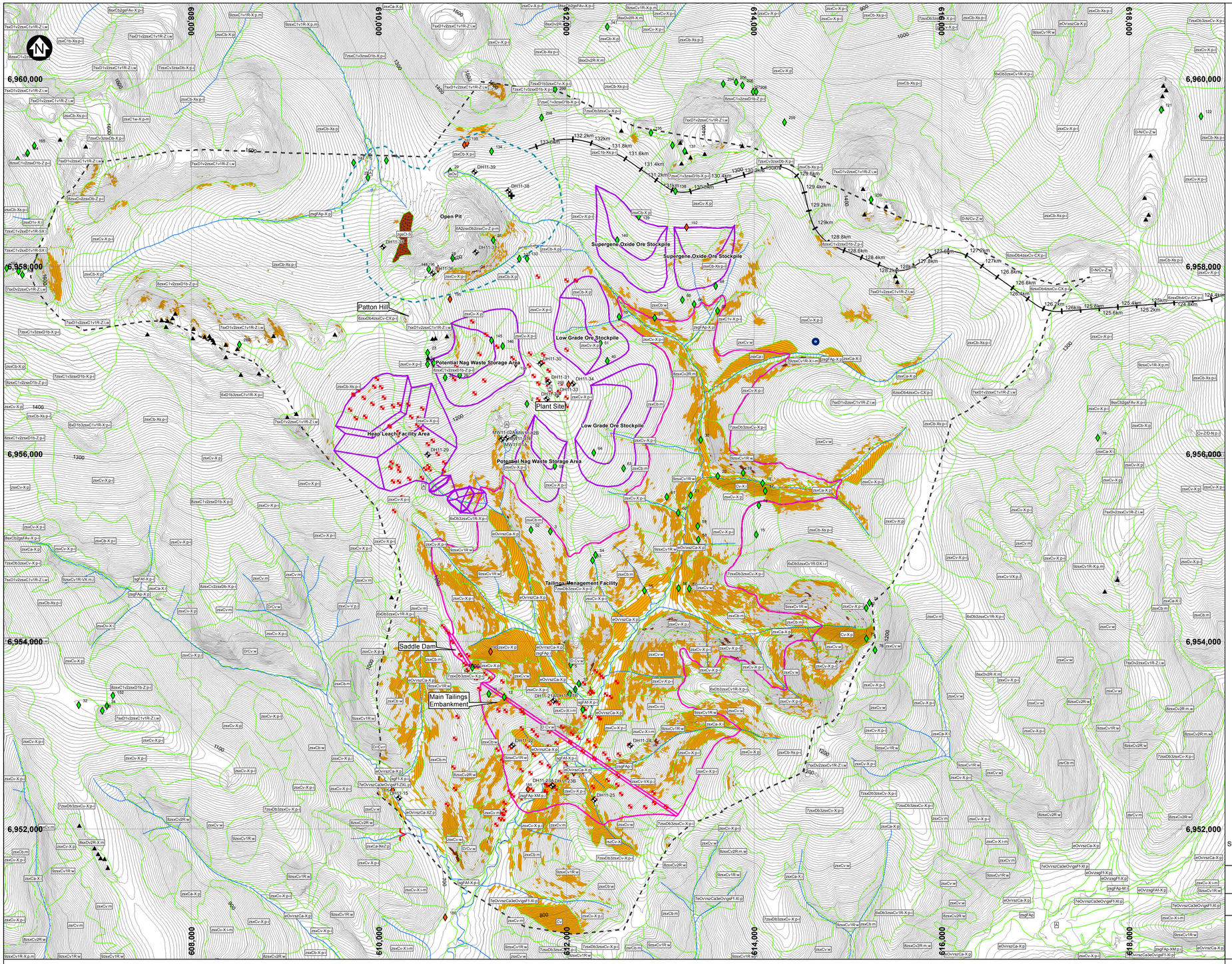

LEGEND:

GENERAL

- 5M LIDAR CONTOUR
- 100M LIDAR CONTOUR
- RIVER
- STUDY AREA

PROPOSED FACILITIES

- ROAD

FIELD TRUTHING LOCATIONS

- KP, 2011
- AECOM, 2010
- GEOTECHNICAL DRILLHOLE, 2011
- TESTPIT, 2011

TERRAIN FEATURES/ HAZARDS

- TOR
- TERRAIN UNIT
- SOLIFLUCTION LOBE

PERMAFROST RELATED FEATURES

- THAW LAKE
- PINGO
- ACTIVE THERMAL EROSION
- THAW FLOW

TERRAIN STABILITY

- UNSTABLE
- POTENTIALLY UNSTABLE

NOTES:

1. BASE MAP: TIN CREATED FROM 5M CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 83 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:20,000 FOR 24x36 ("D" SIZE) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. REFER TO FIGURE 1 FOR TERRAIN UNIT LEGEND.
5. TERRAIN MAPPING INCORPORATES EARLIER WORK BY AECOM.
6. TERRAIN MAPPING UNDERTAKEN TO TERRAIN SURVEY INTENSITY LEVEL C.
7. REFER TO TABLE 2 IN THE REPORT FOR DEFINITION OF 'UNSTABLE' AND 'POTENTIALLY UNSTABLE'.

SCALE 400 200 0 400 800 1,200 1,600 2,000 m

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

MINESITE TERRAIN HAZARDS MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-325/8	3

FIGURE 5 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	30MAR'12	ISSUED WITH REPORT	CMS	KK	JEH	KJB

KP FIGURE SAVED: M:\1\01\00325\08\A\GIS\Figs\MineSiteTerrain(D_size).mxd; Mar 22, 2012 3:22:49 PM kkrauszova

Knight Piésold
CONSULTING

APPENDIX A

FIELD TRUTHING FROM PREVIOUS TERRAIN MAPPING

(Pages A-1 to A-14)

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
1	LEJ02b					In same polygon as LEJ02a, now in a deeper hollow between R boulders as opposed to purched on top as LEJ02a. More mineral soil than LEJ02a before hitting rock. Same eco. Frost jacking of boulders in area.
2	FES01	Polygon # 1011	611578	6956533	Within sparse Sw stand dominated by taller birch and willow.	
3	FES02	Polygon # 1085	611828	6955173	Within Sw stand with little ground veg. Site is dominated by moss. Some Sw regen.	Hit boulders at 62cm depth. C horizon is very gravelly.
4	FES03	Polygon # 1234	611921	6953941	Within Sw stand with very little understory vegetation. Occasional Bw within subcanopy. Plot just ~25 m west of road. Somewhat open canopy.	Effective rooting to 19cm. On steep slope, well drained, colluvial material. C horizon has abundant angular coarse fragments.
5	FES04	Polygon # 1234	612045	6953752	Within Aw/Sw mixwood stand slightly drier than Fc within same polygon.	
6	FES05	Polygon # 1277	612265	6953345	Plot ~10 m from trib to Casino Creek. Small stunted shrubs until on banks of trib. Willows and birch larger near water. Browsing very evident throughout site. One lone tree within plot with large scars and stunted growth.	On Casino Creek floodplain. Layered horizons of SiL, Ah, and sandy C.
7	FES06	Polygon # 1291	612174	6953270	Some standing dead trees. All trees look slightly stressed with short needles and dead lower branches.	Some exposed blocks (angular) at surface near bottom of slope. Thin Ah horizon, then C horizon with coarse fragments. Large rock / boulder / block at 30cm, could not dig further
8	FES07	Polygon # 1250	612032	6953440	Within stunted Sb stand. Some peatmoss. Dominated by moss and lichen. Plot is upslope of flowing creek ~30 m. The odd tree is over 4 m tall but the majority are under 5 m tall within stand.	Thick moss layer (~13cm), 7cm LFH followed by Ah, Bm, and C - coarse fragments at bottom of pit, could not auger through them (50cm). Did not hit permafrost by 50cm. Steep slope.
9	FES08	Polygon # 1205	612093	6953488	Within riparian area with stunted spruce but no aspect or slope.	Floodplain north side of Maloy Creek. Tussocks. Level. Minor seepage at bottom of pit. Hit boulder at bottom.
10	FES09	Polygon # 1085	612132	6953548	Within aspen/spruce forest. Drier than most. Should split Fm into dry and wet mixedwood.	
11	FES74	Polygon # 1329	611172	6953440	Site on steep slope with conifer dominating. Very little ground vegetation present. Some evidence of fire with a burned stump within plot.	S-facing steep slope. No surface stones observed. No Ah horizon. Well drained. Coarse fragments abundant.
12	FES75	Polygon # 1329	611335	6953406	Within coniferous forest. A little thicker understory with moss dominating. Some Bw within understory.	No surface stones.
13	FES76	Polygon # 1247	611017	6953628	Open coniferous forest with some aspen and birch in overstory. Larger trees are Sw and have an open canopy.	On N-facing slope nearing crest of hill. Small bedrock outcrops throughout area. Hit bedrock on one side of my pit - see photos 500-502. Very stony, angular, bits of cobbley weathered bedrock in rest of pit. Coule only get to ~40cm depth.
14	FES77	Polygon # 1236	610996	6953718	On a north facing slope. **Surface stones present**. Trees stunted (Sw).	On N-facing slope - near top. Organic to 17cm. **Very stoney pi**t. Did not reach permafrost.
15	FES86	Polygon # 1091	614023	6955139	Large amounts of standing dead snags - appears to have been a fire through this area. One large spruce outside of plot.	NW-facing slope, tall shrub association. Standing Sw and Sb dead snags - previously affected by fire. Gravelly layer at top under LFH and Ah horizon. Strange. Abundant coarse fragments. Water pooling at bottom of pit.
16	FES87	Polygon # 1060	614052	6955450	On north facing slope. With small scrub spruce. None are over 5 m tall. Not organic soil but permafrost was encountered. Depth to permafrost: 36 cm.	Permafrost at 36cm depth. N-facing slope, mid slope. Evidence of cryoturbation - pockets of buried organic. Uneven horizons.
17	FES88	Polygon # 1060	614118	6955604	Within Fe association on a slope of 55 with Fcs surrounding.	N-facing slope. Pile of blocks and angular cobbles. Above and to south of Casino Creek, SE of camp.
18	FES89	Polygon # 1050	614091	6955685	Recently flooded along edges of creek. Some conifer within but part of Fc stand north of plot. Little small perm with stones for substrate.	On floodplain of tributary to Casino Creek. Evidence of active flooding in recent past. No LFH. Gravelly, sandy soil. ~3m from edge of creek. Buried organic and buried Ah horizon.
19	FES90	Polygon # 1033	613883	6955797	South facing conifer stand. Very little vegetation diversity throughout stand. Phacelia mollis 7V 613858 E 6955754 N.	On S-facing slope. White spruce forest. Clay content in soil - took sample.
20	FES91	Polygon # 1050	613613	6955764	Stand dominated by Sb (shorter trees). Some Sphagnum within stand.	
21	FES92	Polygon # 1042	613322	6955556	Within Sr association. Old winter road ~20 m to the west of plot. Plot within linear plot along Casino Creek. Little forb diversity. Site dominated by low and tall shrubs.	On floodplain in riparian area of Casino Creek. On west side of Casino Creek. Note: the Om horizon has been inundated by mineral soil throughout. Due to past flooding activity.
22	FES93	Polygon # 962	610519	6956955	Within footprint. Tor ~50 m north of plot. Some Fe ~50 m to the east.	On S-facing slope. Tor ~25m upslope to the north. Low shrubs. Angular rocks near surface. Hit rock/block at bottom of pit (65cm).
23	FES94	Polygon # 942	610520	6957079	A tor within a bigger polygon. Very little vegetation on it.	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
24	FES95	Polygon # 968	610585	6956968	At the base of a tor ~80 m south. Some boulders within St as well as some small Sb.	
25	FES96	Polygon # 968	610706	6956814	Within sparse forest canopy. Boulders at surface. Shrub slightly taller than Sm. Dominated by birch and willow.	On S-facing slope lower down than FES93 - in sparse white spruce seepage. Seepage in pit. (Did one pit ~5m upslope of current position, hit a large stone/block at ~12cm depth). Buried organic in pit. Seepage into pit, water filled pit at 17cm depth.
26	FES97	Polygon # 968	610861	6956840	Within tall shrub association between Fcs. ~2 m tall dominated by willow.	
27	FRR04	Polygon # 841	609883	6958946	Site disturbance: placer mining a few decades ago. Species list on reverse - not good for rare plants, so did not do plot here. "C.HOLOST" waypoint = possible rare sedge.	
28	FRR05	Polygon # 885	610785	6958087	Area disturbed by road building/mining activity, but plot in undisturbed area.	
29	FRR06	Polygon # 885	610760	6959013	In the drainage between two peaks, near road; area has been disturbed - lg. machinery has torn up shrubby area - colonized by CALACAN, ERIOPHORUM, CAREX. Wet, pools of water in ruts; exposed organic soil; shrubs and HYLOSPL on higher ground; graminoids i	
30	FRR22	Polygon # 1042	613431	6956148	Tiny annual plant growing in seepage on old road bed. Plot describes the veg in the immediate vicinity along the road (not in adjacent forest); long harrow plot, but not 400 m2 because place where POLYCAU occurs is different from most of road. Only one	
31	FRR26	Polygon # 908	611219	6958280	Quick plot on felsenmeer to document Selaginella sibirica. Polygon mapped as 7Sm2An1St - mostly Sm in this area, but small felsenmeer/boulder area where we found SELASIB.	
32	LEJ01	Polygon # 1419	606800	6953320		Broad ridge crest near base of oval-shaped rock knoll. Moderately dilatant. Mottles in B horizon. Minor seepage present.
33	LEJ02a	Polygon # 1300	607050	6953260		Crest of rocky knoll (oval-shaped). Weathered bedrock surface with isolated bdk outcrops. LEJ02b is in deeper hollow between boulders
34	LEJ03	Polygon # 1300	607100	6953310	Felsenmeer large boulder on slope; abundant rock lichen; moss and lichen 25% (not including rock lichen); small component of polygon 1300.	
35	LEJ05	Polygon # 1884	606505	6947430		Gentle toe slope in tributary valley (stunted spruce). Heavily tussocked grassy ground. Seepage entered pit slowly after digging (assumed organic cryosol, therefore permafrost at 35cm, but could not be confirmed).
36	LEJ06	Polygon # 1825	606420	6947450		Low floodplain. Colours of all Ah and C horizons the same.
37	LEJ07	Polygon # 1693	606375	6947460		Very minor mottles throughout Bm. Narrow, level plain on valley bottom, above river level. Uncertain: minor sand seams, especially lower --> fluvial setting, similar to other previous site.
38	LEJ08	Polygon # 1805	606255	6947490		Mid-slope of mixed forest, E aspect, relatively steep. Minor undulations across slope. Relatively dry, loose soil, but pebbley
39	LEJ09	Polygon # 1876	605985	6947360		Shallow, rocky soil, mid-slope, SW-facing aspect slope. Boulders scattered across slope. Bedrock outcrops on upper slope and ridge.
40	LEJ10	Polygon # 992	612435	6956990		Large polygon around ?? with NE aspect. Sloping, sparse spruce (some stunted). Very spongey ground --> permafrost.
41	LEJ100	Polygon # 2081	605150	6944150	Open bog. Actually this entire huge polygon is mostly bog with variable density and height of Black Spruce (Bo/Bc) and similar ground cover - ERIOPHO and SPHAGNU indicate bog.	
42	LEJ101	Polygon # 1796	609105	6948270	Evidence of forest fire charred stump. * Pretype is 10Fbx but actually is a mosaic of Fbx, Lx and Fb on south face. Plot was done on upper part in forest. ARCTUVA much more prominent than VACCVIT on Lx. *Note: Cypripedium guttatum in plot.	WSW slope of aspen, few ?, shrubs, bear berry, bog cranberry. Fire history because irregular Ah horizon (thin, too), and little lichen/moss, and charred wood. Lots of decomposing woody debris at surface.
43	LEJ102	Polygon # 1796	609150	6948150	South facing slope with stunted dry aspen. *Note about 1000 Cypripediums at this location. *Many aspen showing disease that causes clumped growth of leaves followed by dieback. Some trees show the leaves and others dieback and irregular twisted trunks.	Upper slope, S-facing, just below lunch spot on ridge crest overlooking Dip Creek valley and small thaw lake. Numerous frost boils, which have the appearance of ground squirrel burrows without the hole. Granules mixed with coarse sand (all <1cm). Inter
44	LEJ103	Polygon # 1833	609230	6947860	Conifer forest on alluvial fan. NOT conifer bog; however, transition to conifer bog at approx UTM 609350 E 6947780 N. Permafrost at 90 cm.	Distinct black spruce forested alluvial fan (not colluvial), (steepest ~29% --> 7%). Two small boulders near apex, but likely fallen from side valleyside. Test pit at apex also silt / sand cumulic regosol. Permafrost deep - 89cm.
45	LEJ104	Polygon # 1827	609565	6947715	Forest transition to bog.	Toe slope descending to shore of small thaw lake, adjacent to "perfect" fan. Turbic cryosol - suspected because disruption In Ahys. Black spruce forest.
46	LEJ105	Polygon # 1849	609520	6947715	Thaw lake surrounded by marsh and open interspersion. Richest wetland seen. Eriophorum cf viridi-carinatum. 3 pintail, 2 GW teal, 1 comon snipe, dragon flies, pine grosbeak, moose on hillside.	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
47	LEJ106	Polygon # 1974	610495	6949030	Substrate: sand and gravel. Wide riparian willow thicket along Casino Creek.	Casino Creek riparian floodplain, downstream of proposed ? dam. Fresh sand deposits across floodplain. Sand / gravel bars in meandering creek. Pit at edge of recent sand deposit, ~15m from active channel.
48	LEJ107	Polygon # 1974	610390	6949065	Organic soil 45 cm. Permafrost 47 cm.	West gentle toe slope bog of Casino Creek (downstream of dam site). Organic cryosol? - or not quite since mainly fibric, so O layers need to be >60cm? Slow seepage into bottom of pit.
49	LEJ108	Polygon # 1679			Fco correct. Mostly PICEGLA, some BETUNEO.	
50	LEJ109	Polygon # 1055	611875	6955870	Conifer forest that burned several years ago. Dead standing spruce snags 20%, bare ground 50%. Snags generally 10-25 cm dbh, up to 15 m tall. Soil: cryosol. Permafrost: 60 cm.	Boulders in soil pit. Burn site. Frost on surface today. Hit permafrost at 60cm. SW facing slope.
51	LEJ11	Polygon # 950	612360	6957180	Field Veg Assoc recorded as Sm and Fcs. More tall shrub than LEJ10 and greater conifer component.	Bushy, mossy, licheny slope just downslope of rough road terminus, SW of Proctor Gulch. Cryoturbated, but too stony to reach permafrost.
52	LEJ110	Polygon # 1141	611622	6955188	Conifer forest with minor decid component. Trees up to 20 m tall. No permafrost at 56 cm.	No permafrost. Drier than last site.
53	LEJ111	Polygon # 1136	612278	6954862	Black spruce forest 10-20 m tall. Permafrost at 50 cm.	In big patch of sphagnum.
54	LEJ112	Polygon # 1149	612310	6954920	Veg assoc: Fco/St. Permafrost at 76 cm. Very similar to LEJ111 but with denser alder understory - along draw.	
55	LEJ113	Polygon # 1188	612830	6954540	Black spruce of variable heights 1-10 m, thick moss and lichen layer. Substrate: organic 30-40 cm, turbo cryosol. Depth to permafrost: 71 cm.	On SE-facing slope. Gentler slope than above. Hit permafrost at 71cm. Evidence of cryoturbation observed. Uneven organic horizon.
56	LEJ114	Polygon # 1242	613195	6954568	Sw on lower slope above Casino Creek. Black spruce - 5-10 m.	Alder, feather moss, sphagnum, willow, Labrador tea.
57	LEJ115	Polygon # 1151	613310	6954560	Dry slope. Former forest fire site (~20 years ago). Many tall charred spruce trunks lying on ground and some standing snags. Substrate: stony. No permafrost at 50 cm.	**On W-facing slope. Burn area about 20 years ago. Some surface stones. Very stony soil.**
58	LEJ116	Polygon # 1091	613405	6955085	Scattered tall white spruce among modertely dense brich saplings.	
59	LEJ117	Polygon # 1089	613400	6955230	Field veg assoc: Fbw/Fcs. No permafrost at 63 cm.	Some angular block slopes in area. W-facing slope. C horizon is quite gravelly, small coarse fragments. Bit of clay content in B and C horizons.
60	LEJ118	Polygon # 1067	613190	6955370	Dense and tall alder thicket over streamlet. Narrow stream valley bottom (on slope).	
61	LEJ119	Polygon # 1059	613069	6955541	Tall white spruce > 20 m forest with very little subcanopy.	Hit a large boulder / rock at 35cm depth. Did not hit permafrost by 35cm
62	LEJ12	Polygon # 959			Field Veg Assoc: Sr (riparian tall shrub). Riparian willow thicket along upper Casino Creek. Heavy moose browse on willows and droppings present. Long linear polygon - upper part is Sr, NOT Fco.	Floodplain of upper Casino Creek (narrow, level). Cobbley / bouldery creek, mineral staining. Apparently groundwater below Proctor Gulch is highly acidic.
63	LEJ120	Polygon # 1059	612608	6955845	Tall white spruce (~20 m).	SE of camp, coming up steep hill. Upper slope. Similar to last pit. Fairly smooth up hill. Not many surface stones. Steep slope.
64	LEJ121	Polygon # 992	612290	6956010	Sm but frequent tall white spruce. Thick moss layer. No permafrost at 45 cm.	Upper slope. No permafrost by 45cm. Very rocky, could not go deeper. Suspect permafrost not too much deeper. Sphagnum and pooling water about 50m downslope - very likely permafrost near surface there.
65	LEJ13	Polygon # 923	612940	6957450		Mid-slope on SW facing, moderately steep valleyside of Casino Creek (mixed forest). No bedrock, no boulders at surface. Minor undulating surface expression.
66	LEJ14	Polygon # 923	613360	6957595	Field Veg Assoc: Fco/St; Landform Assoc: St. Open conifer forest on s-facing slope with tall willow shrub.	More angular boulders exposed around nose of gentle ridge. Mosses / organics growing directly on cobbley soil.
67	LEJ15	Polygon # 936	613610	6957525	Conifer forest with dense lichen ground cover; tree canopy ~20%; lichen ground may have shown up as Ro on air photos; very large white spruce: dbh 75 cm, probably 25 m tall (photo) at UTM 613680 E 6957689 N	Steep, lichen-covered slope, open spruce. Dry soils overlying cobbley talus. Steep, shadowed, bouldery slop.
68	LEJ16	Polygon # 907	613590	6957790	Field Veg Assoc. recorded as Fcs and St. Funnel above creek. Tall shrub and tall white spruce (some up to 25 m). Several Salix spp. One spruce measured at 75 cm dbh at UTM 613680 E 6957689 N.	Variable ground, funnel-shaped wet basin. Little streams, shallowly gullied ground. Large (>1m) boulders on high ground areas. Sheetwash / spring meltwater runoff setting. Water-deposited layers (interbedded silt and sand).
69	LEJ17	Polygon # 923	613235	6957640	Mixed forest, somewhat stunted; only ground shrub in understory, charred stump - could be very old burn.	

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70	LEJ18	Polygon # 922	612560	6957460	Conifer forest on slope pretyped as 5St3Sd2Fw.	
71	LEJ19	Polygon # 1160	615230	6954410		Alpine, open ridge crest (long ridge polygon SE of camp), soil pit crosses into frost boil. Rounded crest. Angular to subangular cobbley surface, few boulders. No obvious bedrock exposure. Frost boils common, but poorly developed.
72	LEJ20	Polygon # 1170	615195	6954355	Tall shrub on steep 60% slope dominated by willows and small trees. Birch and spruce.	SW-facing, upper subalpine slope, bushy
73	LEJ21	Polygon # 1172			Viewed from across valley stunted mixed forest 75% decid 25% conifer; spruce taller than poplar. SE facing slope.	
74	LEJ22	Polygon # 1191			Viewed from across valley; rather tall canopy entirely white spruce; some lower tall willow or aspen.	
75	LEJ23	Polygon # 1204	615196	6954030	Part of polygon has denser low shrub (BETUGLA 30-60 cm tall, 50% cover), other part has about 5% shrub (BETUGLA) 30 cm - mainly lichen and moss and extremely low BETUGLA <10 cm. Very sparse stunted spruce cover 1-5%. Rocky cobble. Steep slope.	Very steep, very angular talus slope mostly covered in lichen, with patches of exposed cobbley talus. Minor slope sloughing of talus. NW aspect. Drought surface "soil" because all coarse fragments below organics. Permafrost suspected - slight lumpy lob
76	LEJ24	Polygon # 1209	615290	6953905	Tall shrub. Appears to be former burn - some fallen spruce skeletons with charring.	Moderately large, E facing, mixed wood polygon, E of high ridge. Smooth slope, no obvious bedrock. Shrubby. Distinct soil horizons --> stable --> no permafrost?
77	LEJ25	Polygon # 965	619505	6956910	Slope: irregular; Aspect: all directions. Rock covers about 50% between tors and felsenmeer. Many impressive tors in this cut. *Most of tundra surrounding tors and felsenmeer should be Sm (dom by BETUGLA) rather than Sd. Hoary marmot seen.	No soil. Large tor complex dividing two valleys. Granodiorite pinnacles, round at edges, blocks topple and fall. Base of tors surrounded in "halo" of large boulders. Dominantly weathered bedrock. Tor surface.
78	LEJ26	Polygon # 1000	619580	6956430	Vegetation breakdown accurate as pretyped. Scattered boulders across landscape. Dwarf birch overall dominant.	Hollow between bedrock outcrops and boulders on large bouldery slope with bushy / mossy vegetative cover, typical of veg-encroached boulder slopes. SSE-facing, but high elevation. Cryoturbated phase of Brunisol, because bedrock shallow, and permafrost s
79	LEJ27	Polygon # 1000	617665	6956170	Lower part of polygon 1000.	
80	LEJ28	Polygon # 1021	619820	6955835	Pretype correct. Tall thicket shrub 1.5 - 4 m tall. Scattered tall white spruce 5% emergent. Dbh of trees: 24, 25, 17, 44 cm ~ 20 m tall.	Middle of big bushwhack ? . Bouldery slope with gradual increase in soil and moisture. Tiny surface runoff channels and grassy / sedge. Midslope wet area. SSE-facing.
81	LEJ29	Polygon # 1125	620145	6955040	Tall spruce 20 - 25 m.	Middle of large mixed forest. Softer ground, grassy, alder between spruce. Occasional large boulders exposed.
82	LEJ30	Polygon # 1106			Riparian willow thicket along Dip Creek trib; NO marsh present.	
83	LEJ31	Polygon # 1130			Open bog but on gentle slope (Fen?). 5-10% black spruce.	
84	LEJ32	Polygon # 2012	601130	6944935	Probably should be called Fen since water is flowing through. Very hummocky from cottongrass and moss.	Valley bottom toe slope (gentle bog). Very wet, tussocky ground surface, standing water at base of tussocks. Bog on small, old, inactive alluvial fan. Water perched on permafrost table.
85	LEJ33	Polygon # 2029	601080	6944980	Active stream 1-2 m wide. Riparian willow thicket mostly 1-2 m tall. Some taller willow. Does not happen to be marsh in polygon.	
86	LEJ34	Polygon # 2028			Very similar to LEJ32 where full plot done. Open fen/bog with 5% black spruce and ERIOVAG hummocks.	
87	LEJ35	Polygon # 2041	600990	6945075	Dry mixed forest open canopy on dry slope. Gray jay, boreal chickadee, YR warbler, olive-sided flycatcher observed.	Toe of large, multi-fingered polygon on E-facing valleyside. Unvelievably easy digging and sandy in bottom. ~3-15m (2 pits dug as a check) above valley bottom.
88	LEJ36	Polygon # 2031	601130	6944950	Coniferous forest 10-20 m. Black spruce, almost no deciduous.	NE-facing bs forest
89	LEJ37	Polygon # 1879			Mosaic of aspen forest, dry aspen barren, mixed spruce-aspen-birch in mini valley; tall aspen or mixed on upper. Patches of dry barrens on s-facing slope.	
90	LEJ38	Polygon # 1974	604400	6943675	Field Veg Assoc: Bo and Bc. Spruce bog to open bog - open in centre and more treed around fringes. Spongy sphagnum mat. RTHA, SSHA, WWCR, GRJA observed.	Dip Creek valley bottom bog (level topography). Lots of spongey ground. Approximately half way between Dip Creek and steep grassy aspen slope on valleyside. Seepage entered excavated pit moderately fast.
91	LEJ39	Polygon # 1974	604135	6943670	Moisture regime recorded as 9 on data sheet. Small pond surrounded by sedge marsh surrounded by treed black spruce bog. One Carex sp. dominant. Some Calamagrostis, Chamaedaphne and Ledum around fen.	
92	LEJ40	Polygon # 1974	604220	6943596	Very tall bottomland conifer forest. Red squirrel, boreal chickadee, WWCR observed.	Excavated fresh face in hole of creek-eroded tree trunk (fallen across creek). Well preserved, interbedded medium-coarse sand and silt. Buried humic horizons and roots. Creek flowing near bankfull due to antecedent rain. Dip Creek bank (floodplain).

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93	LEJ41	Polygon # 2095	603865	6943875	Dry south-facing slope with dense bearberry; stunted aspen. This polygon varies from 1) Aspen Woodland - up to 50% cover trees up to 10 m; 2) Dry slope mostly bearberry, some grass clumps. Aspen as scattered low seedling/saplings; 3) Dry lower slope wit	Steep slop (SE-facing) with bear berry, grasses, small aspen, and bedrock outcrops. Numerous small (<0.3m) bedrock outcrops, especially at toe slope and on mid-slope "ridges". Dry, hot (summer) slope. Little talus rock material exposed, covered by
94	LEJ42	Polygon # 1852			From helicopter stripe mosaic on N face; bog-like slopes with B. Spruce 20% and low shrub (BETUGLA etc.) and deciduous forest - birch. *Should be Fbw NOT Fm.	
95	LEJ43	Polygon # 1628	605110	6949810	Mosaic along stream floodplain. Shrub bog at this UTM but surrounding riparian willow thicket along stream.	
96	LEJ44	Polygon #1612	605005	6949880		Moderately steep, mixed forest slope with W aspect. Quite sandy, especially at depth, relatively little coarse fragment content. Two small silt inclusions (lenses) within Bm3 (more grey), likely from variable slopewash. No evidence of cryoturbation i
97	LEJ45	Polygon # 1596	604730	6949840	Pure birch forest on upper slope 10-15 m; open understory.	Upper ENE-facing slope with grassy understorey and birch trees. Stonier soil on upper slope
98	LEJ46	Polygon # 1601	604470	6949795	Open stunted conifer on crest - should be Fco	Gentle, rounded ridge (near crest). Gradually more boulders (isolated) as we alked uphill. Soil pit near two large (2m) boulders.
99	LEJ47	Polygon # 1361	601690	6952430	Top of plateau is actually Sm not Sd (some Sd but much less). Tors present in NW part of polygon: about 60% rock.	
100	LEJ48	Polygon # 1314	602030	6952710	Permafrost at 35 cm. N-facing permafrost slope, erratic patches of Krummholz black spruce; very thick moss and wet, relatively few lichen and other areas with few spruce.	Mid-upper slope of large " solifluction stripe " polygon, on slightly drier "stripe" of birch (red), compared to willow / grass (yellow). Excellent high ice content permafrost. Clear, refrozen meltwater on permafrost table. I dug quick test pit in depr
101	LEJ49	Polygon # 1314	602330	6953080	Stunted black spruce shrub. Could have Sc for shrub conifer. Thick moss in hummocks. Permafrost at 25 cm.	
102	LEJ50	Polygon # 1215	602350	6953170	Riparian shrub - on stream floodplain; creek flowing in middle.	
103	LEJ51	Polygon # 1281	602395	6953245	Water table 30 cm. Mostly black spruce 3-5 m tall; NOT Bog but Conifer Shrub.	Extremely "gooey" soil, rapidly dilatant (like wet concrete). Rapidly infilled with seepage water. Dug pit at transition from stunted krummholz black spruce area and shrubby seepage (surface streamlet) area. Angular cobbles / boulders elsewhere in krum
104	LEJ52	Polygon # 887	599510		Northing recorded as: 695850. Valley bottom. Moose trails. Floodplain of large creek 4-5 m wide. Burned conifer skeletons. White and black spruce through community.	Continuous alluvial floodplain along creek at WNW edge / corner of study area. Interbedded silt / fine sand, with buried Ah horizon. Large, well rounded cobbles / boulders beneath overbank flood deposits, small boulder (50cm) at bottom pit. Some erosio
105	LEJ53	Polygon # 882	599530	6958305	Dry deciduous forest on S-face slope, quite young. Many fallen tree trunks indicate historic fire. Trees mostly 8-15 cm dbh 10-15 m tall.	Dry, steep rocky valleyside with aspen and birch. Above LEJ52. Loamy brunisol, (50cm deep). Charred stumps / fallen trees --> forest fire
106	LEJ54	Polygon # 909	599475	6958225	Shrub on N-facing mossy slope. Some groves of yg mixed forest. Permafrost at 35 cm.	Test pit in toe slope across creek from LEJ52. Medium steep sloping bog. Mineral soil beneath ~38cm of organic material. Preliminary observations: Sloping bogs = mineral soil with permafrost, Gentle valley bottom bogs = organic cryosol
107	LEJ55	Polygon # 1570	609690	6950375	NO Mr present but some patches of open Bog. Riparian willow shrub along stream 1.5-4 m tall. Lower shrub surrounding tall shrub consists of lower willow, VACCULI, BETUGLA, and class as St	Shrubby valley bottom. Seepage / floodplain area. Cumulic regosol in level, shrubby area.
108	LEJ56	Polygon # 1554	609500	6950420	Depth to permafrost: 30 - 60 cm.	Middle of homogeneous black spruce forest in tributary on W side of Casino Creek. Spruce becomes taller, denser upslope. Moderately rapid seepage filled soil pit to 42cm from surface. Wet concrete-like consistency. Permafrost controlled? --> Yes, 2nd
109	LEJ57	Polygon # 1510	609780	6950540		Lower slope of beautiful mature aspen slope (SW-facing). No Ah horizon, therefore forest fire history?, also no lichens. Loamy soil with increasing colluvial fragment content with depth.
110	LEJ58	Polygon # 1585	609830	6950405	Mixed forest, some white spruce tall up to 25 m; aspen 15-18 m.	Mixed aspen, birch, white spruce slope across from uniform B.S. Brunisol. Sandy loam. Relatively few coarse fragments. Step moss and grassy understory.
111	LEJ59	Polygon # 1725	616340	6948845	Marsh in pingo centre; mainly Calamagrostis; level centre but steep sided crater surrounding marsh with tall conifer forest of white spruce on thick moss of surrounding crater.	
112	LEJ60	Polygon # 1686	616320	6948745	Conifer bog on gentle slope 10%; thick moss 95%; permafrost at 30 cm.	
113	LEJ61	Polygon # 1740	616110	6948570	Should be Fc, not Bc. Probably permafrost where moss. Part of polygon where ground cover is mostly lichen (esp Cladina, some sphagnum) is clearly not Bog. At lower edges of polygon is more herb some Eriophorum.	
114	LEJ62	Polygon # 1686	615840	6948785	Edge of 1686 and 1740. Conifer bog similar to LEJ60 on floodplain of creek.	
115	LEJ63	Polygon # 1681	615590	6949295		Large thaw lake in forested bog (gently sloping) with extensive retrogression thaw slumps along the uphill side (faster than trees can adjust). Numerous fallen trees and fresh soil exposures. Pit dug in freshly excavated face of headscarp of retrogres

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116	LEJ64	Polygon # 224	615401	6969290	Coniferous black spruce on N face.	N-facing black spruce forested slope opposite side ridge from teep, rocky, grassy slope. Notably cobbley / stoney.
117	LEJ65	Polygon # 246	615360	6969200	Polygon is mosaic of dry grassland (Lx) and dry stunted aspen forest (Fbx).	Very steep sun-baked grassy slope with patchy aspen. Bedrock outcrops along ridge and in "ribs" down slope. Uneven Ah horizon at surface, possibly because of water / wind erosion between tufts of grass. Angular colluvial parent material. Depth of coll
118	LEJ66	Polygon # 251	615390	6968820	Riparian mixed forest along creek on narrow floodplain. Flowing creek 1.5 m wide. Monkshood in flower. Near valley bottom.	Lumpy floodplain of 2m wide step-pool stream between steep dry grass / aspen slope and striped bog-slope. Sandy cumulic regosol. Cobble-boulder bed and gravels / sand. Pit dug in floodplain at base of "deciduous" strip between spruce bog slope.
119	LEJ67	Polygon # 260	615325	6968785	Rocky soil. No permafrost. *Clearly NOT Fc, but Fcw. This polygon is 'striped' with Sw and Fbw.	**Soil pit within narrow strip of birch / alder forest growing on rocky boulder ground that appears to be like a stone stripe on steep permafrost slope, talus boulders exposed at surface and beneath mosses/grasses. Pit immediately adjacent in boggy stripe**
120	LEJ68	Polygon # 260	615360	6968785	Sw or Bc on rather steep slope. Permafrost 25 cm deep. Sparse Black spruce and thick moss (esp. Sphagnum) layer.	Moderately steep boggy "stripe" adjacent to bouldery, better drained deciduous forest stripe. Only 3m away from bouldery talus-like deciduous strip! (deeper permafrost, better drained)
121	LEJ69	Polygon # 804	618340	6959670	Moisture regime transitional between 2 and 3. Slope % and Aspect variable. Mostly steep and variable rock faces covered in crustose lichens. Pockets of soil in nooks and crannies that support grasses, moss and forbs.	Pit 1 = bedrock surface, Pit 2 = pocket of soil/veg. Crest / ridge of low-moderate tor. Pockets of organics growing directly on rock and on shallow (<30cm) patches of mineral soil.
122	LEJ70	Polygon # 849	618765	6959600	Sm at this location. Nearby shrub conifer (Sc) in polygon. Shrub growing on moss covered felsenmeer boulders.	Scrubby, bouldery slope downhill of weathered bedrock, talus, tor complex. Dwarf --> taller birch, willow, alder, labrador tea, all growing on step moss and lichens that discontinuously blanket boulder field. xCv from veg. perspective, (best to leave of
123	LEJ71	Polygon # 782	619110	6959600	Substrate/soil: silty sand. Depth to permafrost: 50 cm.	Dense, tall shrub on moderate slope on valleyside (E-facing). Pit within grassy, slightly mossy area adjacent to alder patch. Suspected seepage / snowmelt runoff area. Permafrost encountered in pit at 50cm depth and slightly farther upslope between s
124	LEJ72	Polygon # 782	619380	6959750	Riparian willow thicket stunted along bottom of creek. Low willow browsed by moose. *This polygon is a mosaic of St, some Fco and Sc (or Sw?).	
125	LEJ73	Polygon # 751			Viewed from creek. Mixed forest with tall white spruce and shorter paper birch. From ground, there did not appear to be much St but from air it was evident that pretype is correct.	
126	LEJ74	Polygon # 544	619440	6963610	Sm mainly, very top is Sd. Should be	
127	LEJ75	Polygon # 566	619460	6963510	Moisture regime: subxeric - mesic. This is dry S slope with dense shrub thicket. Structurally should be St.	
128	LEJ76	Polygon # 566	619850	6963570	Field veg assoc: Fbx/Sx	Moderately steep slope with "patchwork" of tree/shrub patterns (colour). Patch of stunted aspen with mixed forest around. Perfect Brunisol. Smooth transition from Bm to C horizon. Matrix to clast supported colluvial soil. Dug LEJ75 to W as test hole
129	LEJ77	Polygon # 534	619750	6963697	Thick moss on N facing slope. Permafrost at 30 cm.	Very steep, N-facing, sloping bog. Patches of cobble talus exposed at surface, much of which is lichen / moss covered. Essentially an organic mat (fibric) overlying cobbley talus with permafrost. High ice content in cobbley talus permafrost.
130	LEJ78	Polygon # 719	610175	6961095	Permafrost at 27 cm. Very low shrub tundra. BETUGLA is < 20 cm. *Should this be Sd (very little Dryas) but very low shrub, or Sm? Ptarmigan - red eyebrow, all black tail in flight, 5 seen, white underparts, grayish brown upper.	Homogeneous very low shrub, mossy high alpine polygon. Smooth slope. Permafrost in mineral soil, but thick organic mat on surface. 2cm-wide pore ice lens in base of pit (photo). Seepage filled pit bottom slowly.
131	LEJ79	Polygon # 734	610390	6960930	Very low tundra mostly < 10 cm on thinner soil edge of felsenmeer boulder. Permafrost at 50 cm.	
132	LEJ80	Polygon # 914	611496	6958080	*Polygon appears to be entirely Sm, NO Sd. Permafrost at 43 cm. Near Patton Hill.	Sharp bend just N of airstrip, at base of Patton Hill. Good turbic cryosol (distorted, buried Ahy). Dwarf birch, mossy NE aspect.
133	LEJ81	Polygon # 886	611580	6958085	*NO Sd in polygon; mostly Sm dominated by BETUGLA 1 m; St in disturbed area.	
134	LEJ82	Polygon # 825	611200	6959225	Mostly Sm. Scattered clumps of black spruce 2-5 m tall. Permafrost 38 cm. Aspect S.	Northernmost perimiter of open pit footprint. Directly S-facing, but spongier, mossy ground. Permafrost surface dry.
135	LEJ83	Polygon # 797	612900	6959425	Small area of characteristic Sd with frequent rock outcrops, shallow soil, very stony, very low vegetation.	High alpine ridge crest NE of camp. Boulder ground with bedrock outcrops along ridge; smooth discontinuous cover of veg / soil. Dryas covers ground surface; no mosses; didn't reach permafrost (or just too stoney, but cryoturbated).
136	LEJ84	Polygon # 837	613130	6959290	Felsenmeer of huge boulders 1-3 m diameter, covered in abundant lichens.	Pit 1 = bedrock; no soil, Pit 2 = soil; patch of mosses / lichens / heather. Felsenmeer "slope" of weathering bedrock NE of camp, near tors. Large boulders, mainly. Other than rock lichens, just moss growing in patches directly on boulders.
137	LEJ85	Polygon # 797	613260	6959230	Slope: steep and variable. Tor with broken lichen covered rocks. Small pockets of soil where plants grow. Dense Dryas patches on more level side slope are not reflected in quadrats.	Crest of "one-sided" tor, NE of camp. Sheer cliff on ESE side (~10m), repose angle boulders on WNW side. Freshly fallen fragment of boulder / bedrock at base of tor
138	LEJ86	Polygon # 863	613160	6958805	Field veg assoc: St, Fcs. Large boulder ground mostly soil covered. Tall shrub (mainly willow) with emergent white spruce 10 - 20 m tall. Does not appear to be Sm in this polygon.	Tall shrub, sparse black spruce, boulder slope. Rocky ground covered with vegetation; with "holes" to fall through while walking. Isolated standing water pool at base of boulders.

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139	LEJ87	Polygon # 871	612770	6958530	Permafrost: 47 cm. Water table: 39 cm. Male moose seen in this polygon. Sm with scattered black spruce, uniform. Shrub layer gradually gets taller further down in polygon.	SW-facing gentle slope NE of camp (headwater of Casino Creek). " Footprint ". Excellent representation polygon --> low shrubby sloping bog. Wet, concrete-like consistency. Rapidly seeped into pit.
140	LEJ88	Polygon # 884	612540	6958280	Field Veg Assoc: St, Fcs. Prominent conifer component and tall willow.	SW-aspect, steeper slope (NE of camp, across from Proctor Gulch). No more permafrost! Convex-up slope --> more sun, less ice (edge of real "forest" begins). Drier brunisol.
141	LEJ89	Polygon # 749	612435	6960555	Sd - low shrub < 20 cm, includes stunted low black spruce, thick moss, NO Dryas present. Willow ptarmigan 3, chestnut head. Permafrost at 48 cm.	Long, gentle solifluction slope. Silty-loam soil. Long, wet slope. Imperfect - poor drainage.
142	LEJ90	Polygon # 800	609730	6959105	Sm but low 30-40 cm. 5 willow ptarmigan.	
143	LEJ91	Polygon # 825	610080	6959130	Low 8 m transition to Sd? About 30 cm high.	
144	LEJ92	Polygon # 885	610530	6957970	On top of Patton Hill, undisturbed area of low Sd.	Top of Patton Hill, on undisturbed site with slight S aspect. Very cobbley ground with little matrix material. Too stoney to detect permafrost.
145	LEJ93	Polygon # 931	611200	6957210	Sm transition to St. Bouldery soil.	W side road directly above camp, in " Footprint ". Typical shrubby boulder bog slope. Lack of permafrost in pit therefore boulders +8m from upslope road edge --> drained suprapermafrost groundwater. Cryoturbated
146	LEJ94	Polygon # 947	611320	6957150	St willow thicket 2 m tall below road. Polygon is variable with St, Sm, Sc (spruce shrub).	
147	LEJ95	Polygon # 2081	604975	6944980	Proposed airstrip. Open bog near Dip Creek, very hummocky from Eriophorum. Substrate: silty. Permafrost at 40 cm. Water table: 13 cm.	Flat tussock bog adjacent to Dip Creek in proposed AIRSTRIP polygon. More realistically floodplain polygon than fan. Rapid dilatancy (coarse silt). Trace of clay, negligible sand.
148	LEJ96	Polygon # 1974	604960	6944930	Field Veg Assoc: Sr and Fc. Mostly coniferous forest (tall white spruce) along Dip Creek. Occasional groves of POPUBAL. Narrow band (5-15 m) of Sr along creek edge with ALNUINC, SALIX, young BETUNEO, BETUGLA 1.5-5 m tall.	
149	LEJ97	Polygon # 1974	604975	6944860	Permafrost: 50 cm. Sedge marsh in oxbow of Dip Creek. Standing water 20 cm deep.	Oxbow marsh on S side of Dip Creek. Sphagnum / red stem at fringe, sedges in marsh centre. Permafrost at transition to silty mineral soil - encountered at 30-50 cm depth (deeper in centre of marsh).
150	LEJ98	Polygon # 2081	605075	6944810	Proposed airstrip. Permafrost: 52 cm. Watertable: 50 cm.	Raised circular "spot" in lower end of triple fan complex (higher, drier), abuts onto Dip Creek oxbow. Black spruce forest, not boggy. Deeper permafrost in fine-textured soil. Trace / some clay, at plastic limit - 3mm worm.
151	LEJ99	Polygon # 2081	605155	6944205	Small stream through conifer bog, richer with flow and therefore Salix. Generally too narrow a feature to map but it is on the proposed airstrip footprint. Many Black Spruce dead near streamlet especially downstream from winter road.	Small stream in middle of large old fan (AIRSTRIP). Flowing through tall grasses. Prominent iron staining on stream bed (mucky and grasses). Mixture of silt and vfs and grassy organics (undecomposed) to bottom, then fine - medium sand. Lots of undec
152	LES01	Polygon # 1260	607164	6953421	Within Sm eco. Small tor to the north of plot. Fe to the south of plot. Some lichen on ground with peat moss dominating.	In colluvium near tor, on apron below rocky knoll and bouldery talus. Minor seepage. Large, distinct mottles present in BC horizon. Near tor, at edge of shallower slope, slope becomes steeper slightly downslope.
153	LES02	Polygon # 184	616011	6966571	West side of creek north of crossing. Sw dominated site with occasional Pb in canopy. Within riparian veg - large Sw with riparian shrub to the west. On the north end of plot has increased cover of rose. Increase horsetail closer to creek edge.	Sandy soils. Thin band of finer sand material and a think layer of buried organic indicating past flooding. ~15m from Canadian Creek within active floodplain. No gravels observed in pit. Top and bottom horizons the same.
154	LES03	Polygon # 184	615944	6966603	Spruce have needle casts on them. Tree species under 5 m tall. Very thick willow all the same species. Ground veg is dominated by horsetail and moss. Two small tribs to the east of plot.	Abundant coarse fragments under soil surface, ~40% (photo 30). Cobbles and pebbles within floodplain. Could only dig pit to 20cm due to coarse fragments. Possibly disturbed site.
155	LES04	Polygon # 184	616013	6966539	On south side of creek. Slight transition just south of plot. Some down woody debris (willow dead). Some very tall willow. 1553-1555: photos of typical vegetation. Sw dominates overstory. Riparian with Pb. Understory contains some Sw but dominated	Very thin LFH. Medium to coarse sand in C horizon. Pockets of buried organic. Ah horizon <10cm.
156	LES05	Polygon # 424	616054	6966501	Within stunted Sb stand. ~50 m south of Canadian Creek. Was mapped as Mr but is not. Dominated by small black spruce.	
157	LES06	Polygon # 1232	604855	6953376	On top of slope with tor just outside of plot.	Surface rocks ~15-20%. Shallow soil over rocks in many places. Soil pit was deeper area between rocks / boulders. Bedrock outcrop upslope to NW ~20m (photo 93). Near crest of ridge. Wet soil - jiggly. Moderately dilatent. Hit cobble and boulder at
158	LES07	Polygon # 1232	604803	6953377	On rock outcrop. More than 20C veg so classified it as Sd. 3-leaved saxifrage and ferns growing within rock crevice.	On bedrock outcrop. Few areas with soils. Shallow LFH and soils mainly, but soil pit to 55cm hit boulders. Deeper soils than I was expecting on bedrock outcrop on small ledge. Mostly shallow soils on rock and surface rock / boulders and bedrock.
159	LES08	Polygon # 1232	604757	6953438	Within Sm ecosystem - Betula dominating with some boulders within area. Tor to the north west.	
160	LES09	Polygon # 906	606199	6957909	Within Sd association. Some surface boulders with limited vegetation between them. Site dominated by lichens.	Near crest of tall, rounded knoll. Patterened ground, sorted rocks, polygons, and earth hummocks. Horizons appear to be cryoturbated with pockets forming throughout. Bottom was rocky. Top of pit was very pebbly / cobbley - angular coarse fragments. D
161	LES10	Polygon # 906	606158	6957949	On side slope. Just below Sd with Sd on plateaus.	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
162	LES100	Polygon # 425	616764	6964933	Evidence of fire observed (burned stumps throughout stand). Mix of all species. Black spruce within the understory. A lot of leaf litter present on ground. Standing dead shrubs throughout stand.	Lower slope, just above road cut S of Britannia Creek crossing, immediately S of mucky high ice-content permafrost cut. Mixed forest, mossy and litter understorey.
163	LES11	Polygon # 898	606031	6957982	On plateau with Fe on the steeper parts of cliff. Some parts are softer.	
164	LES12	Polygon # 831	606255	6959208	Depth to permafrost: 85 cm. Plot ~5 m west of small seepage area. Carex lugens found on top of hummocks and Carex aquatilis is found along seepage. Seepages run throughout polygon.	Water at surface in places. Sphagnum mosses. Wet. Hit permafrost at 85cm depth. On south-ish facing slope. Solifluction? Heavy mottling of soils and gleyed. Seepage present. Coarse fragments at bottom of pit. Buried Oh horizon at ~82cm, pocket, c
165	LES13	Polygon # 831	606326	6959288	Within Fe not much veg on boulders. Slightly steep slope. Sd on top.	Uphill of LES12, on S-facing slope. Weathered bedrock and rock lines. Seepage on slope below - flowing downslope in areas.
166	LES14	Polygon # 831	606149	6959134	Just below plot LES12. Dry soil with Fe throughout. Not enough bare rock to be pure Fe. Will be classified as Sd.	Within weathered bedrock area downslope of LES12. No LFH. Rocks / stones at surface. Abundant coarse fragments within 30cm of surface.
167	LES15	Polygon # 852	605920	6958983	On south facing slope. Some boulders within plot. Birch changing colour already.	Between weathered bedrock / colluvial area, lower down on slope than LES14v. Hard to dig past 30cm.
168	LES16	Polygon # 860	603092	6959496	On a north facing slope. Stunted Sb throughout polygon. Not as wet as thought to be. Substrate/soil: Cryosol. Depth to permafrost: 60.	Hit permafrost at 59cm. Some cryoturbation evident. Uneven horizons.
169	LES17	Polygon # 787	603154	6959754	Plot along creek - see photos - pretty much a small permanent creek. Lots of small drainages throughout probably caused by flooding and high surface water flows.	In floodplain. Willows and low shrubs appear fairly well established. Channel cuts (dry) within floodplain area. Channel is steep and strong flow. Hit boulder / cobble at 65cm, could auger no further.
170	LES18	Polygon # 2226	607150	6941128	On top of ridge with loose rock. Site dominated by shale-like rock. Some taller shrub and some sparse conifer.	About 50% surface stones. On crest of ridge. Stones angular. Coarse fragment content high. Difficult to dig past 30cm.
171	LES19	Polygon # 2238	607092	6941043	On SW facing slope. Very sparse spruce canopy. Not sure enough to call a canopy. Probably closer to tall shrub association - but dry - should most likely put modifier on ecosystems. Botrychium in plot.	On steep slope. 220 degree aspect. Abundant angular coarse fragments, difficult digging.
172	LES20	Polygon # 2224	607237	6940976	Within sparse coniferous stand. Trees are slightly smaller than other spruce stands. Tall shrub layer observed with some lichen and mosses.	On slope, similar to LES19. Abundant coarse fragments. No stones observed at surface.
173	LES21	Polygon # 2114	608606	6944087	Birch and willow and aspen ~1.5 m tall. Thick with scattered Sw ~3 m tall.	In riparian area of tributary to Dip Creek. Evidence of recent flooding (within last few days). Willows, alder. Ground cover buried by sediment from recent flood. Possibly hit permafrost at 65cm - hard digging.
174	LES22	Polygon # 2201	604352	6941764	Within sparse Sb canopy on north facing slope. Site dominated by moss and lichens. Very low diversity of vegetation.	On slope in treed area. Abundant angular coarse fragments. A few boulders at surface throughout area.
175	LES23	Polygon # 2207	604350	6941706	With south facing slope stand dominated by Aw. Very little ground veg. Lots of litter. Evidence of fire in the area. Burned stumps and logs present.	On W-facing slope. Aspen stand. Coarse fragments in C horizon. Bm redder colour. Well drained, drier site.
176	LES24	Polygon # 2212	604450	6941706	This association has a small component of aspen within the understory.	
177	LES25	Polygon # 2240	609827	6941497	Ptarmigan on Sd landscape near this plot. On crest of hill some Sm just to the south. On north facing slope with exposed rocks.	
178	LES26	Polygon # 2231	609753	6941248	Within dry shrub stand. Small Bw, Pb and Aw under 5 m. A few scattered Sw and Bw ~5m in height. Not enough to call an overstory. Evidence of historical burn - burned stumps observed.	On steep S-facing slope. Tall shrub dominated. Dry site.
179	LES27	Polygon # 2114	608670	6944194	Within tussocks area. Mapped as Bo - a bit different due to tussocks. Most veg is growing on top of hummocks. Nutrient is difficult to determine - lack of sedges and rich indicators??	Permafrost at 70cm depth. Bg is gleyed. Under 30cm thick organic. In bog / drainage area. Tussocky. Hit mineral at 30cm - Cg - very mottled and gleyed.
180	LES28	Polygon # 2092	608593	6944072	Scattered stunted spruce (black), site dominated by peat mosses. Plot is just up slope of small creek. Permafrost at 35 cm.	On a N-facing slope, sphagnum mosses.
181	LES29	Polygon # 2114	608605	6944085	With shrub layer of small creek. Looks like it was recently flooded. Creek within plot.	
182	LES30	Polygon # 2114	608610	6944148	Within Bc association. Larger Sb within plot. Less hummocks and increased ACTARUB.	
183	LES31	Polygon # 1909	609376	6946958	Within open bog just south of Dip Creek. Tussocks throughout.	~20m S of Dip Creek. Shrubby bog. Soil pit in between tussocks. Sphagnum, feather mosses, cotton grass, dwarf birch, Labrador tea.
184	LES32	Polygon # 1974	609370	6947003	Gravel bar on Dip Creek. Very little veg growing.	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
185	LES33	Polygon # 1974	609391	6946964	Plot near old oxbow - along bank of old oxbow increased grass within old oxbow. Some bog species on west side of plot. Some of Sw have yellow witches broom. Willow is very tall ~3 to 4 m tall. Some small Sw and Bw regen.	On bank of an oxbow, S of Dip Creek. Oxbow on one side of bank and lowish drainage on other side of bank (almost berm-like, but natural). White spruce stand. Hit permafrost at 63cm depth. Mottling in Bm horizons.
186	LES34	Polygon # 1974	609458	6946814	~14 m tall black spruce within stand. ~15 m from sm creek. Some small birch within stand.	
187	LES35	Polygon # 1941	609504	6946811	Some standing dead willow. Some of stand is not very tall. Mix of Sw, Sb and Bw. ~20 m to the west is a small creek. Very low diversity within plot. This is mixedwood on north facing slope. Depth to permafrost: 32 cm.	Small creek tributary to Dip Creek, to SW. To SE, slopes up to more mixed forest stand and slopes down to N. Somewhat thick layer of feather moss (~4cm + Of). Hit permafrost at 32cm depth.
188	LES36	Polygon # 2020	609456	6946730	Within Sb stand. White spots on map appear to be lichen through the canopy. South side of trees are dark red - maybe from prevailing wind? The odd birch in canopy up and down slope. Trees become larger upslope.	On N-facing slope, Sb stand. Hit bedrock (weathered) at 31cm but could dig / auger through it. Lighter A horizon = Aej.
189	LES37	Polygon # 1796	609384	6946798	Within shrubby bog trees ~2.5 m tall. Dominated by sphagnum. Ledu dec.	Shrubby bog. Sphagnum, scrub, sb.
190	LES38	Polygon # 1846	611492	6947660	Dwarf birch on south side of plot. Very low diversity of vegetation. Soils disturbed. Lines of taller birch throughout probably from placer mining. Permafrost at 40 cm.	Disturbed site - wetland. Growing back dominated by cotton grass. Permafrost at 40cm. Soils appear mixed. In level bog just N of Dip Creek. TS is mixed with organic and upper subsoil. Then hit buried organic and Bm horizon. Melting permafrost and s
191	LES39	Polygon # 1796	609311	6948222	On south facing slope with patchy aspen canopy from fire? or erosion?	
192	LES40	Polygon # 1974	611588	6947830	Within fen-like area around thaw lake. Dominated by sedge and grasses. Water near or at surface.	On edge of thaw lake. In drainage water in pockets at surface. Large chunks of frozen organic starting at ~65cm. Hit solid permafrost at 70cm depth.
193	LES41	Polygon # 1974	611643	6947746	Along Dip Creek. Large white spruce. Open bog surrounding larger spruce on other side of creek.	Thick LFH under stair-step moss. On bank of Dip Creek, on bank slope. Feather mosses, bog cranberry. Below is small bar that has been recently flooded.
194	LES42	Polygon # 1974	611586	6947743	Within open bog with cotton grass dominating.	
195	LES43	Polygon # 2026	613807	6945218	Plot on steep slope. Very little vegetation diversity.	Very steep, dry, S-facing slope. Some surface stones. Small bedrock outcrops / blocks on walk up to site. Grassy. Stones in pit. No LFH. No Ah. No trees in immediate site.
196	LES44	Polygon # 2026	613840	6945217	Within dry aspen forest. Very steep slope. Next to dry grassland.	
197	LES45	Polygon # 2018	613856	6945203	Within mixed stand with Sw and Bw dominating over story. Two large veteran trees present in plot.	S-facing slope, near bottom of steeper sloped aspen and grassland. Very tall spruce near pit.
198	LES46	Polygon # 1978	611648	6945599		On gradual slope. Sb bog - but shallow organic soils - hit mineral at 16cm. Permafrost at 31cm.
199	LES47	Polygon # 1978	611792	6945953	Within open bog. Increased amounts of red sphagnum in this spot. Scrubby little black spruce. Water very close to surface.	Sphagnum bog, bottom of gentle slope before steeper slope to creek.
200	LES50	Polygon # 606	615522	6962932	On very steep slope ~70%. Surface stones.	Along road where Andy dropped us off NE of camp. Road cut. No LFH. Abundant coarse fragments. Grassy slope - grasses, rose.
201	LES51	Polygon # 598	615786	6962984	Close to pure birch stand on south facing slope? One to two large white spruce present. One vet within plot. Very tall willow throughout plot. Evidence of fire with charred stumps and logs observed. Some of smaller trees have broken tops. Phacelia m	Dry S-facing slope with birch and juniper. Some coarse fragments, mainly in C-horizon.
202	LES52	Polygon # 567	616048	6963242	Very little veg within plot. Lots of leaf litter on ground. Rose is dominant shrub within stand. Some fallen rotten birch on ground.	On NE-facing slope. Mesic soils. Large coarse fragments at bottom of pit - large cobble.
203	LES53	Polygon # 598	615934	6963174	Within pure aspen stand. Lots of litter within plot.	Near top of hill - NE of camp, 1st road landing. Black/grey rock layer underlying Bm horizon.
204	LES54	Polygon # 797	613671	6959947	Within Fe slope. Large angular boulders throughout. Little vegetation except in small plateaus.	In felsenmeer, weathered bedrock, (stony colluvium?). Majority of area is rock, small patches of soil and vegetation
205	LES55	Polygon # 760	613808	6959965	Small stunted spruce throughout under 3 m. Some surface stones along ground. Shrubs are ~2 m tall. Fits to a tall shrub better than an Sm association.	Below felsenmeer. Still quite rocky, but more vegetation, soils. Tall shrubs. Hit boulder at 20cm, could not dig deeper. N-facing slope
206	LES56	Polygon # 775	613876	6959931	On Fe. Very little veg. Dominated by rock.	
207	LES57	Polygon # 760	613990	6959862	Shrubs ~2 m tall - shorter in some places. Ground is dominated by moss covered boulders.	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
208	LES58	Polygon # 760	614021	6959861	On a north-facing slope. Permafrost encountered at 34 cm. ~5 m west of plot water heard running under ground below some boulders.	On N-facing slope. In solufluction? Strip. Boulders in strips running downslope on either side of plot area. Tall shrubs growing in bouldery strips, but none in the permafrost mossy area where pit is situated. Hit permafrost at 34cm. Evidence of cryo
209	LES59	Polygon # 760	614324	6959537	On north facing slope. Permafrost at 50 cm. Some short shrub. Mostly dominated by mosses: HYLOSPL 75%, SPHAGNU 20%.	On solifluction strip. Mineral soil at 13cm depth, mottling present. Moss, ground shrubs. Cryosol - turbic or static, not organic. Similar to LES58.
210	LES60	Polygon # 678	617963	6962256	Plot on NE facing slope with birch dominating overstory. Large amounts of boulders present in plot.	Abundant surface rocks.
211	LES61	Polygon # 685	618045	6962219	Site is right on small creek. The area has been flooded during the summer. Sand and silt are over vegetation. Along a trib to Britannia Creek.	1m from edge of tributary to Britannia Creek. Evidence of recent flooding. Sand accumulation at surface. No LFH. Hit water table at 75cm.
212	LES62	Polygon # 685	618085	6962128	Hit permafrost at 65 cm. 22% slope, 280 aspect. On side slope beside trib to Britannia Creek.	On 280 degree facing slope, upstream of tributary to Britannia Creek. Sphagnum moss, dwarf birch, Labrador tea, scrub sb, lichens, bog cranberry.
213	LES63	Polygon # 37	619440	6973157	On island within Yukon River. Pure balsam poplar stand. Lots of leaf litter present. Two spruce just outside of plot.	Tall poplar, on island just off shore in Yukon River. May be layers of B and C horizons - I just put one of each as the colour is very close, texture is the same, so it is difficult to tell.
214	LES64	Polygon # 37	619441	6973359	Along Yukon River. Gravel bar within side channel.	
215	LES65	Polygon # 37	619254	6973225	Within conifer stand. Group of conifers growing on island. Ground veg not as tall or dense. Lots of leaf litter.	
216	LES66	Polygon # 37	619302	6973212	Low diversity of vegetation. Shrub layer not as thick or as tall as previous plot.	On island in Yukon, near mainland. On W-side of island in mixed conifer and deciduous stand. Texture the same throughout pit. Loam. Slight colour changes.
217	LES67	Polygon # 40	619646	6973033	Within north facing slope (28 degrees) with 40% slope. Boulders underlying.	Near island, on mainland, N-facing, fairly steep slope with birch. Boulders / blocks at surface in places. Soil is stoney. Did not dig soil pit. Expect brunisol. Shovel in ground, hit stones.
218	LES67b	Polygon # 47	620625	6973050	Plot number "LES67b" because two "LES67" plots recorded in field. On an island within the Yukon River. Dominated by balsam poplar.	
219	LES68	Polygon # 34	620250	6973350	On island along the Yukon River. Pictures and UTMs taken from helicopter.	
220	LES69	Polygon # 75	620900	6972425	On island within the Yukon River. Large spruce trees.	
221	LES70	Polygon # 227	620354	6969539	Within very sparse mixedwood forest. Was typed as St but should be changed.	On S-facing slope. Some surface stones / small bedrock bits. Think I hit weathered bedrock near surface (about 18cm depth). Cobble size angular chunks kept breaking off further and further into the side slope. Photos… Soil intermixed.
222	LES71	Polygon # 211	620283	6969620	Within Sx association? Need to check on the classification. Along ridge very thick shrubs. May be Sx or St not quite sure. Dry aspect. Some scattered conifer and Bw but not enough to call a canopy.	On S-facing slope. Bedrock outcrop just upslope of pit - near ridgetop. Soils similar to last.
223	LES72	Polygon # 206	620413	6969644	Field Veg Assoc: Sm or Fcs? Not sure what to call. Lots of scrub, black spruce but rocky soil. 32% slope with an aspect of 354 (aspect of 20 recorded by JM).	On N-facing slope. Thick feather mosses, dwarf birch, and stunted sb. Was expecting permafrost, did not hit by 30cm. Very coarse fragments (~20%), difficult to dig. Some areas of sphagnum, very soft, lush walking. Just below ridge S of Yukon River.
224	LES73	Polygon # 184	617827	6973490	Medium to rich site - large tall shrubs present but forb and moss layer absent. Thick shrub layer. Lots of leaf litter on the ground.	Broadleaf forest, just north of Yukon River. Sandier at bottom of pit, rest is loam. Riparian floodplain area.
225	LES74	Polygon # 42	617370	6973279	Little bit of low spot. With some richer species. The occasional Sw within the canopy, but not within plot. Rocks just south of plot up a slope. Depth to permafrost: 57 cm.	On N-facing slope, S of wetland on S bank of Yukon River. Terraced site? Does appear somewhat terraced. We are on the lower slope, it comes up from wetland, then levels out for ~3-5m then rises again and appears to level out again. Permafrost at 57cm
226	LES78	Polygon # 1884	617435	6971250	Within riparian area. With large spruce trees. The most diversity within riparian that has been encountered.	On floodplain of Britannia Creek. No evidence of recent flooding. Pit is very stony - rounded and subrounded. Layering of Ah and C horizons. Cumulic Humic Regosol.
227	LES79	Polygon # 184	617395	6971280	Within broadleaved riparian area. Right beside Britannia Creek.	
228	LES80	Polygon # 107	617324	6971292		SE-facing sl ope - faces towards Britannia Creek. Very steep slope. Abundant boulders and surface stones, with bits of veg. growing over. No LFH. Very steep, small bedrock outcrops were observed in polygon.
229	LES81	Polygon # 107	617299	6971252	Within grassy slope with slumping and eroding soil.	
230	LES82	Polygon # 165	617224	6970750	Within conifer forest with stunted spruce with Britannia Creek ~40 m to the east. Poppy	Bog-like wetland. Organic to 34cm, hit permafrost at 36cm depth. Pocket of mineral soil at ~30cm depth. Slopes slightly towards Britannia Creek to the east.

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231	LES83	Polygon # 219	613015	6969818	Within Sw polygon. Not organic soils and rocky. On north facing slope. Site dominated by BETIGLA and feather moss.	Bedrock outcrops at top of slope. On N-facing slope, black spruce and feather moss. No sphagnum. Expected permafrost. Very rocky. Did not reach permafrost by 85cm depth.
232	LES84	Polygon # 219	613071	6969911	Fcs forest with tall shrub understory.	
233	LES85	Polygon # 151	613077	6969932	Within mixedwood young forest. Fire evidence through standing dead snags - burned.	Upper slope. Mixed wood birch and spruce. Feather moss, Labrador tea.
234	LES96	Polygon # 1506	625832	6950651	Fe association. Within a steep slope with Fe falling down hill.	
235	LES97	Polygon # 1454	625709	6950864	Short shrubs not dominated by Dryas but majority of shrubs lower than 20 cm making it Sd. On a steep slope with boulder fields running down slope all along hill side.	Moderately steep mountain slope at SE corner of LSA (just outside). Boulder slope with vegetation overgrowth at base of high boulder talus / weathered bedrock peak. Wet concrete-like consistency near base. Suspected permafrost.
236	LES98	Polygon # 1423	629024	6950984	Within St association.	
237	LES99	Polygon # 1423	626138	6951056	A bit wetter than normal Sm. Creeks on both sides of plot. VACCULI is turning as well as BETUGLA. Substrate/soils: turb cryosol; depth to permafrost: 34 cm.	Long, gentle "tongue" in middle of upper alpine basin, with veg patterns indicative of cryoturbation. Distinct cryoturbation evidence in permafrost: Ahy bands, Mottles of B...
238	LRR01	Polygon # 780	621364	6959929	Plot describes the area at the base of tors/top of felsenmeer. Some PICEGLA below plot, but not much; infrequent on landscape.	
239	LRR02	Polygon # 839	615247	6958711	Betula and Ledum all ~ 30 cm tall on mineral soil - gravelly, below tors; Salix spp. are in the bouldery-tors areas.	
240	LRR03	Polygon # 782	619373	6959450	Creek bed and riparian area - gravelly/cobbly; plot in shrubbier area upstream; downstream: broader floodplain, very rocky, not as much veg.	
241	LRR07	Polygon # 444	614051	6965443	Fmr - BETUNEO not BETUPAP as written in veg assoc description. Gb - probably better classified as An (placer mine tailings) - not naturally this much exposed gravel. Area was placer mined in the 1980s - lots of exposed gravel with some birch, poplar and	
242	LRR08	Polygon # 408	613989	6965627	Plot on edge of POPUTRE stand - mainly open grassy slope. ARTELAC seems to drop out of the community with elevation gain (but yesterday we observed more ARTELAC and PHACMOL at higher elevations on the same slope). ARTELAC also in adjacent POPUTRE stands	
243	LRR09	Polygon # 403	614475	6966047	Evidence of fire (some charred CWD). No mosses/lichens; ground cover = POPUTRE litter. Probably Fbx (not Fm or St as mapped) because only one spruce in the area - predominantly aspen ~10 m tall. Not sure if this trend continues upslope - maybe more con	
244	LRR10	Polygon # 408	614199	6965687	50% Mineral Soil = bare mineral soil OR moss OR litter. Quick plot to the east and upslope of LRR08 because wanted to see where the PHACMOL occurs - no obvious differences in habitat between LRR10 and LRR08, so not sure why PHACMOL is absent from LRR08 -	
245	LRR11	Polygon # 444	614196	6965604	CYPRGUT and CYPRMON (?). Birch-spruce stand at base of steep grassy slope. Shift polygon boundary north so that LRR11 falls inside polygon # 444.	
246	LRR12	Polygon # 444	614112	6965595	On road bed. Sparsely vegetated - exposed gravel/mineral soil; disturbed site.	
247	LRR13	Polygon # 33	617263	6973389	More fen than marsh. Water in gaps between Eriophorum tussocks.	
248	LRR14	Polygon # 31	617368	6973555	50% Org. Matter = Salix and Betula leaves - lots on ground. PICEGLA dominated stand with significant SALIBEB tall shrub layer (>5 m) - site richer than a pure spruce stand because of deciduous component? Site supports diverse forb and low shrub communit	
249	LRR15	Polygon # 26	617326	6973680	15% Mineral Soil is exposed riverbank silt. Quick plot to illustrate relative proportions of dominant species. Species listed on reverse and not in this plot can be assumed to have <1% cover. Gb: substrate mainly finer than "coarse textured gravels and	
250	LRR16	Polygon # 1725	616322	6948857	10% Water = pool in centre of pingo. 10% Org. Matter = graminoid litter. Marsh.	
251	LRR17	Polygon # 1756	616301	6948851	Slope and aspect are variable. Slope position = crest, upper slope, middle slope. Plot representing vegetation along pingo mound - all around the perimeter, therefore, aspect and slope are variable. Mound is ~10 m high at its highest.	
252	LRR18	Polygon # 1756	615939	6948508	% Water: 0 - big pond in centre, but % covers represent banks; % Mineral Soil = % Bare Ground (on data sheet) - 15% cover, soil exposed by slumping; % Org. Matter = % Litter (on data sheet) - 15% cover, CALACAN litter. Pingo #2 - botton has more water th	
253	LRR19	Polygon # 1681	615681	6949173	Plot includes shore and pond vegetation, but not "upland" (i.e. above thaw lake) Sb forest. Surrounding forest is ~8 m tall Sb with feathermoss and lichen for groundcover.	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
254	LRR20	Polygon # 1686	615545	6949297	Plot describes vegetation around perimeter of thaw lake and along drainage which runs southeast; surrounded by tall (i.e. ~10 m) Sb. Bank of thaw lake is slumping - trees falling into water; large cracks in soil, banks falling into water. Difficult to c	
255	LRR23	Polygon # 1913	606537	6946722	ROSAACI ~30 cm tall. See reverse for a more complete species list (species not listed here are not dominant).	
256	LRR24	Polygon # 1073	623755	6955396	Complete species list on reverse side of page. Plot represents north facing, slightly moister slope: interesting species found in this area and not really elsewhere.	
257	LRR29	Polygon # 1834	611169	6947803	Quick plot to document the apparent absence of ARTELAC and PHACMOL from this south-facing steep grassy slope.	
258	LRR30	Polygon # 1789	611686	6948061	Thaw lake. Plot describes bank area ~1 m from water; not much transition from surrounding upland to water. Site seems richer than other thaw lakes - firmer edge, mineral closer to surface; aquatic plants present. Did not estimate % cover for aquatics b	
259	LRR31	Polygon # 574	618724	6963605	Symphoricarpos site. Re-visit to site where Symphoricarpos was found during reconnaissance survey (because if present, this would be a significant range extension for the species). Did not find any. Vicia americana recorded during reconnaissance survey	
260	LRR32	Polygon # 628	611732	6962121	Did not do plot because area heterogeneous - rock outcroppings and fine shale mixed with taller shrub areas. Found ultramafic rocks (confirmed by Scott); found some species not before observed in study area (e.g. Rhododendron lapponicum, Andromeda polifo	
261	LRR33	Polygon # 310	616351	6967673	Similar to other Lx. Rock outcrops, but nothing intersting growing there - Castilleja, Pote.niv., lots of Bupleurum.	
262	LRR34	Polygon # 1506	624975	6950753	Quick felsenmeer plot - bouldery outcrops don't seem to have many species of interest; lots of moss and lichen.	
263	RM1				Pingo	Old pingo with grassy marsh in collapsed "crater" (Western of two). Small remnant pond. Likely seasonally flooded (high groundwater and surface water inputs).
264	RM1vE					Collapsed pingo with larger "crater" pond. Much younger pingo than RM1vW. Fully enclosed --> no outflow. Numerous slumps and cracks on rim. Leaning mature trees, some curved trunks. LWD in pond --> not yet decayed. Wet concrete-like sediment in coll
265	RM1vW					West Pingo: collapsed pingo with high rim. Very steep: 70-90%. Mossy. Remnant ponds and outflow channel. Silt loam, soft, loose walls. Well used moose trail. Rim ~10m high. Diameter 40-50m inside.
266	RM2v		615590	6968775		Lower slope of large mixed-forest polygon. Steepness, horsetail, grasses. Birch, black spruce, white spruce, alder. N-facing "319" type polygon outside the boggy stripes. Comments/Thoughts: Valleysides that exhibit convex-up long profile and an overst
267	SB01	Polygon # 365	615740	6966662	Understory AVI: D4Aw10. 25% poorly decomposed wood. Immature Aw stand; ~3 m height, scattered standing remnants. Aw has silver colouring from air - seemingly being attacked throughout area by unknown insect. Soils shallow with coarse frags and bare so	Total soil pit coarse frags: 50%
268	SB02	Polygon # 184	615899	6966475	AVI: A16Sb10. Buried organic horizons to 10 cm. Mottles present. Alder, willow, Bw dominate understory shrub.	Buried organics to 10 cm. Mottles/gleying 15 cm.
269	SB03	Polygon # 943	608513	6957166	Heath tundra - willow shrub - dwarf birch dominated. Plot located at crest of long slope near area of exposed bedrock. Willow/dwarf birch/mosses dominate. Cryosolic soils.	mottles/gleying at 10 cm.
270	SB04	Polygon # 1913	606672	6946763	Plot located on steep grass/forb dominated sideslope immediately above Dip Creek. Likely types out similar to all other open, well drained, south facing slopes.	
271	SB05	Polygon # 551	610514	6963530	Tundra slopes transect. Plot located on N. facing, poorly drained, wet tundra slope. Dwarf birch/Lab tea/Sphag moss dominate. Permafrost at 30 cm keeps moisture and surface water high year-round. Scattered scrub Sb throughout.	Permafrost at 31 cm. Seepage present.
272	SB06	Polygon # 2193	610965	6941982	Main canopy AVI: A05Bw8Sb2. Understory dominated by thick layer of dwarf birch and willow. High % CF in profiles. Plot located at upper slope position. Shrubby slopes transitioning into open alpine. West facing side of valley wall in this vicinity do	
273	SB07	Polygon # 2240	610685	6940964	Alpine saddle. 2% slope drops off dramatically. Plot located at saddle of alpine area. Good deal of exposed bedrock. Herb mat dominates with patches of dwarf birch and willow scattered throughout alpine type no question!!	bedrock at surface.
274	SB08	Polygon # 2205	610206	6941620	Tundra slope transect. Plot located on open tundra slope. Scattered dwarf birch and willow shrub through site dominated by ericaceous shrubs and feathermoss. Drainage poor due to permafrost layer encountered at 30 cm depth. Should type consistently.	
275	SB09	Polygon # 1705	609812	6948824	Main canopy AVI: D12Aw9Sw1. Dry south facing Aw stand. Similar to many south facing slopes in the area. Aw immature. Understory open, dominated by short shrubs. No veg samples taken! Characteristic Aw stand. Bear scat in plot!	
276	SB10	Polygon # 1688	609654	6949236	Main canopy AVI: B09Bw6Sb4; understory AVI: A05Sb8Bw2. Bw-Sb/Lab tea-feathermoss. N facing Bw-Sb stand. Imperfectly drained as evidenced by high cover ericaceous shrub and feathermoss. Characteristic of similar topographic positions throughout LSA.	Drainage imperfect though no mottles observed.

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
277	SB11	Polygon # 365	614952	6966217	AVI: A10Aw7Sw2Bw1. Plot located on west side Canadian Crk. Slope with numerous dead standing snags - remnants of previous burn. Blowdown prevalent across hillside.	
278	SB12	Polygon # 544	619197	6963646	Scrubby Sb/Lab tea - dwarf birch slope. Plot located near top of Sb/D. brich-LabTea scrub slope. Open tundra slope to west. Sb/alder to west. Colluvium on fractured bedrock immediately below moss layer. Very little soil present.	
279	SB13	Polygon # 574	618722	6963601	Main canopy AVI: C08Aw8Bw1Sw1; understory AVI: B04Aw10. Immature Aw stand on SW facing slope. Some Bw and Sw scattered throughout understory of Aw/Bw/willow. Buffaloberry is dom shrub.	
280	SB14	Polygon # 2140	601196	6943376	Immature Aw stand. Main canopy AVI: C09Aw9Sw1. Understory AVI: B05Aw10. Characteristic Aw stand on S or SW facing, well-drained slope. No concerns accurately typing std.	CF class: small gravels.
281	SB15	Polygon # 2140	601355	6943360	Open, dry, S-facing slope. Vegetation primarily ground shrubs (bearberry).	
282	SB16	Polygon # 2240	602780	6942145	AVI: C06Sb10. Sb treed bog (slope). Sb stand on N facing slope. Characterized as Sb treed bog on slope. Permafrost encountered at 18 cm, thawed layer above surface water moving downslope over surface of permafrost. Should type consistently wieh conif	Mottles/gleying at surface. Bmy2 horizon frozen. Seepage present.
283	SB17	Polygon # 2184	602740	6942316	Shrubby bog. Open shrubby bog - D. birch/N. Lab tea/ cotton grass. Cotton grass and Sphagnum hummocks throughout. Permafrost at 18 cm. Surface water held up as a result. Sphagnum/cotton grass hummocks created.	Permafrost at 18 cm. Seepage present.
284	SB18	Polygon # 894	605681	6958060	Alpine crest (table top). Much of vegetation hardened off. Done for season. Crest and upper slope position easily typed same.	Minor evidence of cryoturbation.
285	SB19	Polygon # 759	604883	6960270	Rocky scree slope grades into birch shrub.	
286	SB20	Polygon #			Surface and subsurface drainage channels into shallow gully. High water table.	
287	SB21	Polygon # 2136	599985	6943470	C12Aw9Sw1. Wolves heard further down Dip Creek. Bearberry, bog cran, low bush cran, and buffaloberry provide ample forage for bears. Good wildlife habitat. Bear sign present. Aw std on dry, S facing slope. Typical of those observed throughout the ar	O.EB subgroup.
288	SB22	Polygon # 2132	600113	6943246	Site 109. Sb treed bog. South of site 108 (=SB21) where slope decreases and drainage is poor.	
289	SB23	Polygon # 2132	600185	6942998	Depth to permafrost: 30 cm. Shrub layer generally < 1m. Extremely hummocky ground with tussock sedge, VACCVIT and SPHAGNU comprising hummocks.	
290	SB24	Polygon # 1421	620660	6951944	AVI: A15Sx10/C5Bw9Sb1. Site in proximity to historic placer mining activity. East of old air strip. Area also appears to have been burned in early 90s. Remnant Sx with regenerating Bw and Sb.	O.EB subgroup. High % sm. Gravels in Bm horizon.
291	SB25	Polygon # 1455	620653	6951802	AVI: B22Sx10. Productive, healthy Sx stand on steep hillside. Ground vegetation dominated by feather moss. Avg. ht. ~22 m. Avg. DBH 30 cm.	O.EB subgroup. Thick mor humus form with evidence of historic burn as seen through charcoals. Gravelly Bm horizon.
292	SB26	Polygon # 1972	608536	6946051	AVI: C13Sb8Bw2. High lichen cover. Sb dominated stand on NW facing slope.	
293	SB27	Polygon #	611658	6973460	AVI: D12Pb10. Island in middle of Yukon River. Site is unlike any other within LSA. Poplar stand with rich shrub layer.	Poorly developed soil horizons as a result of depositional characteristics and periodic flooding events.
294	SB28	Polygon # 44	613793	6973079	AVI: C21Bw9Sw1. Lg std of high quality Bw. Healthy with outstanding form.	Buried log at 36 cm with former Ah horizon below.
295	SB29	Polygon # 39	613919	6973035	East of pure Bw stand grades into mixedwood type. Very large Sw stems (~30 m ht, diameter 57.8 m). B30Sw10/B24Bw10. Ground vegetation and soils similar to that of site 115 (SB28).	
296	SB30	Polygon #	635414	6957579	AVI: B18Se10. Site near large "hoodoo" like outcropping at/near crest of slope. Type continued downslope to NW for ~200 m before grading into poorly drained Sb bog.	below 22: coarse frags, massive. O.R subgroup. Colluvial material. Very shallow soils. High % coarse frags. Very moist, though recent heavy rains may have elevated.
297	SB31	Polygon #	634959	6957682	Site 118. Scrubby Sb treed bog. Large patches of BETUGLA.	
298	SB32	Polygon # 3819	611733	6959586	Shrub slopes. Rocky/bouldery scree slope grades into SALIPLA/BETUGLA shrub slope on south facing site. Shallow soils with poor drainage.	
299	SB33	Polygon # 767	611879	6959889	Site #120. Shrubby scree slopes (at road summit). BETUGLA, EMPENIG, VACCVIT, SAXITRI, DRYAS, SALIGLA, TOMENIT, FLAVCUC, CLADMIT, CLADSTE, LUPINUS, DRYOPTE, POLY….	

Name	PlotNumber	Location	UTMEasting	UTMNorthing	SiteNotes	SoilNotes
	TEST	At camp	611544	6956946		Midslope just E of road, immediately above mine camp. Little to no visible ice (minor crystals).

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APPENDIX B

PHOTOS

(Pages B-1 to B-5)

PHOTO 1 – Site of the proposed Open Pit

PHOTO 2 – Proposed Plant Site

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PHOTO 3 Site of the proposed Tailings Embankment (view to the north)

PHOTO 4 – Hill top with Tors in the distance

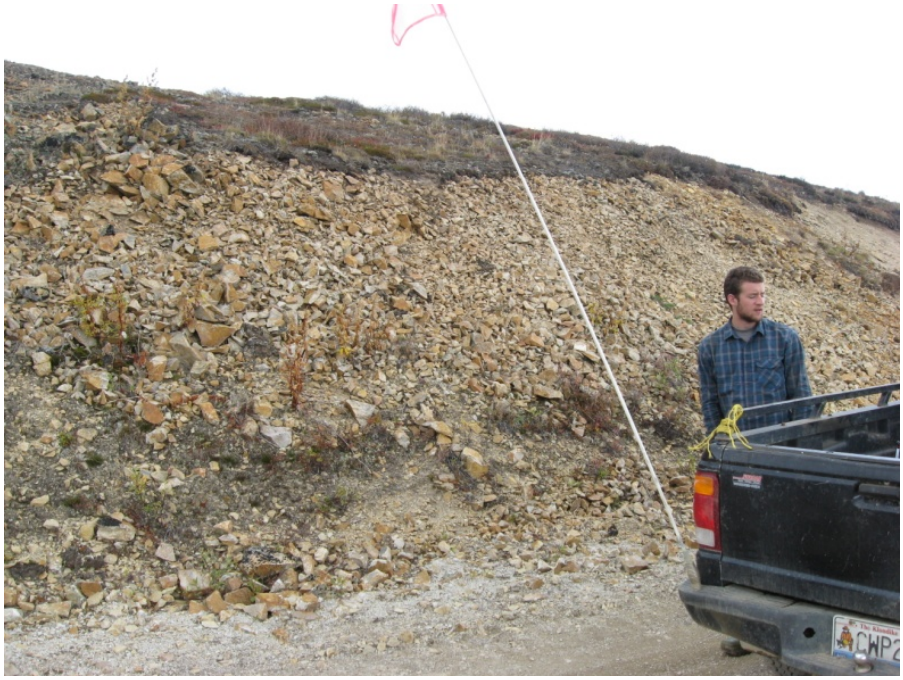

PHOTO 5 – 'Felsenmeer' at the site of the proposed Open Pit (WP 196)

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PHOTO 6– Thick Blanket of Re-worked Loess in the North Part of the Footprint of the proposed Open Pit

PHOTO 7– Loess Deposit (WP 199)

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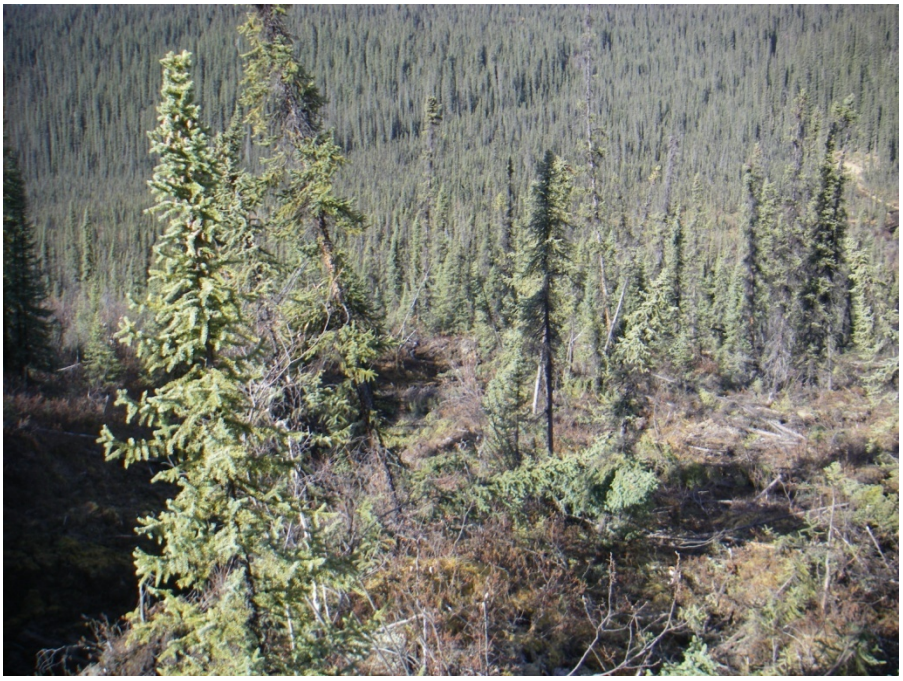

PHOTO 8 – Possible Thaw Flow at the Site of the Proposed Tailings Embankment