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REPORT ON

Phase 1A Geotechnical Slope Stability Assessment of the East Wall of the Grum Pit, Faro Mine, Yukon

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REPORT

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APPENDICES

1.0 INTRODUCTION

The Anvil Range open pit mining complex is located approximately 15 km north of the town of Faro in central Yukon. The mining complex was operated from 1969 to 1998 and is currently in the process of being decommissioned.

Three large open pits were mined during operations; the Faro Pit the Vangorda Pit and the Grum Pit. The Grum Pit experienced large scale slope instability along the east wall during a temporary shut-down in 1996-1997. Water from the Grum Pit currently requires treatment prior to release to the environment, and possible future instability on the east wall could displace large volumes of water in the pit which could in turn impact the water treatment planning. The Yukon Government retained Golder Associates Ltd. (Golder) to carry out a slope stability assessment of the instability zone, and the scope of the assessment is summarized in Section 2 of this report.

This report presents the results of the Phase 1A geotechnical slope stability assessment of the east wall of the Grum Pit. A site visit for geotechnical inspection of the east wall was carried out by our Mr. L. Pohl on August 26, 2009. A summary of the available background information on the Grum Pit and the current pit status is presented. The status and the engineering geology of the Grum Pit are described. The east wall slope instability is discussed based upon current field observations and a comparison review of photographic records. The current slope stability conditions are discussed. The probable slope instability mechanism governing the ground movement of the east wall is discussed. Finally, recommendations are provided regarding a slope monitoring program that will be required in order to quantify the current displacement and movement rates within the instability zone.

2.0 SCOPE OF STABILITY ASSESSMENT

This Phase 1A slope stability study was carried out under the terms and conditions of the Yukon Government purchase order number C00001404. The following Phase 1A scope of work for the study was outlined in Golder's proposal date July 15, 2009 (Reference 1).

- A desk study review of available technical documentation of the Grum Pit including pit wall design reports with information on the geology of the pit, rock and soils strength parameters, hydrogeology of the pit, slope design and stability analyses, as-built pit survey plans prior to flooding, as-built plans of the previous dewatering wells and groundwater monitoring levels.
- A two-day site visit during the summer of 2009 for the inspection of the east wall of the Grum Pit in order to assess the current slope stability conditions, characterize the overburden geology and the slope instability mechanism. During the site inspection, the safety conditions for access within the instability zone would be also evaluated with respect to the future implementation of slope stability monitoring of the instability mass and of the area behind the back-scarp.
- The review of the results of the bathymetry survey. The bathymetry survey would be used to define the underwater profile and volume of the instability mass that has already moved into the pit below the water line. This information would be combined with the as-built survey of the pit prior to flooding, if available, and the survey of the current instability area will support an assessment of the evolution of the ground movement to date.
- The review of the results of the 2009 topographic survey of the current instability zone. This survey would be used to define the above-water profile of the instability mass.
- Provide recommendations regarding a slope monitoring program intended to quantify the displacement and movement rates within the instability zone. Alternative monitoring methods and coverage would be addressed as required, and could involve consideration and review of prism monitoring, Global Satellite Position (GPS) monitoring, LIDAR and possibly INSAR, and other possible slope monitoring techniques. The slope monitoring program should support the determination of current and future displacement rates within the instability area. Displacement rates will be required to estimate the impact of ground movement on the rise of the water level in the pit, which will be addressed in Phase 2.

3.0 GRUM PIT STATUS

The following summary of background information on the Grum Pit is based on the review of the limited technical documentation that is currently available (References 2 and 3). At the time of the preparation of this report, technical documentation on the slope design of the pit walls could not be found. A paper copy (Reference 4) of an as-built plan dated September 11, 1997, is the only available survey plan of the pit prior to flooding. The available topographic plans of the Grum Pit area are based on aerial photo surveys and were carried out in 2003 and 2009.

The inactive lead-zinc Grum Pit is located in the southeast portion of the Anvil Range mining complex. The mining complex consists of the Faro Mine site, which was in production from 1969 to 1992, and the Vangorda Plateau Mine site, which was in production from 1986 to 1998. The Vangorda Plateau Mine site consists of the Vangorda Pit and Grum Pit, as shown in Figure 1. The Grum Pit is located in the Vangorda Plateau approximately 12 kilometres southeast of the Faro Pit, which was the largest open pit at the mining complex. The Grum Pit is located approximately 2 km northwest of the Vangorda Pit.

The mining history of the Grum Pit is summarized below.

- The Grum deposit was discovered in 1973.
- Exploration programs were carried out from 1975 to 1977, and included an underground exploration program. The underground development consisted of a ramp from a portal at approximately the 1,265 meter elevation and two declines developed along the ore zone for approximately 700 meters.
- The development of Vangorda Plateau Mine site was started in 1988 with initial dewatering of the overburden deposits in the area of Vangorda and Grum pits. A small lake, the Doal Lake, located within the Grum Pit area was drained.
- Mining at the Grum Pit was carried out intermittently from 1990 to 1992 and consisted mostly of overburden and waste rock stripping. Only limited quantity of ore was mined prior to a temporary mine shut down in 1993.
- The site was under temporary shut down from 1993 to late 1994, when stripping at the Grum Pit was subsequently resumed.
- Apparently, mining at the Grum Pit was carried out from late 1994 until another temporary mine shut down in late 1996. Mining activities were once again resumed in mid-1997 and ceased permanently in 1998.
- Since the mine shut down in 1998, the mine site has been under care and maintenance status.

The Grum deposit consists of two separate ore zones, *i.e.,* the Main Zone and the Champ Zone. Only the Main Zone had been partially mined when the mining activities were ceased in 1998. The Grum Pit was originally planned to be developed in two or more mining phases. The available technical documentation (References 2 and 3) indicates that the Phase 1 Pit was nearly completed at the time of mine shut down in 1998, and that the Phase 2 expansion had been started with pre-stripping. However, the status of the Grum Pit at the time of the shut down could not be confirmed during this study as the original mine design and final as-built plans could not be located. In addition, mining of the lower benches of the Phase 1 Pit apparently intersected the underground exploration workings, but further details could be found either.

The Grum Pit has an elliptical to semi-circular shape, which extends approximately 850 metres in the north/south direction and approximately 600 metres in the east/west, as shown in Figure 2. The east wall represents the main slope of the mined pit. The crest of the east wall is located at approximately the 1,300 meter elevation. The actual elevation of the pit floor at the time of shut down is unknown. The only available survey plan of the pit prior to flooding and dated September 11, 1997 (Reference 4), indicates the pit floor at approximately the 1,162 metre elevation, as shown on Figure 3. Information provided by SRK Consulting indicated that the pit floor had been assumed at the 1,140 meter elevation for the purpose of water management studies (Reference 5). A bathymetry survey of the Grum Pit carried out during September 2009 by Laberge Environmental Services, indicates the pit floor is currently at approximately the 1,137 metre elevation, as shown on Figure 4. Therefore, the east wall is approximately 160 meters high.

Since mining operations were stopped in 1998, an in-pit lake has accumulated in the pit. The water level in the pit has been continuously rising, as indicated by the monitoring data presented in Figure 5. The monitoring data indicates that water level has increased from approximately the 1,186 meter elevation in early 2004 to the 1,205 meter elevation by mid-2009. The available 2003 topographic plan of the Grum Pit based on an aerial photogrammetric survey, shown on Figures 1 and 2, indicates a water level at the 1,185 meter elevation. Accordingly, the water level has increased by approximately 20 meters in the last 5 to 6 years. The pit overflow elevation is located on the south side of the pit, at approximately the 1,230 metre elevation.

The east wall of the Grum Pit has been affected by slope instability of the overburden slope for many years. Apparently, the slope instability was initiated during the temporary mine shut down from late 1996 to mid-1997, when mining, dewatering operations and slope depressurization were suspended (Reference 6).

Since the Grum Pit is partially flooded, the movement of the instability zone into the pit has been considered to have displaced water in the pit and contributed to the rise of the water level. Ongoing ground movement may be continuing to displace and increase the water level in the pit. Consequently, concerns have been raised that the ground movement may be reducing the time remaining until the water in the pit will overflow into the outlet channel on the south side of the pit. It is understood that the overflow of pit water can potentially affect the surface water quality and the management plan of the mine site, and that an understanding of when the pit may overflow will be valuable to the ongoing closure planning.

This study addresses the slope instability mechanism governing the ground movement of the east wall and provides recommendations for a slope monitoring program in order to quantify the current displacement and movement rates within the instability zone.

4.0 GRUM PIT ENGINEERING GEOLOGY

The following summary on the Grum Pit is based on the review of available technical documentation (References 2 and 3).

4.1 Overburden Soils

The overburden soil deposits and the surficial landforms of the Vangorda Plateau have been deposited and formed by the most recent of the glaciation events. Extensive overburden deposits exist in the area of the Grum Pit include till deposits and glacio-fluvial silts, sands and gravel deposits. Figure 6 shows a contour map of the overburden/bedrock contact previously interpreted by Anvil Range (Reference 7). Overburden thicknesses greater than 100 meters were encountered as described in the dewatering assessments of the Grum Pit (References 8 and 9). The overburden soil deposit thickness varies from approximately 100 metres in the east portion of the pit. A buried channel, *i.e*., thalweg (bedrock valley), that is interpreted to trend north/south exists in this area of the pit. The overburden deposit thickness decreases to less than 40 metres in the northeast and southeast area of the pit, and pinch out toward the west side of the pit.

The majority of the overburden sediments overlying the bedrock in the Grum Pit area are described as glacial till. However, a sand and gravel layer varying in thickness from 20 to 30 meters was reportedly encountered at depth along the alignment of the north/south trending buried channel (Reference 8). Further investigations carried out for the dewatering of the Grum Pit (Reference 9) identified a second upper sand and gravel layer. These interpreted glacio-fluvial layers were previously interpreted on the cross-sections presented in Figure 7 (Reference 9).

The thick overburden soil sequence was exposed in the pit slopes on the east wall of the Grum Pit. The large scale slope instability developed in these sediments.

4.2 Bedrock Geology

The bedrock geology of the Grum Pit consists of metamorphic rocks of the Mt. Mye and Vangorda Formations. A regional geology map of the Anvil Range area is presented in Figure 8 (Reference 2).

The Grum deposit has been described as consisting of three to five highly folded layers of massive and disseminated sulphide mineralization within a 150 meter thick sequence of phyllites. The most important mineralized zone is associated with a basal carbonaceous member of the Vangorda Formation. Other thin low-grade zones were also described to exist within the Vangorda Formation, while more significant mineralized zones would also exist in the upper part of the Mt. Mye Formation.

The geologic units within the Grum Pit include the following main rock types.

- The Vangorda Formation consists of mostly soft, highly fissile, calcareous phyllites. This unit also includes, to a lesser degree, mafic meta-igneous rocks occurring as highly foliated chlorite phyllite and carbonated chlorite phyllites that are widespread near the ore zones. An important mineralized sulphide zone is associated with a basal carbonaceous member of this formation, with the carbonaceous rocks being soft, highly sheared and gouged immediately below this zone. Elsewhere, these rocks are described to exist as moderately hard, highly fractured, black siliceous phyllites.
- The Mt. Mye Formation also consists of soft phyllites which are non-calcareous and less distinctly banded than those of the Vangorda Formation.
- Minor post-metamorphic dykes.

The granitic Anvil Batholith outcrops approximately 1.5 km northeast of the Grum deposit. Major faults bound the metamorphic sequence and the granitic rocks, and therefore the batholith is considered unrelated to the deposit.

The ore zones in the Grum deposit are described to exhibit complex superimposed poly-phase fold structures that plunge at a shallow inclination to the northwest. Schistocity or fissility, in the case of phyllites, represents the main pervasive rock fabric in the rock masses in the Grum Pit. The schistocity has been described as axial planar to a second phase of folding, and dips at shallow angles (10 to 30 degrees) generally to the southwest. The overall deposit elongation parallels the axial direction of the second phase folds, and plunges at 11 degrees toward 315˚ azimuth.

In terms of distinct geologic structures, several faults are reported to exist within the Grum deposit (Reference 2). The main structural features include the following.

- Faults that truncate the deposit on the northwest and southeast sides, and would not be exposed in the pit. The main off-set displacements within the deposit are associated to these moderately dipping (35 to 45 degree) structures. In the vicinity of these faults, the surrounding rocks vary from intact rock that is similar to the enclosing phyllites to approximately 3 to 10 meter thick zones of gouge and fractured rock.
- A steep northwest dipping fault set trends approximately 060˚ azimuth, and intersects the deposit with a down drop of approximately 60 meters to the northwest.
- Smaller faults mapped underground and later in the pit, trend on average 080˚ azimuth and are steeply-dipping.
- Joints mapped underground and on surface tend to strike 060˚ azimuth and dip sub-vertically.

4.3 Surface Water and Groundwater

The Grum Pit is located on the Vangorda Plateau to the northwest of Vangorda Pit. The terrain in the area of the Grum Pit prior to mining consisted of a gentle depression in south sloping terrain.

The main drainage in the area of the Vangorda Plateau is the Vangorda Creek. The Grum Pit is located to the north of this creek, and most of the area in the vicinity of the pit prior to mining drained to the Grum Creek, a secondary tributary flowing into Vangorda Creek. Apparently, the pit area prior to mining was not intersected by well defined drainage, rather it was described to be generally wet, and a shallow lake, the Doal Lake, was located within the current pit area. As part of the mining development, surface water was subsequently diverted around the Grum Pit via the Grum Interceptor Ditch.

Groundwater investigations were originally carried out as part of the development of the Grum Pit in order to address the requirements for depressurization of the thick overburden soil deposits encountered in the east portion of the pit (References 8 and 9). As a result, several piezometers and dewatering wells were drilled into the sediments exposed along the upper portion of the east wall of pit.

The majority of overburden sediments were described as low permeability glacial till with low rates of groundwater flow. However, the basal and upper layers of saturated sand and gravel encountered along the possible buried channel, or thalweg, were encountered to be confined aquifers, possibly interconnected in some areas and appearing to extend throughout the thalweg and possibly the surrounding areas. These confined aquifers were considered to be the most important water-bearing hydrogeological units in the Grum Pit area.

Piezometric data had indicated groundwater flow in a southerly direction, with recharge occurring from the north and northeast of the pit area, and discharge occurring in the gentle valley to the south of the pit (Reference 9). Artesian groundwater conditions encountered in the aquifer under the area of Doal Lake had indicated that groundwater flow to the discharge area was restricted, possibly due to low permeability zones within the aquifer system.

Dewatering wells were installed and operated during the development and mining of the Grum Pit, and were permanently shut-down when mining operations were discontinued in 1998. Figure 9 shows the water level monitoring data from the dewatering and observation wells during mining of the Grum Pit. Maximum water level data for observation wells 89-2, 89-3 and 89-4, and for dewatering wells 89-5 and 91-3 prior to pumping that are located in the area of the east wall indicates groundwater elevations at least at approximate 10 meters below ground surface. The elevation datum of these wells is consistent with the ground elevations prior to mining, and the oldest available water levels measured in these wells also appear to be consistent supporting this interpretation of groundwater elevation (Reference 9).

Since mining operations ceased in 1998, water from groundwater flow, surface run-off and precipitation has accumulated in the pit, forming the existing pit lake. Monitoring of the in-pit water level presented in Figure 5 indicates that the elevation of the pit lake has continued to increase, and the current water level is at approximately the 1,205 meter elevation.

5.0 EAST WALL INSTABILITY

The east wall of the Grum Pit has been affected by slope instability of the overburden materials that have been exposed at the top of the east wall. Apparently, the slope instability was initiated during the temporary mine shut down from late 1996 to mid-1997, when mining, pit dewatering operations and pit slope depressurization operations were suspended. However, technical documentation on the development of the pit wall instability could not be located at the time of this review.

The initial extent of the instability is shown on Figure 3, and the initial failure was approximately 300 metres long in a north/south direction. Based on field observations and a comparison of 1997 topography versus 2003 topography, it would appear that a portion of the failure debris at the crest of the slope was mined out, and that the slope behind the back-scarp was laid back. The size of the failure zone has increased since 1997, and the failure is now approximately 350 metres long. The large scale slope instability zone now extends almost the entire length of overburden soils exposed on the east wall of pit wall (Photographs I-1 to I-3).

The overburden deposits in the instability zone consist of glacial till and layers of sand and gravel that fill a north/south trending buried channel. These sediments were reported to be saturated, with confined aquifer conditions existing within the sand and gravel layers.

The slope stability conditions of the east wall of the Grum Pit that are discussed in the following sections are based on the following data:

- observations made during the site visit of August 26, 2009;
- comparative review of photographic records of 2005;
- review of the available 2003 and 2009 topographic plans of the Grum Pit area;
- review of the 2009 bathymetric survey plan of the Grum Pit; and,
- available 1997 pit plan and overburden/bedrock contour maps (Reference 4 and 7).

5.1 Geotechnical Field Inspection

A site visit for geotechnical inspection of the east wall instability was carried out by our Mr. L. Pohl on August 26, 2009. Photographs are shown in Appendix I.

The following observations were made during the site inspection in order to characterize the slope instability mechanism governing the ground movement on the east wall.

In the north-central portion of the instability zone, the overall slope in the overburden soils has failed, and a back-scarp extends from the top of the failure zone to the crest of the pit wall. This back-scarp appears to be about 50 meters high in the north-central part of the instability zone. In the central part of the instability zone, the back-scarp is located below the crest of the slope, and a remnant of the re-sloped portion of the slope behind the original failure remains. In the south portion of the failure zone, the failure has extended beyond its original 1997 limits, and the backscarp again extends to the crest of the slope.

The overburden soil sequence is exposed along the current back-scarp. At the southern portion of the scarp, a thick sequence of brown, coarse SAND with gravel and cobbles, and SAND and GRAVEL is exposed along the base of the back-scarp (Photograph I-14). This sequence is overlain by glacial till in the upper portion of exposed back-scarp (Photograph I-15). This glacial till deposits (Photograph I-13) are predominantly gray, firm, low to medium plasticity, poorly-graded, SILT and fine-SAND with gravel and cobbles.

During the walk over inspection carried out along back-scarp, a continuous crack, only a few millimetres wide with sharp edges, was observed along most of the base of the back-scarp. This cracking has developed between the failure debris that has accumulated at the base of the back-scarp and the bottom potion of the back-scarp. The general observations of this feature suggest recent on-going downward movement of the failure mass ahead of the back-scarp.

The failed overburden soils bounded by the back-scarp have undergone large deformation and settlement, which has resulted in a large area of subsidence in the failure zone. The original catch-benches that were excavated on the slope have been largely destroyed. In the central portion of the failure zone, remnants of the originally excavated catch-benches indicate signs of rotational slide failure, with resulting downward movement into the pit (Photographs I-4 and I-8).

At the south end of the instability zone (Photographs I-9), cracks are visible along and below the edge of the upper ramp defining the current south limit of the slope instability area. The remnants of a previous back-scarp that was observed in 2005 is also observed at the south end, and the scarp is defined by a steep face immediately above the main failure mass on the lower portion of the wall (Photograph I-4 and I-10). This previous back-scarp at the south end of the instability zone is clearly visible on photographs taken in 2005, shown in Appendix II, and defined the south limit of the instability zone at that time. Consequently, the observation of the upper back-scarp indicates that the instability zone has migrated further south since those photographs were taken in 2005.

In the same area along the south end of the instability zone, a series of obsequent scarps and graben structures are observed below the current back-scarp and above remnants of a previous back-scarp (Photographs I-5 and I-9). These structures have developed as the slope instability progressed further south forming the obsequent ridges and graben features in between the two back-scarps.

In the north-central portion of the failure zone, older obsequent ridges and graben features (Photographs I-7, I-10 and I-11) are also observed within the failed ground. These features probably represent previous stages of slope instability with regressive failure developing further east of the initial slope failure. These features in the north-central portion of the failure zone occur on higher ground than the main failure area in the central portion of the failure zone where rotational slide failure appears to have been dominant. In addition, the failure slope below the area where these features are observed has deformed to a steeper slope than observed in the most central part of the failure zone. This observation is also indicative that the failure materials accumulated in the lower slope in that area have been pushed by the subsequent failure of the upper slope. Therefore, it is possible that the slope instability was originally initiated in the central portion predominantly as a rotational slide where the maximum overburden thickness was exposed by the excavation of the pit wall. Subsequently, the initial slope failure progressed with regressive failures expanding the initial limits of the instability zone to south and north possibly into areas of shallower bedrock, as well as extending to the east and to the upper portion of the east wall.

Further to the north and along the upper portion of the east wall, the overburden soils are observed to be overlying the bedrock. A series of stepped failures on the overburden soils are observed along the upper north portion of the failure zone, defining the back-scarp and the limit of the instability area. The overall thickness of overburden soils exposed on the east wall pinches out toward the north end of the wall. However, as a result of the poor stability performance of the overlying overburden slopes in that portion of the pit, the overburden-bedrock contact is covered and is not clearly exposed. Failed overburden soils are observed covering some of the underlying rock slopes apparently as a result of soil slope failure along the margin of the main instability zone and undercutting of the overburden soils by bench scale failure of the underlying rock slopes.

At the north end of the overburden instability zone, above the in-pit lake, bedrock is exposed along an erosion gully where the failed soils from the upper wall have been partially eroded (Photograph I-16). The exposed schist/phyllites exhibit a pervasive foliation that dips at 30 to 40 degrees to the west (245º dip-direction). Overall, these rocks exhibit signs of relaxation with open fractures developed mostly along the dominant schistosity and joints. However, it is not evident if failure of the bedrock has had a significant role in the overall instability mechanism of the soil slopes, or if limited deformation of the bedrock along the lower wall occurred as a result of been pushed by the failure of the overburden soils.

The toe of the slope instability zone is located below the in-pit lake, which is currently at approximately the 1,205 meter elevation. Consequently, the toe of the failure zone is not visible. In a similar manner, the overburden-bedrock contact is also not visible below the slope instability area.

Overall, the area of the failure zone below the back-scarp is wet with shallow ponds accumulated in depressions within the failed ground. Intense seepage is observed emanating in the “higher ground” at the north-central portion of the failure zone where obsequent ridges and graben features are observed (Photograph I-11). Apparently, the ground is saturated to the surface within most of the failure zone.

The walk over inspection carried out along and behind the crest of the east wall indicated that the slope instability has reached the crest of the pit wall above the north-central portion of the failure zone, as observed on Photograph I-7. In this area, the slope in the overburden soils has failed up to the crest of the pit wall with tension cracks developed near the crest of the wall. These tension cracks extend only a few meters behind the crest of the wall, and no tension cracks were observed further away from the crest.

On the north portion of the east wall, just to the north of the overburden failure zone, the rock slopes also exhibit signs of instability (Photographs I-6 and I-12). The bench rock slopes exhibit poor stability performance with loss of catch-benches due to sliding on the pervasive westerly dipping rock fabric. Multi-bench rock slope instability has also developed on gray phyllites that occur adjacent to the main instability zone on the overburden soils. The bench slopes excavated on the gray phyllites have failed with settlement and loss of the catch-benches. Continuous cracks are observed behind the crest of the upper bench on phyllites with approximately 1 meter vertical drop (Photograph I-12). Structural orientation mapping data collected during the site inspection is presented on the stereonet of Figure 10. This limited orientation data set was obtained by mapping of a few rock exposures along the north end of the east wall. The pervasive westerly dipping foliation, *i.e.,* schistosity or fissility, represents the dominant geological discontinuity that is characteristic of the rock masses exposed along the east wall.

The results of the review of additional data sources are discussed in the following sections.

5.2 Review of Topographic Plans

For the purpose of the assessment of the slope instability process, the following topographic plans were used.

- The paper copy of the 1997 Grum Pit status plan (Reference 4) shown in Figure 3, was scanned and scaled to the NAD 83 UTM coordinate system.
- 2003 topographic plan of the Grum Pit area prepared from aerial photos, and is shown in Figure 2.
- A topographic contour map, with a 2-meter contour interval, of the Grum Pit area was prepared by Golder using the 2009 DEM (digital elevation model). As per the 2003 survey, the 2009 DEM was also prepared from aerial photos. The contour map is shown in Figure 11.

In addition to the topographic plans, the 2009 bathymetry survey of the Grum Pit (Figure 4) and the overburden/bedrock contour map (Figure 6), which was scanned and scaled to the NAD 83 UTM coordinate system, were used for this review.

Vertical cross-sections were cut using the above plans of the Grum Pit along selected locations within the instability area as indicated on Figure 12. The cross-sections are presented in Figures 13 and 14. The bathymetry surface of the pit wall below the water level is also shown in the cross-sections.

A review of the cross-sections shows a significant difference in the surface topography between the 1997 pit surface and the most recent topographic surveys (2003 and 2009) in the upper portion of the pit wall. This can be seen on the cross sections of Figures 13 and 14. The 1997 crest of the east wall was located to the west of the 2003 crest and the current crest. This would suggest that additional mining was carried out between the 1997 failure and the 1998 shut-down. Based on field observations it would appear that the crest of the 1997 slope was mined back behind the failure scarp that developed at that time, and that some of the failure debris was probably removed from the upper portion of the slope. Since the pit plans at the time of mine shutdown are not available, it has not been possible to assess the change in the ground surface since that time.

In addition, the cross-sections of Figures 13 and 14 also indicate that failure debris have accumulated underwater in front of the originally mined rock slopes, as indicated by the bathymetry and the 1997 pit surfaces. The failure debris appears to have reached the pit floor forming a shallower underwater slope that is continuous with the slopes within the instability area above the water surface. The failed slopes exhibit inclinations of approximately 23 degrees and 27 degrees measured on cross-sections A and B, respectively.

The 2003 and 2009 topographic plans were imported into SURPAC and 3D surfaces were created. The 2003 and 2009 surfaces were combined, as shown in Figure 15. A comparison of the two topographic surfaces within the east wall instability area shows the 2009 surface is located below the 2003 surface in the upper portion of the failure zone. This appears to indicate downward movement or settlement of that area since the 2003 survey. In the lower portion of the failure zone, the 2009 surface is observed to be above the 2003 surface, which could indicate ground heave or deformation with translational movement to west since the 2003 survey. The differences between the 2003 and 2009 surfaces are also observed on the cross-sections shown in Figures 13 and 14. Based on a comparison of the 2005 and 2009 photographs, which is discussed in Section 5.3, it is evident that the original failure mass has continued to move into the pit, and that additional instability has occurred behind the original failure back-scarp.

Based on the difference between the 2003 and 2009 surfaces, the following differences in volumes between the surfaces in the upper and lower portions of the slopes were calculated.

- The 2003 ground volume above the 2009 surface in the upper portion of the instability area is estimated to be approximately 92,000 cubic meters, as shown in Figure 16. This estimate could represent the volume of ground that has moved downward or settled since 2003.
- The 2009 ground volume above the 2003 surface in the lower portion of the instability area is estimated to be approximately 117,000 cubic meters, as shown in Figure 16. This estimate could represent the volume of ground heaving or translational movement of the lower portion of the slope toward the west since 2003.

It is interesting to note that the change in volume in the lower portion of the slope above the current water level exceeds the change in volume on the upper portion of the slope. The difference is likely due to swell of the displaced material on the lower slope. It is not possible to determine the volume of displaced material below the water line between 2003 and 2009, as bathymetry data prior to 2009 does not exist. However, if it is assumed that the 92,000 cubic meters from the upper portion of the slope swell by approximately 30 to 40 percent, the swelled volume would be on the order of 120,000 to 130,000 cubic meters. This would suggest that the change in volume of the failure debris below the water line since 2003 has been marginal.

The additional water volume accumulated in the pit lake since 2003 has been calculated as approximately 3.5 $\times 10^6$ cubic meters, as shown in Figure 17. During this period, the lake level has increased by approximately 20 meters. This increase of water accumulated in the pit is significantly greater than the estimates of the ground volume that appears to have moved since 2003. Consequently, it would appear that the impact of ground movement on the increase of the lake elevation since 2003 has been marginal.

Finally, the comparison between the 2003 and 2009 surfaces in Figure 15 also shows apparent ground changes in the areas outside the instability zone. These minor differences between the two surfaces are attributed to the accuracy of the two different topographic plans prepared from aerial photo survey.

5.3 Comparative Review of Photographic Records

The comparative assessment of photographs taken on 2005 and the recent site inspection was carried out as part of the present review. Slope stability monitoring has not been carried out on the east wall of the Grum Pit, and this review of photographs allowed a qualitative evaluation of movement and displacement within the overburden slope failure zone.

The 2005 and recent photographic records used for this comparative review are presented in Appendix II. Reference points are highlighted in the photographs in order to illustrate comparison features, and the main observations are as follows.

The review of the 2005 photographs indicates that the failure zone has been active between 2005 and the present time. The extents of the instability zone observed in 2005 have progressed and expanded to the current observed boundaries. The following observations have been identified on these photographs.

- The photographs taken in 2005 show that the slope failure had not yet fully extended to the crest of the pit wall (Photographs II-1 and II-5). However, since 2005 the failure zone has expanded further to the upper wall and has reached the crest of the east wall (Photographs II-2 and II-6). Apparently, regressive slope failures have affected the back-scarp since 2005.
- The instability zone has expanded north beyond the boundaries observed in 2005 (Photographs II-1 and II-5). Since 2005, the slope instability has advanced into the upper benches in overburden soils on the north side of the east wall (Photographs II-2 and II-6).
- The instability zone has also expanded south beyond the boundaries observed in 2005 (Photographs II-1, II-3 and II-7). Since 2005, the slope instability has advanced into the overburden soil slopes at the south end of the east wall (Photographs II-2, II-4 and II-8). The 2005 photograph clearly shows the instability zone bounded by the back-scarp located along the lower portion of the slope, while the recent inspection indicate that the instability has progressed further to the south. The recent photographs show the current limits of the instability zone to be defined by a more recent failure scarp that is located above the back-scarp observed in 2005. In addition, obsequent scarps and graben features have developed in the area between the 2005 and 2009 failure scarps.
- Finally, the comparison of the 2005 (Photograph II-3) and recent photographs (Photograph II-4) also indicates that large displacement has occurred within the failure mass, with significant increase of the height of the back-scarp.

5.4 Discussions of Implications of Possible Future Ground Movement of the East Wall

The qualitative results of the comparative assessment of photographs taken in 2005 and the recent site inspection, together with a comparison of the 2003 and 2009 topography, indicate that the original failure mass continues to slump and move into the pit and that the failure is progressing beyond the original back-scarp limits. In addition, the recent cracking observed between the main failure mass and the base of the back-scarp during the field inspection also suggests that downward displacement of the failure mass continues to occur.

Considering that slope monitoring has not been carried out on the instability of the east wall, it is not possible to determine the past or current displacement rates. However, it is apparent that the magnitude of movement within the failure zone is on the order of at least several meters since 2005. Consequently, further settlement and movement of the failure mass can be expected to continue within the instability zone at the east wall. This process can potentially displace and increase the water level in the pit. However, as indicated by the review of the 2003 and 2009 topographic surfaces compared to the additional water accumulated in the pit lake, the actual increase of the water level in the pit lake due to ground movement appears to have been marginal during this period.

In order to estimate the impact that further instability of failure zone may have on the displacement of water in the pit and on the time remaining until the pit lake overflows the outlet on the south side of the pit, the following calculations have been carried out.

- Based on Figure 5, the pit lake elevation increased from the 1,187 meter elevation in February 2004 to the 1,205 meter elevation in June 2009. The volume of water that has entered the pit during this 64 month interval between February 2004 and June 2009 is approximately 2,159,257 cubic meters. Based on these volumes, the average rate of water into the pit is 33,740 cubic meters per month.
- The pit volume remaining between the current pit lake elevation at 1,205 meters and the outlet elevation at 1,230 meters is approximately 4,546,094 cubic meters.
- The volume of existing failure debris below the outlet elevation at 1,230 meters will not change or displace any water volume below this outlet elevation, even if it were to displace further into the pit. This is because this volume is already below the ultimate pit water level.
- However, the volume of existing failure debris that is above the pit ultimate outlet elevation would displace and reduce the remaining volume in the pit between the outlet level and the current lake level. The estimated volume of existing failure debris above the outlet elevation at the 1,230 meter elevation is approximately 483,969 cubic meters. The outline of this approximate volume is shown on Figure 18. This is approximately 10 percent of the 4.5 million cubic meters of storage volume that remains below the pit outlet elevation.

Based on these volumes, the time remaining until the pit overflows the outlet is approximately 11 years and 3 months, assuming no further displacement of the existing failure mass above the outlet elevation. If the approximately 484,000 cubic meters of existing failure debris above the outlet elevation were to fail into the pit below the outlet elevation, the reduction in time to overflow the pit would be approximately 14 months. Consequently, the remaining time until the pit overflows would be approximately 10 years and one month. These calculations assume that the pit continues to fill with water at the same average rate it has filled over the last five years.

The current slope instability on the east wall appears to have reached an advanced stage in the failure process, with a shallower slope formed at the lower portion of the instability zone. Based on the bathymetry data, the failure debris appears to have accumulated on the pit floor and the lower slope, and forms a continuous slope from the pit floor to the base of the back-scarp of the failure zone. Therefore, it is possible that the failure mass could be in a condition close to equilibrium, and that the on-going movement would likely continue to occur as slow creep deformation. In this case, a catastrophic movement of the existing failure mass into the pit with an associated rapid displacement of water and increase of the lake elevation is not likely to occur.

However, the stability of the existing failure mass in the lower portion of the slope could be disturbed if a large failure occurs on the steep back-scarp slope behind the failure mass. In addition to ongoing movement of the main failure mass, regressive slope failures have affected the back-scarp slopes since 2005. In the north-central portion of the instability zone, the current back-scarp is well behind the original back-scarp. The current scarp is approximately 50 meters high. This progressive failure process of the back-scarp has already extended to the crest of the east wall, and could potentially continue to extend beyond the crest of the pit wall. The risk of the instability progressing further to the west behind the crest of the wall presents the following potential hazards and threats.

- The continuing regression of the slope instability to the east and south, as has occurred since 2005, presents a potential threat to the substation, power lines and water-treatment access road located along the crest of the pit wall. The substation is located within 50 metres of the crest of the current back-scarp. The access road is located immediately behind the back-scarp along the southeast and south side of the failure zone. The power line is located along the south edge of the access road.
- In the case of an overall slope failure of the current back-scarp, it is possible that the failure debris would create additional load, *i.e.,* driving forces, on the existing failure mass on the lower slope. This additional load could disturb the current marginal equilibrium of lower portion of the failure zone resulting in a possible rapid acceleration of ground movement into the pit.
- In the short-term, a rapid failure of the back-scarp and the existing failure debris in the lower portion of the slope would not likely result in a pit wave that would overtop the outlet on the south side of the pit. However, a pit wave from such a rapid failure would present a significant hazard to any water pumping or treatment facilities that are located within the pit and to any personnel that may be temporarily working within the pit limits. Consequently, a back-scarp stability monitoring program and safety procedures for personnel entering the pit are highly recommended. This is discussed further in the following sections.
- Ultimately, as the pit water levels rises and approaches the elevation of the outlet on the south side of the pit, a pit wave from a rapid failure of the existing steep back-scarp could overtop the outlet and send a large volume of water downstream of the pit. Consequently, it is recommended that the stability of the back-scarp be assessed to determine the likelihood of failure of the back-scarp, and the possible need to carry out an inundation study for the area downstream of the pit and to develop a long-term monitoring procedures and possible mitigation measures. This is also discussed in the following sections.

As a result of the above concerns with respect to ongoing creep deformations and to possible rapid failure of the steep back-scarp, and in order to quantify the rates of ground movement within the failure zone, a slope stability monitoring program is recommended to be implemented for the east wall of the Grum Pit, and is discussed in the following section.

6.0 EAST WALL SLOPE STABILITY MONITORING PROGRAM

The results of the current slope stability assessment highlight the requirement to establish a slope stability monitoring program of the east wall of the Grum Pit in order to:

- ensure the safety of personnel who work in the vicinity of the Grum Pit;
- monitor the progression of the instability beyond the current back-scarp limits;
- develop a consistent and better evaluation of ground movements of the existing failure mass; and,
- create a proper record of existing and developing instability.

The components and objectives of a slope stability monitoring program are summarized in Table 1.

Table 1: Recommended Monitoring Program

Monitoring Procedure	Objective	Main Tasks	Frequency
Visual Inspections	Monitor stability of the crest of the back scarp. Monitor progression of the instability zone. Provide warning of failure in the area of the access road to the water treatment plant and power line/substation.	Monitoring based on routine walk over and visual inspection on the most critical areas at the crest of the east wall instability zone.	Every second week during spring, summer and fall, or prior to personnel entering the pit limits.
Extensometer and/or Pins	To provide short-term monitoring between prism surveys of the stability of the crest of the back-scarp in the event of new cracks developing behind the crest of the wall.	Extensometers and/or Pin readings.	If new cracks develop behind the back-scarp, monitor before personnel enters the pit limits.
Survey Slope Monitoring Prisms	Establish ground movement rates on the existing failure mass. Quantify the progression of the slope instability process. Monitor the stability of the crest of the back-scarp,	Topographic survey of fixed prisms.	Spring and fall of 2010. The frequency for future monitoring will be adjusted based on the review of 2010 data. If new cracks develop behind the back-scarp, monitor before personnel enters the pit limits.

The recommended monitoring program is discussed in more detail in the following sections.

6.1 Visual Inspections

The visual inspections can likely be carried out by the Faro site staff without regular assistance from specialized staff. This simple procedure, but effective for the purpose of monitoring the progression of the slope instability beyond the current limits, consists of routine inspection of the area behind the crest of the east wall for signs of cracking beyond the current limits of the instability.

The inspection will involve walking over the entire length of the east wall failure back-scarp crest, and in particular along the access road to the water treatment plant and the power line/substation located behind the back-scarp of the south side of the instability zone.

Photographs should be taken periodically to provide comparable visual references of areas of major interest. It is suggested that reference photographs should be taken during each inspection from similar viewpoints to provide historical comparative records.

All observations should be properly recorded on a log book, along with the photographic evidence. The locations of significant cracking should be recorded by use of GPS or survey.

These inspections should be performed ideally by the same person or team on a regular basis, as visual comparison is crucial.

Early warning of any critical instability condition in the ground behind the current back-scarp should be identified by this monitoring procedure.

For safety reasons, a visual inspection of the crest of the back-scarp should be carried out and documented before personnel are allowed to enter the pit limits. If cracking ultimately develops behind the back-scarp, the visual inspections will need to be augmented with instrumentation to provide information on the rates of movement and the stability status and safety of the back-scarp.

6.2 Extensometers and/or Displacement Monitoring Pins

The monitoring of displacements across tension cracks that may develop behind the crest of the back-scarp can likely be carried out by the Faro site staff without regular assistance from specialized staff. It is recommended that some form of simple instrumentation be installed to monitor displacements across existing and new cracks that develop behind the existing back-scarp. This will be required to ensure the safety of any personnel that may need to enter the pit limits, and also to provide early warning of any rapid failure of the back-scarp.

For this purpose, it is recommended that extensometers and/or displacement monitoring pins be installed across new cracks that develop behind the back-scarp.

It is recommended that extensometers and/or displacement pins should be monitored at least twice a week subject to review depending on displacement rates, or every time prior to allowing personnel to enter the pit limits.

The monitoring data for the crack displacements should be properly recorded on data log books, and the data should be plotted on displacement versus time graphs. The displacement plots should be placed in common areas to be available for review by the personnel in need to access the pit.

6.3 Survey Monitoring Prisms

The intent of the installation of survey monitoring prisms is to monitor slope movement rates of the existing failure mass to the west of the back-scarp, and of the area behind the back-scarp over the long-term. However due to the low frequency of surveys, it is not indented to provide early warning of imminent slope failures. Early warning of imminent slope failures will be provided by routine visual inspection of the back-scarps and additional instrumentations, such as wire-line extensometers and/or displacement pins, should new cracks develop behind the back-scarp.

The topographic survey prism should be placed on metal mounting bases that are solidly founded in “in situ” ground. The entire area within the failure zone can be safely accessed by walking from the lower south end of the east wall.

The recommended locations of the proposed prisms are shown on Figures 19 and 20. The recommended survey prism locations are summarized below.

- Six prisms should be installed within the failure zone in order to provide information on the ground movement within the slope failure area.
- Four prisms should be placed along the crest of the east wall behind the back-scarp of the failure zone.
- Two prisms should be placed along the access road to the water treatment plant located above the instability zone.
- Two prisms should be placed on the upper ramp on the south portion of the east wall behind the current back-scarp of the failure zone.
- At least one prism should be placed on stable ground behind the failure zone for quality control of monitoring system. This control prism could be installed at the north end of the east wall behind the crest of the wall.

Survey monitoring prisms should be placed at least 2 meters from any cracking or slope edges to avoid assessment of local instability instead of major slope deformation.

The prism monitoring data should be reviewed by an experienced geotechnical engineer on at least annual basis.

Finally, it is recommended the survey base station to be installed on the west side of the pit in the area indicated on Figure 20. The base station should be installed on stable ground away from the edge of the pit wall. In addition, it is recommended the survey base to be mounted on double casing cemented into the ground to prevent vertical movement due to ice jacking, as shown in Figure 21.

7.0 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

This report has presented the results of the geotechnical slope stability assessment of the instability zone on east wall of the Grum Pit at the Faro Mine, located in the central Yukon Territory. This assessment has been carried out based on the review of the limited available technical documentation on the Grum Pit, and on the observations of a geotechnical inspection of the pit walls during the site visit by our Mr. L. Pohl on August 26, 2009.

The stability review addresses the current conditions of the slope instability that has affected the east wall of the Grum Pit. The following summarizes the observations and conclusions on the slope stability conditions on the east wall of the pit.

- The upper portion of the east wall of the Grum pit has been affected by an overall pit wall slope failure that has developed in the overburden soils that were exposed in the wall. The instability zone measures approximately 350 metre in length in a north/south direction.

  A thick sequence of till and glacio-fluvial sediments was intersected and exposed on the excavation of the east wall. The overburden soil sequence consists of glacio-fluvial sediments, *i.e.,* sand and gravel currently exposed along the base of the failure back-scarp. These soils are overlain by glacial till in the upper portion of exposed back-scarp. The overburden soils that overlie the metamorphic bed rock attain a maximum thickness in the central portion of the instability zone. The lower portion of the east wall is currently located below the surface of the in-pit lake (1,205 metre elevation) that has formed since the mine shut down in 1998, and the portion of the pit wall below the instability zone is not visible.

  As a result of the large scale slope instability, an approximately 15 metres high, prominent back-scarp has been formed around the current limits of the failure zone. It has reached its maximum height in the central portion of the instability area, where the slope on overburden soils has failed up to the crest of the pit wall. At this location, tension cracks have developed behind the scarp and extend only a few meters behind the crest of the scarp. No additional tension cracks were observed further away from the crest of the pit wall.

  The failure zone within the limits of the back-scarp is characterized by a significant ground depression with the loss of the original catch-benches. The ground within the failure zone has undergone large displacement and settlement.

  At the south end of the slope instability area, obsequent ridges and graben features are observed in an area between a previous back-scarp and a more recent scarp that defines the current limits of the instability zone.

  At the north end of the instability area, a series of stepped failures in the overburden soils are observed along the upper portion of the failure zone, and define the back-scarp and the limit of the failure zone. The overall thickness of overburden soils exposed on the east wall pinches out toward the north end of the wall. Further to the north-central portion of the failure zone, older obsequent ridges and graben features are also observed within the failed ground. These features probably represent previous stages of slope instability with regressive failure developing further east of the initial slope failure.

- Based on the observations of the field inspection, it appears that the slope instability was originally initiated in the central portion of the slide zone, predominantly as a rotational slide through the maximum overburden thickness exposed by the excavation of the pit wall. Subsequently, the initial slope failure has progressed, with regressive failures expanding the limits of the instability zone to the south and north, and possibly into areas of shallower bedrock, as well extending to the east and to the upper portion of the pit wall.

  The obsequent scarps and graben features observed in the south and north-central portions of the failure zone indicate that failure has extended behind the original back-scarp. These features occur on higher ground than the main depressed area in the central portion of the failure zone where rotational slide failure appears to have been dominant.

  The underlying rock slopes and the overburden/bedrock contact are currently beneath the surface of the in-pit lake. Based on the bathymetry survey, it appears that a continuous failure slope exists between the pit floor and the top of the failure debris at the base of the back-scarp. It is unknown if the slope failure has developed only in the overburden soils, or alternatively, if it has also developed in the underlying rock slopes.

- The comparative assessment of photographs taken in 2005 and the recent site inspection allowed a qualitative evaluation of the progress of the overburden slope failure zone. This review of the 2005 photographs indicates that the failure zone has been active between 2005 and 2009. The extents of the instability zone have progressed since 2005 and expanded to the current observed boundaries.

  In the central portion of the failure zone, regressive slope failures have affected the back-scarp since 2005 and have reached the crest of the pit wall.

  The instability zone has also expanded north beyond the boundaries observed in 2005, with slope failure advancing to the upper benches in overburden soils on the north side of the east wall.

  The instability zone has also expanded south beyond the boundaries observed in 2005, with slope failure advancing into the overburden soil slopes at the south end of the east wall. Since 2005, the instability area has progressed from the back-scarp located along the lower portion of the slope to the more recent failure scarp that is located at the crest of the east wall. In addition, obsequent scarps and graben features have developed in the area between the 2005 and the current failure scarps.

- In view of the above observations, it would appear that the overburden slope instability on the east wall of the Grum Pit is currently active with on-going deformation. Consequently, further settlement and movement of the failure mass can be expected to continue into the pit, and potentially displace and increase the water level in the pit.

  Since slope movement monitoring has not been carried out on the instability of the east wall, it is not possible to determine the past or current displacement rates. However, it is apparent that the magnitude of movement within the failure zone could have been on the order of several meters since 2005. The comparison between the 2003 and 2009 topographic surfaces also indicate ongoing ground deformation on the order of several meters over this interval.

However, as indicated by the review of the changes in volume above the waterline between the 2003 and 2009 topographic surfaces compared to the additional water accumulated in the pit lake, the actual increase of the water level in the pit lake due to ground movement appears to have been marginal during this period. Therefore, provided that no significant changes in the stability of the east wall occur, the increase in the water level of the pit lake due to ground movement could be expected to be marginal in comparison to the change of water elevation due from surface run-off and groundwater inflows.

- In order to estimate the impact that further instability of failure zone may have on the displacement of water in the pit and on the time remaining until the pit lake overflows the outlet on the south side of the pit, the following calculations have been carried out.
  - Based on Figure 5, the pit lake elevation increased from the 1,187 meter elevation in February 2004 to the 1,205 meter elevation in June 2009. The volume of water that has entered the pit during this 64 month interval between February 2004 and June 2009 is approximately 2,159,257 cubic meters. Based on these volumes, the average rate of water into the pit is 33,740 cubic meters per month.
  - The pit volume remaining between the current pit lake elevation at 1,205 meters and the outlet elevation at 1,230 meters is approximately 4,546,094 cubic meters.
  - The volume of existing failure debris below the outlet elevation at 1,230 meters will not change or displace any water volume below this outlet elevation, even if it were to displace further into the pit. This is because this volume is already below the ultimate pit water level.
  - However, the volume of existing failure debris that is above the pit ultimate outlet elevation would displace and reduce the remaining volume in the pit between the outlet level and the current lake level. The estimated volume of existing failure debris above the outlet elevation at the 1,230 meter elevation is approximately 483,969 cubic meters. This is approximately 10 percent of the 4.5 million cubic meters of storage volume that remains below the pit outlet elevation.

  Based on these volumes, the time remaining until the pit overflows the outlet is approximately 11 years and 3 months, assuming no further displacement of the existing failure mass above the outlet elevation. If the approximately 484,000 cubic meters of existing failure debris above the outlet elevation were to fail into the pit below the outlet elevation, the reduction in time to overflow the pit would be approximately 14 months. Consequently, the remaining time until the pit overflows would be approximately 10 years and one month. These calculations assume that the pit continues to fill with water at the same average rate it has filled over the last five years.

- The current slope instability on the east wall appears to have reached an advanced stage in the failure process, with a shallower slope formed at the lower portion of the instability zone. Based on the bathymetry data, the failure debris appears to have accumulated on the pit floor and the lower slope, and forms a continuous slope from the pit floor to the base of the back-scarp of the failure zone. Therefore, it is possible that the failure mass could be in a condition close to equilibrium, and that the on-going movement would likely continue to occur as slow creep deformation. In this case, a catastrophic movement of the existing failure mass into the pit with an associated rapid displacement of water and increase of the lake elevation is not likely to occur.

- In addition to ground movement within the failure zone, regressive slope failures have continued to develop beyond the limits of the back-scarp that existed in 2005. This progressive failure process of the back-scarp has already progressed to the crest of the east wall, and could potentially continue to extend behind the crest of the wall. The risk of the instability progressing further to the east and south behind the crest of the wall presents the following potential hazards and threats.
  - The continuing regression of the slope instability to the east and south, as has occurred since 2005, presents a potential threat to the substation, power lines and water-treatment access road located along the crest of the pit wall. The substation is located within 50 metres of the crest of the current back-scarp. The access road is located immediately behind the back-scarp along the southeast and south side of the failure zone. The power line is located along the south edge of the access road.
  - In the case of an overall slope failure of the current back-scarp, it is possible that the failure debris would create additional load, *i.e.,* driving forces, on the existing failure mass on the lower slope. This additional load could disturb the current marginal equilibrium of lower portion of the failure zone resulting in a possible rapid acceleration of ground movement into the pit.
- In the short-term, a rapid failure of the back-scarp and the existing failure debris in the lower portion of the slope would not likely result in a pit wave that would overtop the outlet on the south side of the pit. However, a pit wave from such a rapid failure would present a significant hazard to any water pumping or treatment facilities that are located within the pit and to any personnel that may be temporarily working within the pit limits. Consequently, a back-scarp stability monitoring program is recommended in order to:
  - determine the ground movement rates of the existing failure mass to the west of the back-scarp;
  - monitor the progression of the instability beyond the current back-scarp limits;
  - create a proper record of the existing and developing instability; and,
  - provide advance warning of a possible failure of the steep back-scarp.

  The proposed slope stability monitoring program consists of routine inspection of the area behind the crest of the back-scarp wall for signs of cracking beyond the current limits of the instability and the installation of survey monitoring prisms and possibly extensometers and/or displacement monitoring pins, which are discussed in this report. In addition, safety procedures for personnel entering the pit are highly recommended.
- Ultimately, as the pit water levels rises and approaches the elevation of the outlet on the south side of the pit, a pit wave from a rapid failure of the existing steep back-scarp could overtop the outlet and send a large volume of water downstream of the pit. Consequently, it is recommended that the stability of the back-scarp be assessed to:
  - determine the likelihood of failure of the back-scarp;
  - confirm the possible need to carry out an inundation study for the area downstream of the pit; and,
  - confirm the possible need to develop a long-term monitoring procedures and possible mitigation measures.

Back-scarp stability investigation will likely require geotechnical field investigation, laboratory testing and slope stability analysis. A separate scope of work should be prepared for these proposed investigations. Alternatively, the back-scarp slope could be mined back to an overall slope angle of approximately 2:1 horizontal to vertical, which would likely provide a stable long-term slope. The estimated time for the pit to fill to the elevation of the south rim is approximately 10 to 11 years. Re-sloping of the back-scarp should likely occur within approximately one-half of this interval in order to ensure that the back-scarp is re-sloped and stabilized well before the rising water level can de-stabilize the back-scarp. Accordingly, it is considered reasonable to complete this re-sloping within the next 5 to 6 years.

8.0 CLOSURE

The reader is referred to the "*Study Limitations*" in the beginning of this report and forms an integral part of this document.

We trust this report satisfies your current requirements. If you have any questions or require further assistance, please do not hesitate to contact us.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

ORIGINAL SIGNED

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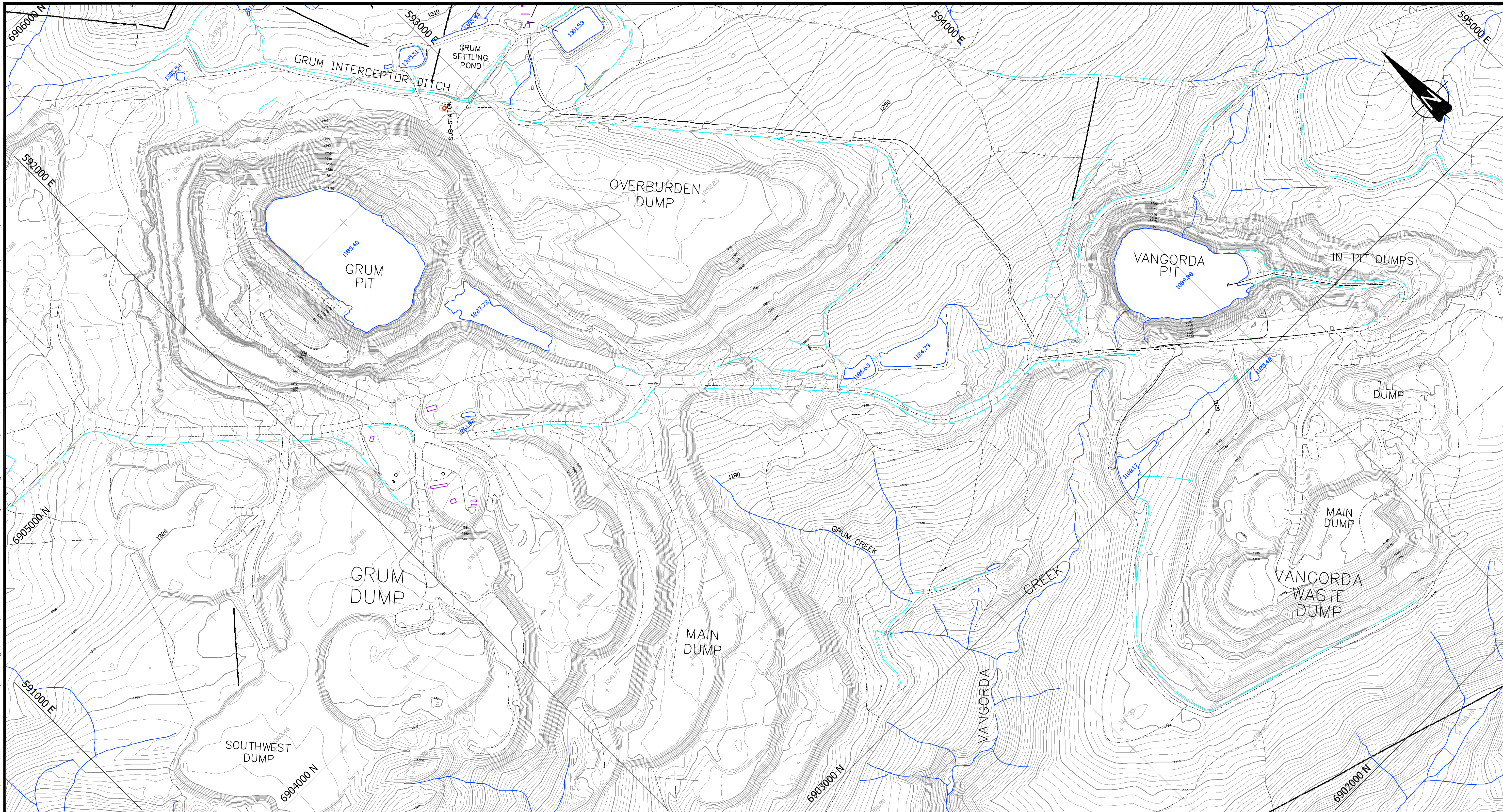

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SCALE IN METRES

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SCALE OF PHOTOGRAPHY: 1:20000
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SURVEY CONTROL BASED ON: UTM PROJECTION, NAD27
COMPILED BY THE ORTHOSHOP, CALGARY, SEPTEMBER 2003
WO 8856

PROJECT

YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE

GRUM PIT LOCATION PLAN

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No. 2000
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CADD	SRR	22SEP09	**FIGURE 1**
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REVIEW	AVC	23MAR10	

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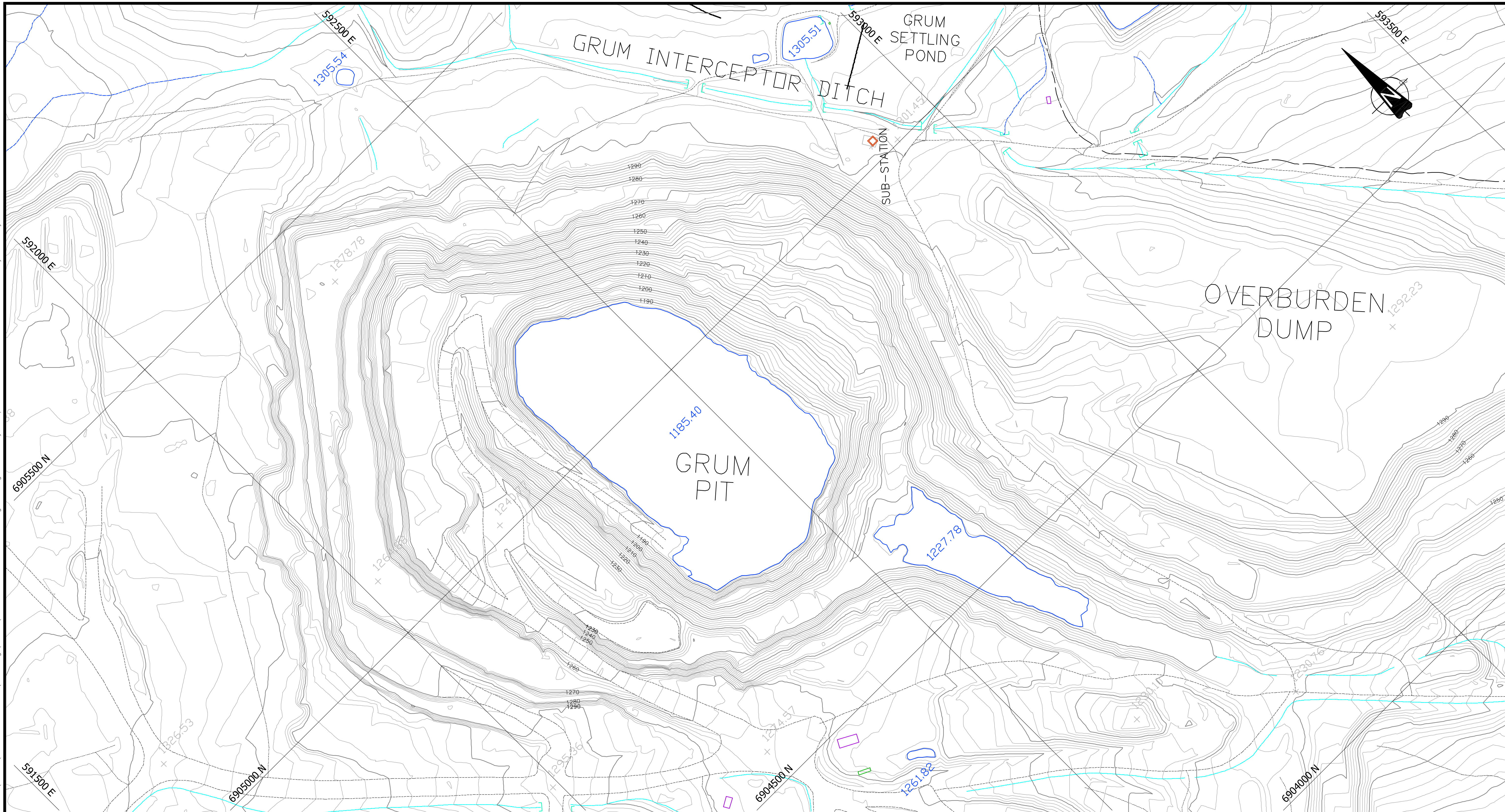

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SRK CONSULTING FARO MINE, YUKON SOUTH 1/2 MAP
SCALE:1:5000 CONTOUR INTERVAL: 2M
DATE OF PHOTOGRAPHY: 03/07/25
SCALE OF PHOTOGRAPHY: 1:20000
SURVEY CONTROL DERIVED FROM EXISTING 1:20000 PHOTOGRAPHY
SURVEY CONTROL BASED ON: UTM PROJECTION, NAD27
COMPILED BY THE ORTHOSHOP, CALGARY, SEPTEMBER 2003
WO 8856

PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE
GRUM PIT (2003)

PROJECT No. 09-1426-0021			PHASE No.	2000
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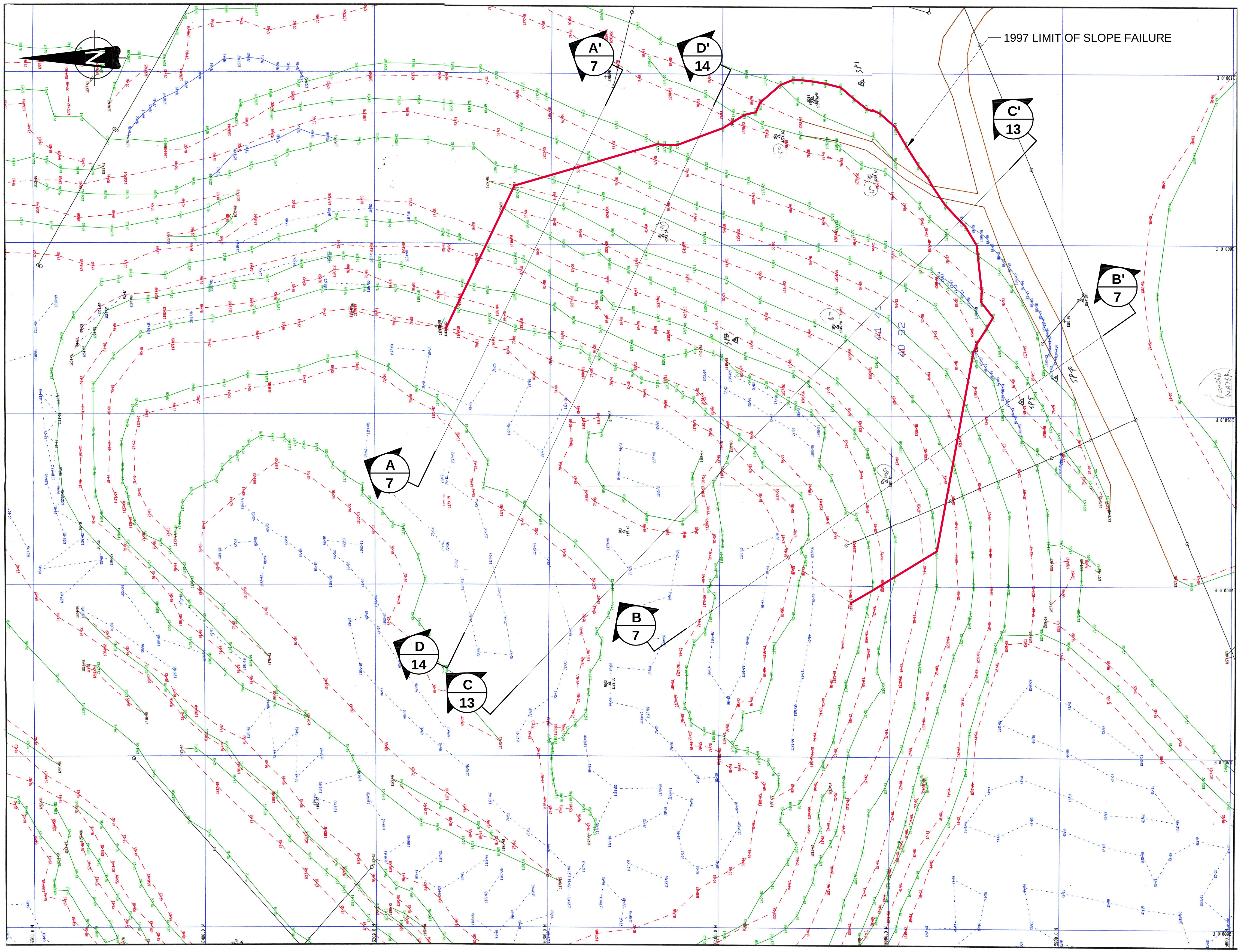
CHECK	AVC	23MAR10	**FIGURE 2**	
REVIEW	AVC	23MAR10		

Golder Associates
Greater Vancouver Office, BC

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.01.dwg Tuesday, September 22, 2009 1:30:11 PM By: sreddy



REFERENCES

1. ANVIL RANGE MINING CORPORATION - "CURRENT STATUS PLAN - GRUM WALL FAILURE AREA". SEPTEMBER 11, 1997 (PAPER COPY PROVIDED BY PITEAU ASSOCIATES).

NOTES

1. DRAWING ON MINE GRID COORDINATES.

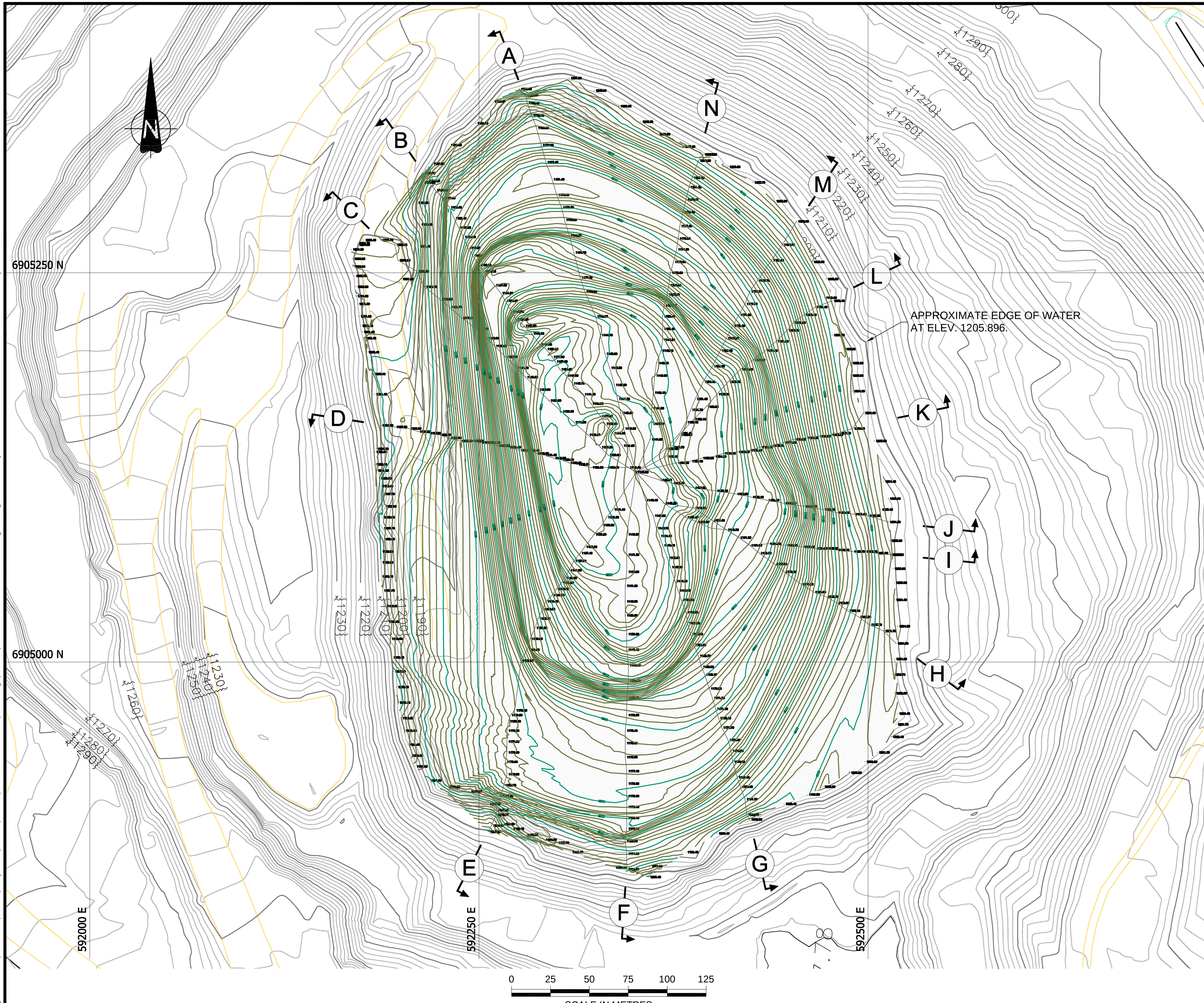
PROJECT: YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE: **GRUM PIT STATUS PLAN (SEPTEMBER 1997)**

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	04NOV09	SCALE AS SHOWN	REV. –
CADD	NS	04NOV09		
CHECK	AVC	23MAR10	**FIGURE 3**	
REVIEW	AVC	23MAR10		

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 19, 2009 9:29:35 AM By: NSmirnova



NOTES

1. CONTOURS BELOW WATER SURFACE BASED ON BATHYMETRY SURVEY.
2. FOR BATHYMETRY ELEVATIONS REFER TO PDF FILE ON APPENDIX DISC.

REFERENCES

1. BATHYMETRY PLAN PREPARED BY LABERGE ENVIRONMENTAL SERVICES.

PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE
GRUM PIT - 2009 BATHYMETRY

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	05NOV09	SCALE AS SHOWN	REV. –
CADD	NS	05NOV09	**FIGURE 4**	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		

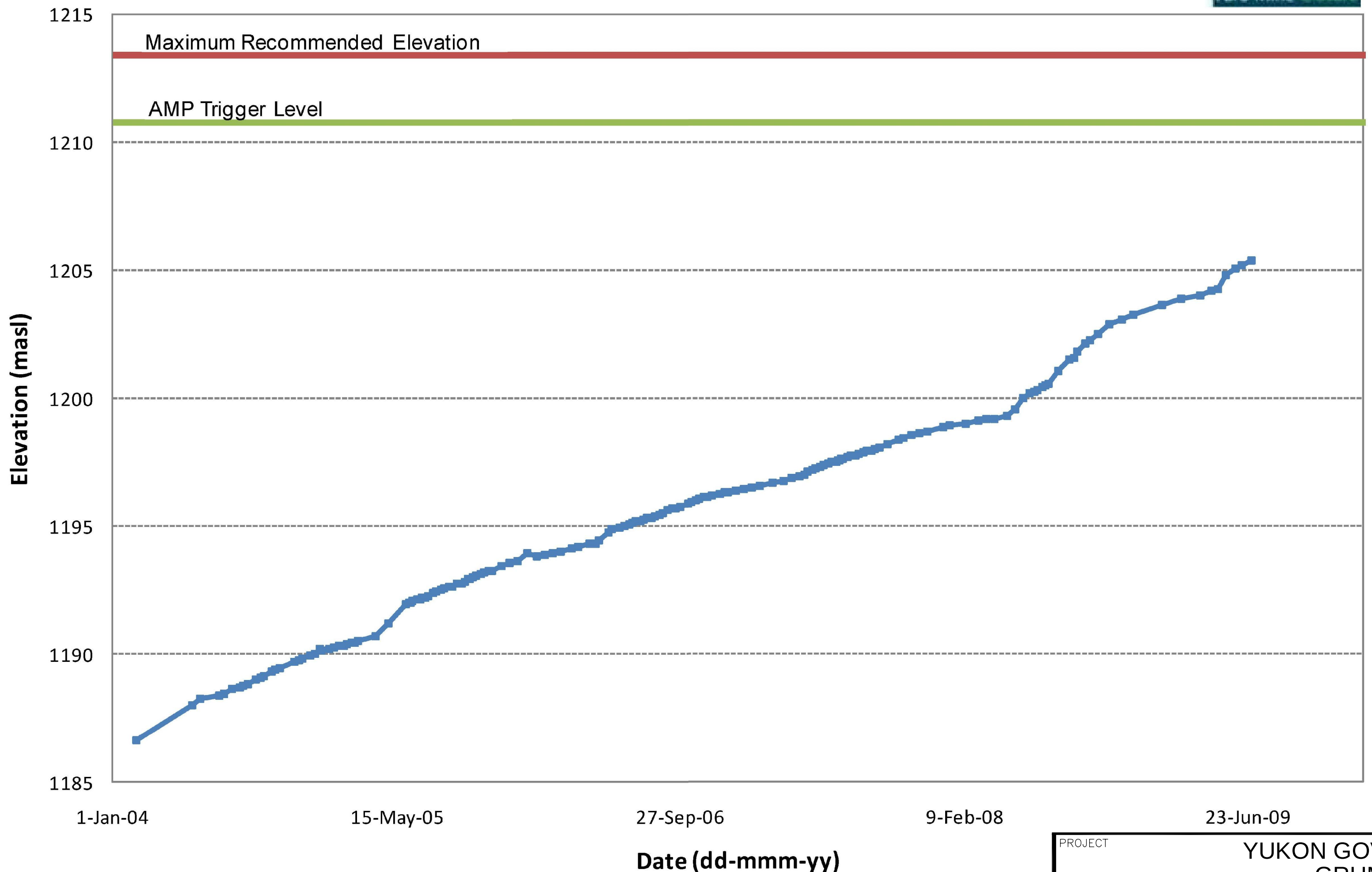
Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.4.dwg Thursday, November 19, 2009 11:58:42 AM By: NSmirnova

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 19, 2009 9:29:35 AM By: NSmirnova

Denison Environmental Services

Grum Pit Water Elevations

Faro Mine Closure



REFERENCES

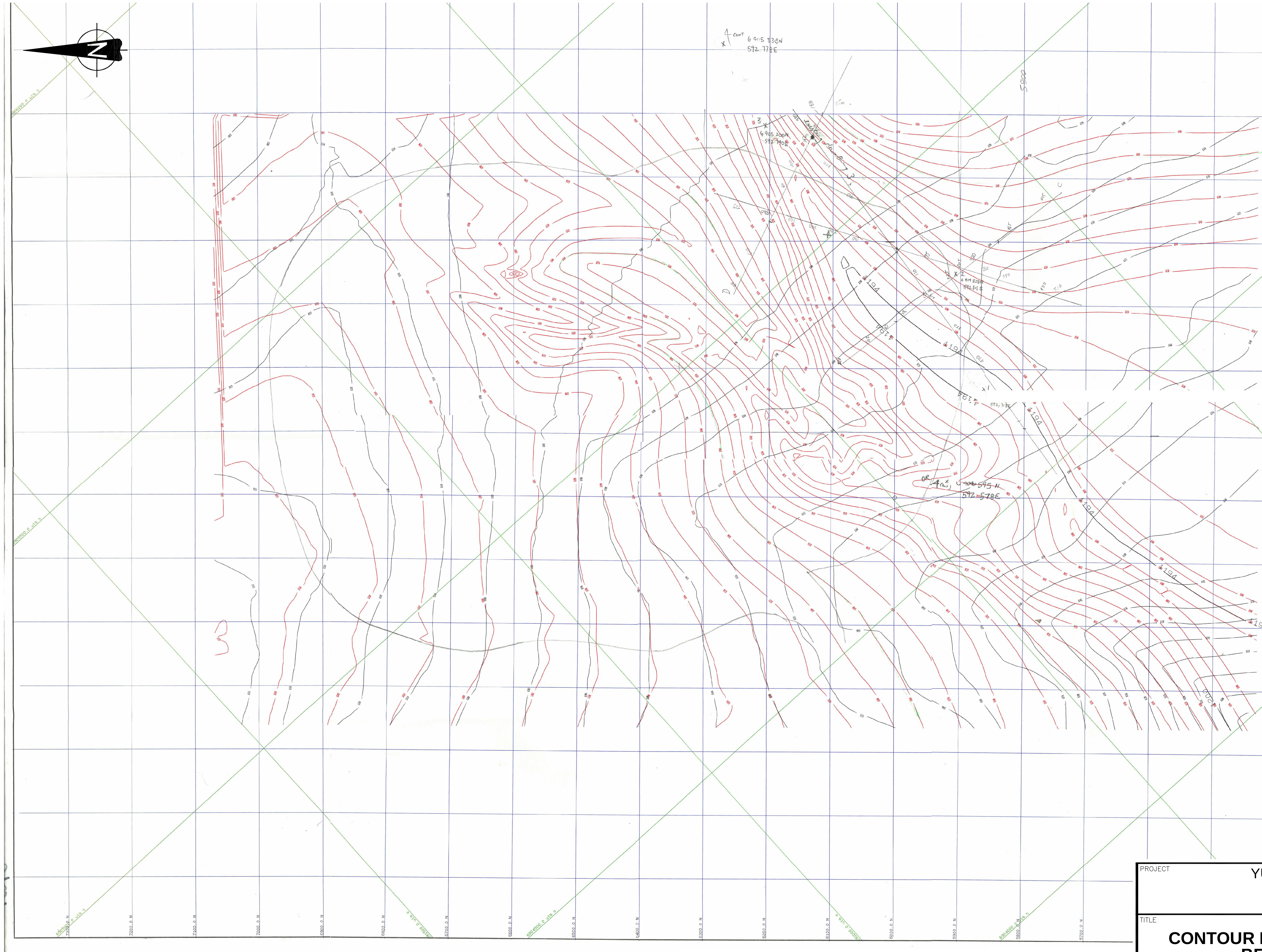
1. DATA FILE PROVIDED BY BRODIE CONSULTING LTD.

PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE
IN-PIT LAKE WATER LEVEL

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No. 2000	
DESIGN	LP	05NOV09	SCALE NTS	REV. –
CADD	NS	05NOV09	FIGURE 5	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		

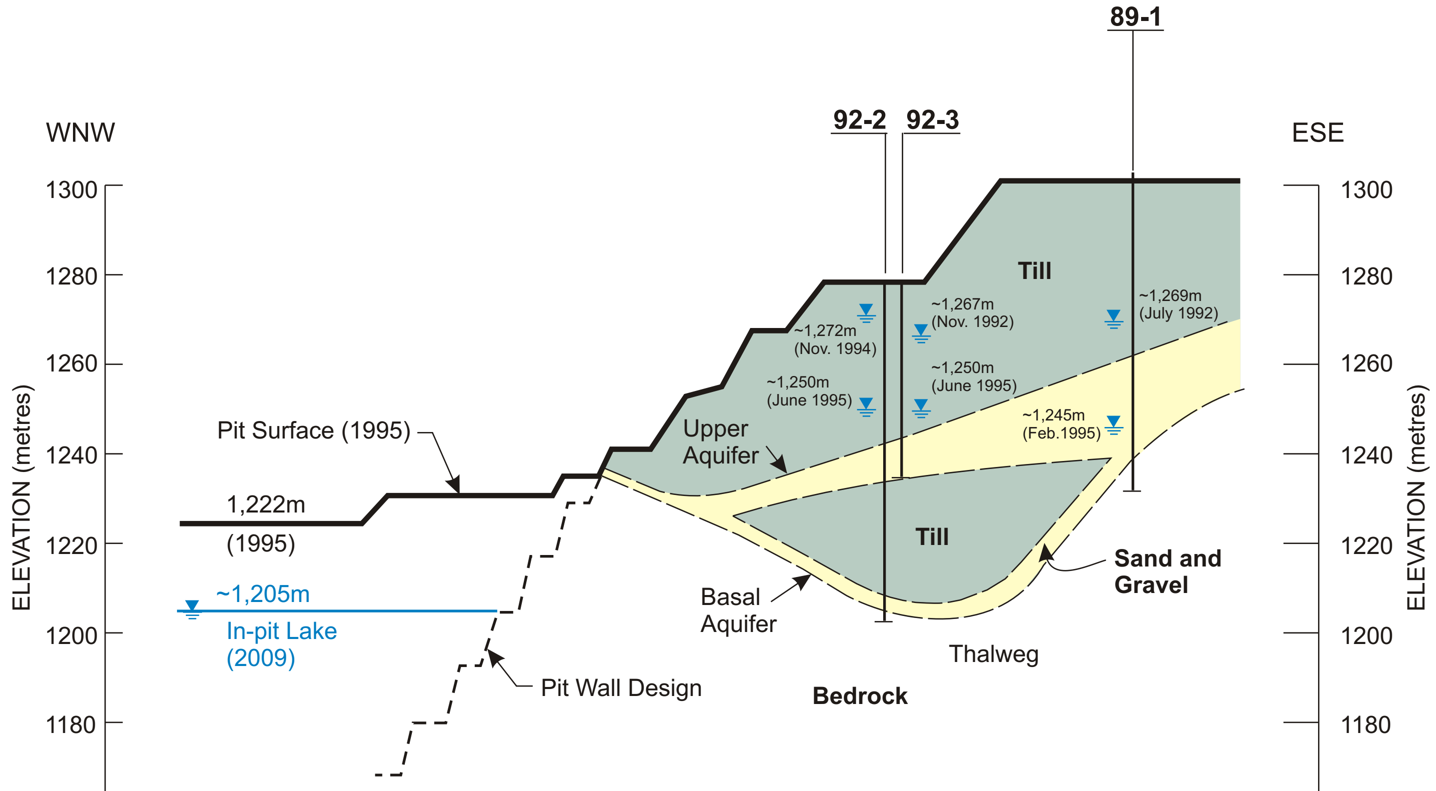


REFERENCES

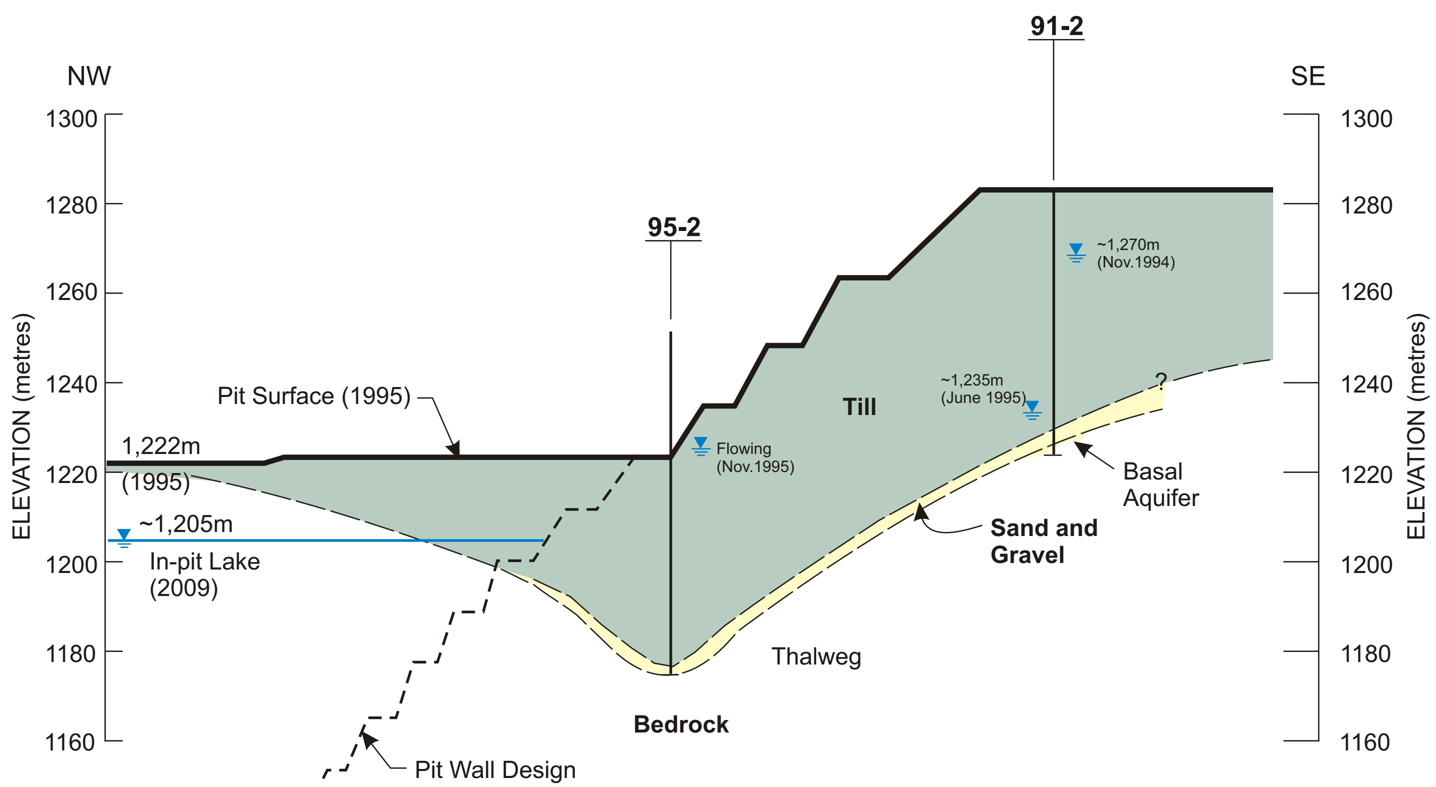
1. ANVIL RANGE MINING CORPORATION - GRUM DEPOSIT TOPOGRAPHY AND OVERBURDEN PLAN. DECEMBER, 1990.

PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON				
TITLE	**CONTOUR MAP OF OVERBURDEN AND BEDROCK CONTACT**				
Golder Associates Greater Vancouver Office, BC	PROJECT No. 09-1426-0021			PHASE No. 2000	
	DESIGN	LP	04NOV09	SCALE AS SHOWN	REV. –
	CADD	NS	04NOV09	**FIGURE 6**	
	CHECK	AVC	23MAR10		
	REVIEW	AVC	23MAR10		

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 19, 2009 9:29:35 AM By: NSmirnova



CROSS-SECTION A - CENTRAL EAST WALL



CROSS-SECTION B - SOUTH EAST WALL

Not to Scale

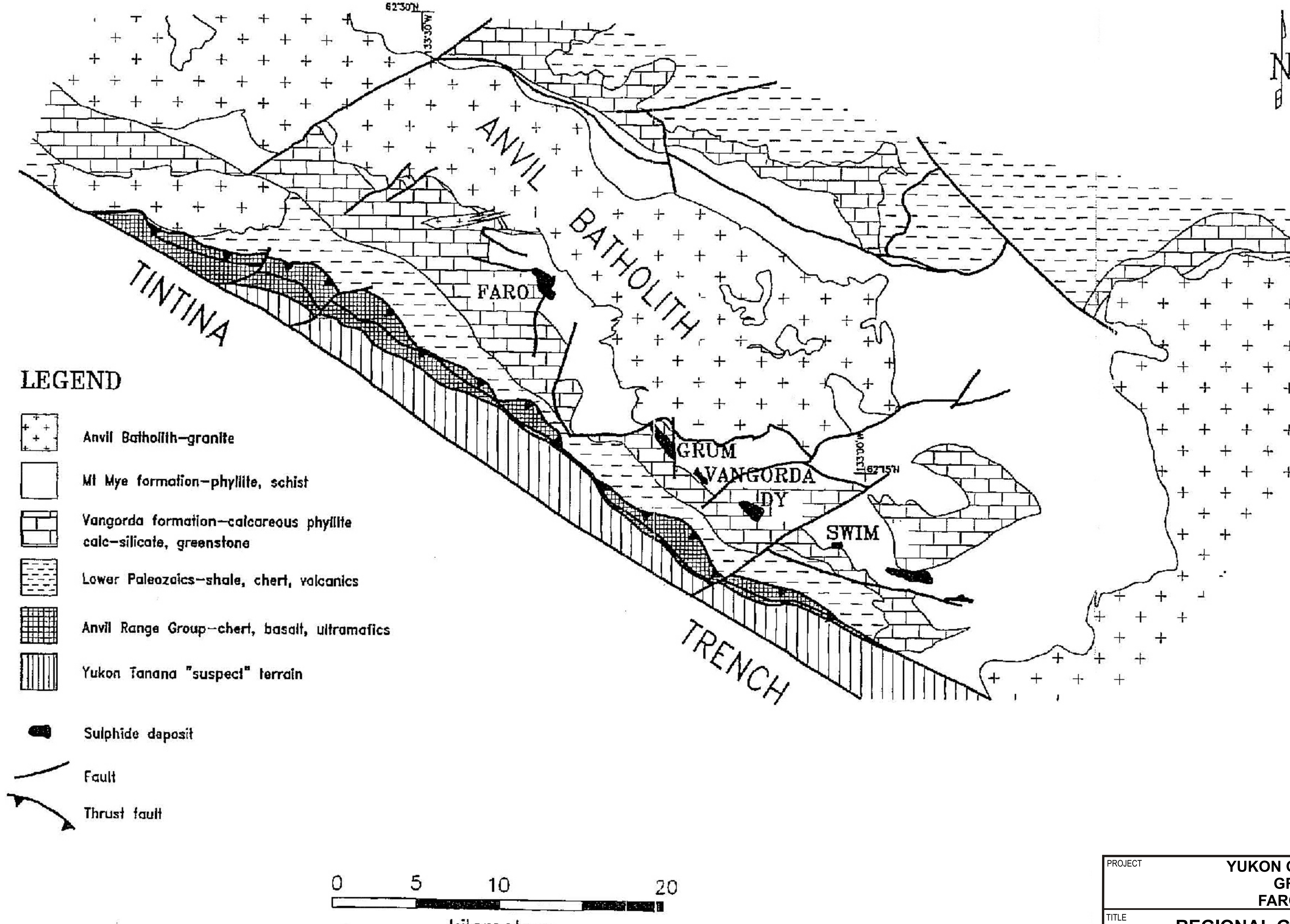
REFERENCE

1. Cross-Section Source - Piteau Associates - Technical Memorandum "Current Groundwater Conditions in the Southeast Walls of the Grum Pit". June, 1995.
2. Locations of Cross-Sections are approximate.

PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON
TITLE	GRUM PIT - 1995 EAST WALL CROSS-SECTIONS (Reference 5)

PROJECT No. 09-1426-0021			PHASE NO. 2000	
DESIGN	LP	22SEP09	SCALE NTS	REV.
CADD	SS	22SEP09	FIGURE 7	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		

Golder Associates



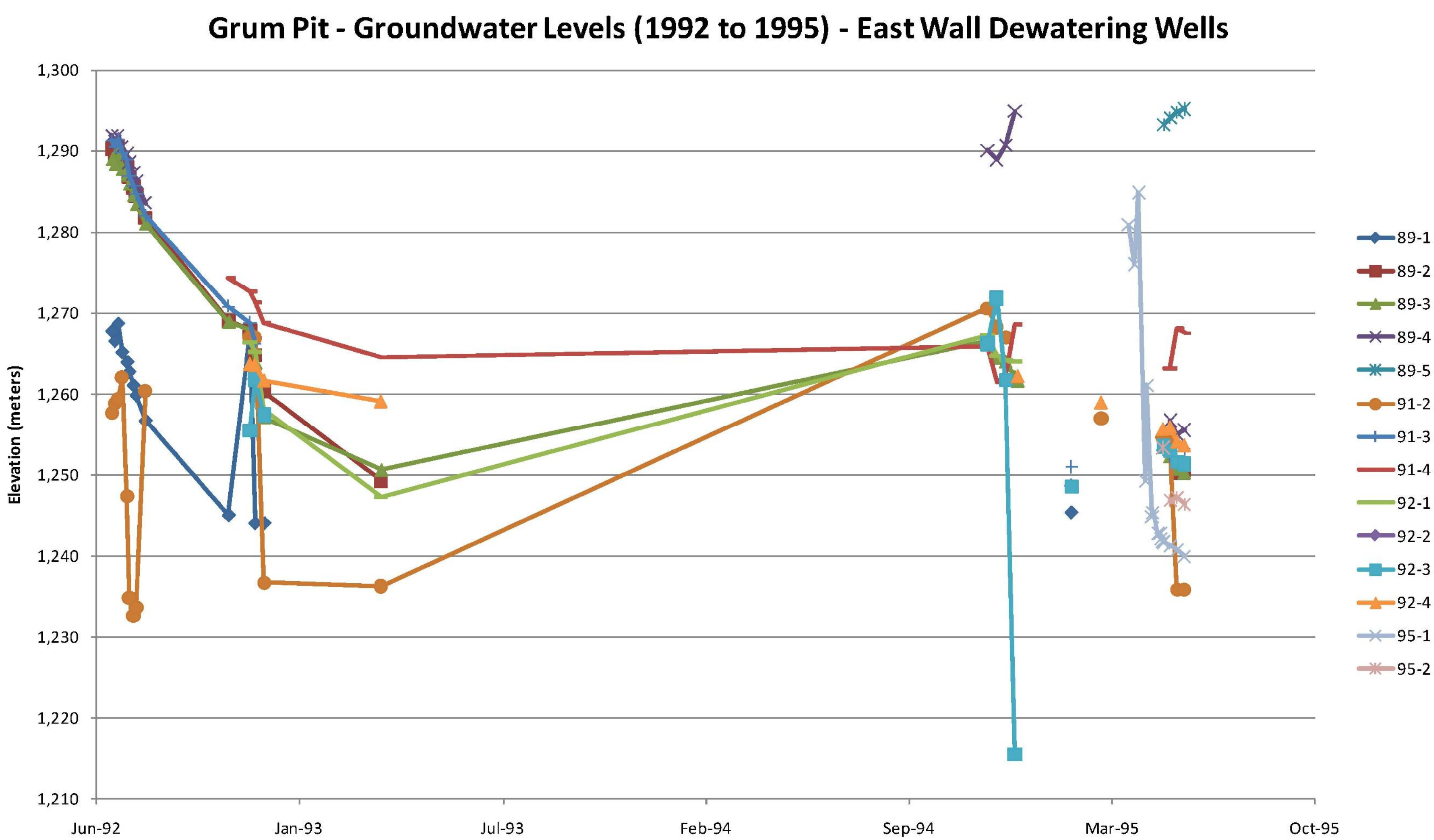
REFERENCE

1. Report by Robertson Geoconsultants Inc., Report No. 033001/3, Dated November 1996 "Anvil Range Mining Complex - Integrated Comprehensive Abandonment Plan" Drawing Taken from Access Mining, 1996.

PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON			
TITLE	REGIONAL GEOLOGY OF THE ANVIL RANGE AREA (Reference 1)			
Golder Associates	PROJECT No. 09-1426-0021		PHASE NO. 2000	
	DESIGN	LP	22SEP09	SCALE / REV.
	CADD	SS	22SEP09	FIGURE 8
	CHECK	AVC	23MAR10	
	REVIEW	AVC	23MAR10	

DRAWING DATE: 22-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_04-05.cdr

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 19, 2009 10:11:09 AM By: NSmirnova



NOTES

1. MONITORING WELLS: 89-2, 89-3, 89-4, AND 92-4
2. PUMPING WELLS: ALL REMAINING WELLS.

REFERENCES

1. DATA SOURCE - PITEAU ASSOCIATES.
   REPORT "GRUM PIT. REVIEW AND ANALYSIS OF HYDROLOGICAL DATA AND DESIGN OF PHASE 1 DEWATERING SYSTEM". JANUARY, 1991.

PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE
GRUM PIT - EAST WALL WELLS WATER LEVELS

Golder Associates
Greater Vancouver Office, BC

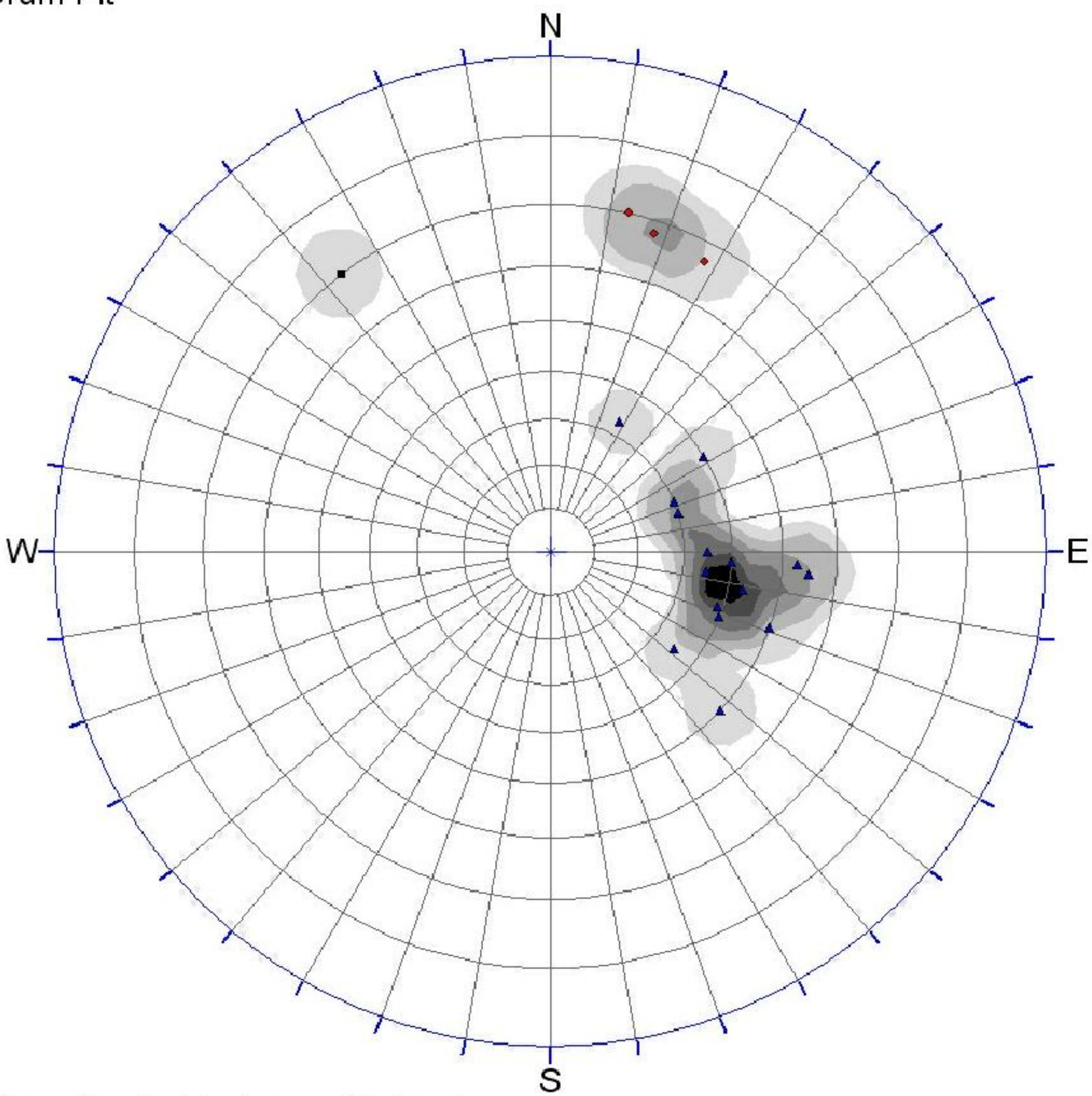
PROJECT No. 09-1426-0021		
DESIGN	LP	05NOV09
CADD	NS	05NOV09
CHECK	AVC	23MAR10
REVIEW	AVC	23MAR10

PHASE No. 2000
SCALE NTS REV. –

FIGURE 9

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 05, 2009 4:28:00 PM By: NSmirnova

Grum Pit



Discontinuity Features - Bedrock

FEATURE TYPE

- ■ Fault [1]
- ▲ Foliation [15]
- ● Joint/Crack [3]

Equal Angle
Lower Hemisphere
19 Poles
19 Entries

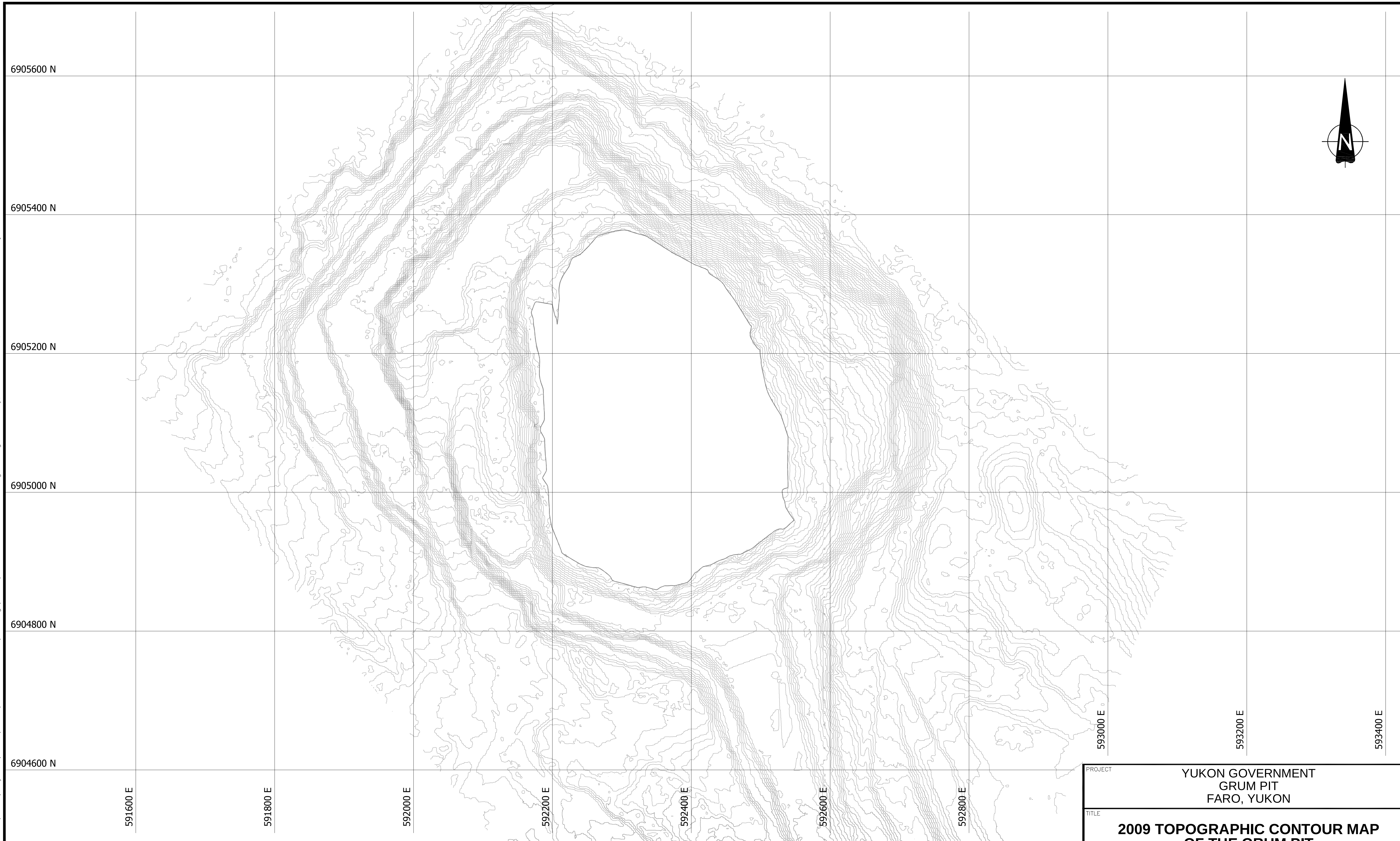
PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE

STEREONET PLOT - BEDROCK

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	05NOV09	SCALE NTS	REV. –
CADD	NS	05NOV09	**FIGURE 10**	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		



Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.11.dwg Thursday, November 19, 2009 11:56:56 AM By: NSmirnova

REFERENCES

1. CONTOUR MAP PREPARED FROM GEOTIFF FORMAT FILE OF THE 2009 DEM PROVIDED BY THE YUKON GOVERNMENT.

PROJECT

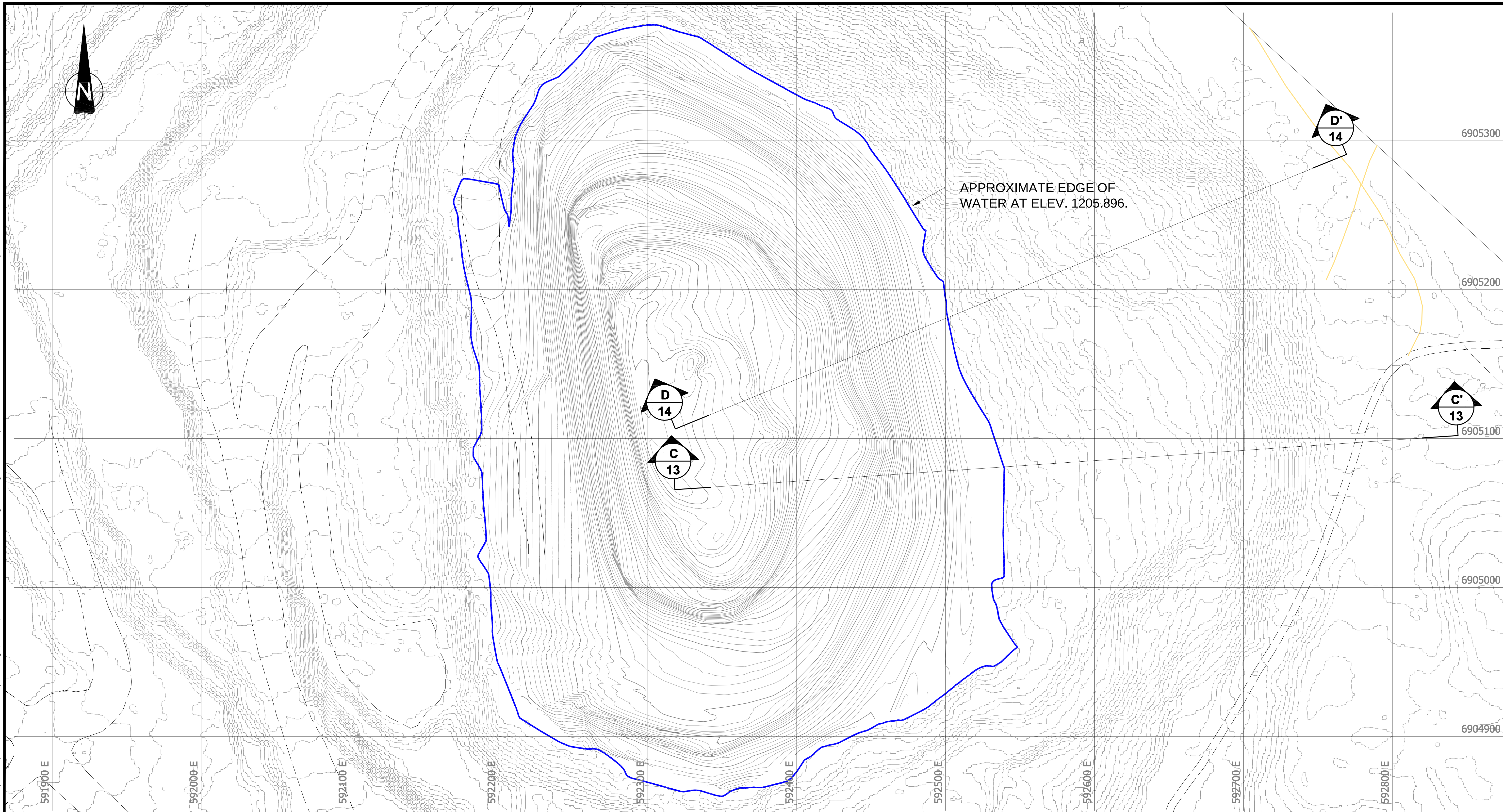
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE

2009 TOPOGRAPHIC CONTOUR MAP OF THE GRUM PIT

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	04NOV09	SCALE AS SHOWN	REV. –
CADD	NS	04NOV09	**FIGURE 11**	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		



Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\2000\Drafting\2000\0914260021-2000-A_Fig.12.dwg Thursday, November 19, 2009 11:43:48 AM By: NSmirnova

REFERENCES

1. PIT TOPOGRAPHY BASED ON THE 2009 CONTOUR MAP (FIGURE 11) AND 2009 BATHYMETRY SURVEY BELOW WATER LINE (FIGURE 4).

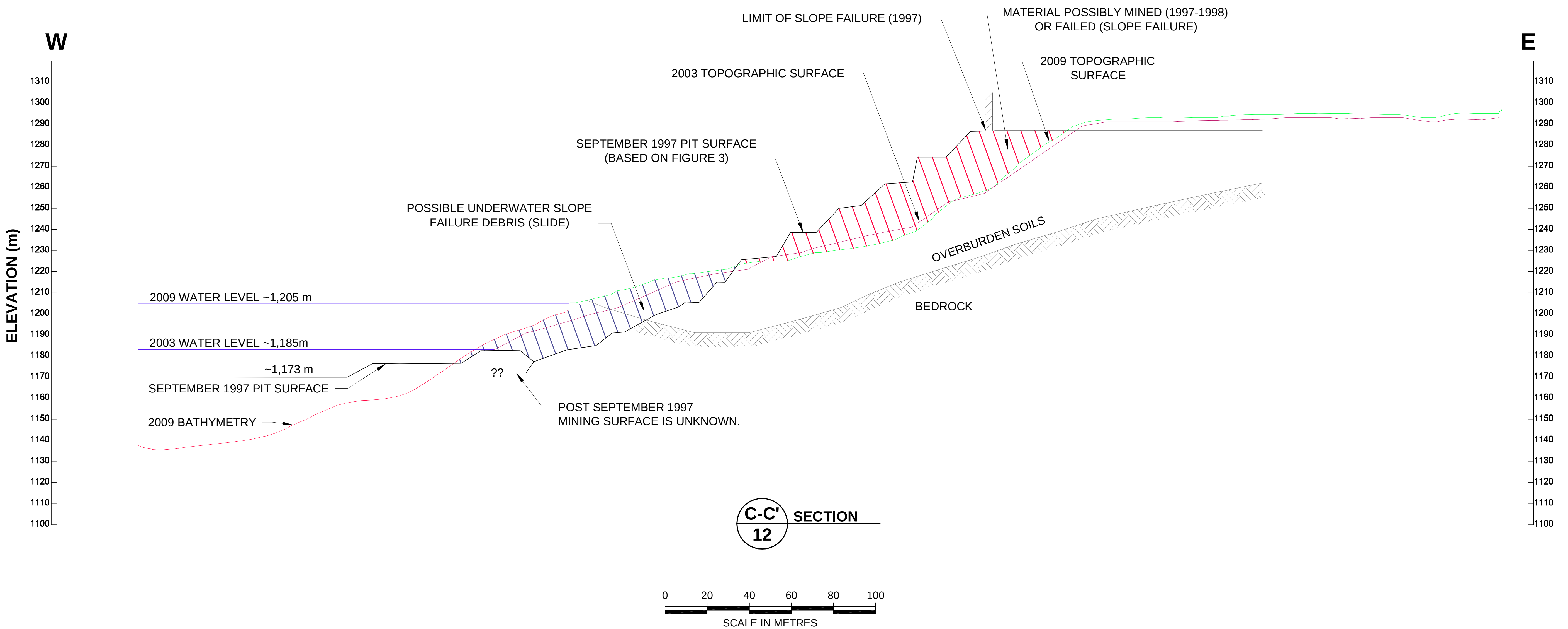
0 25 50 75 100 125
SCALE IN METRES

PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE
GRUM PIT - LOCATION OF CROSS-SECTIONS

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No. 2000	
DESIGN	LP	22SEP09	SCALE AS SHOWN	REV. –
CADD	SRR	22SEP09	**FIGURE 12**	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		

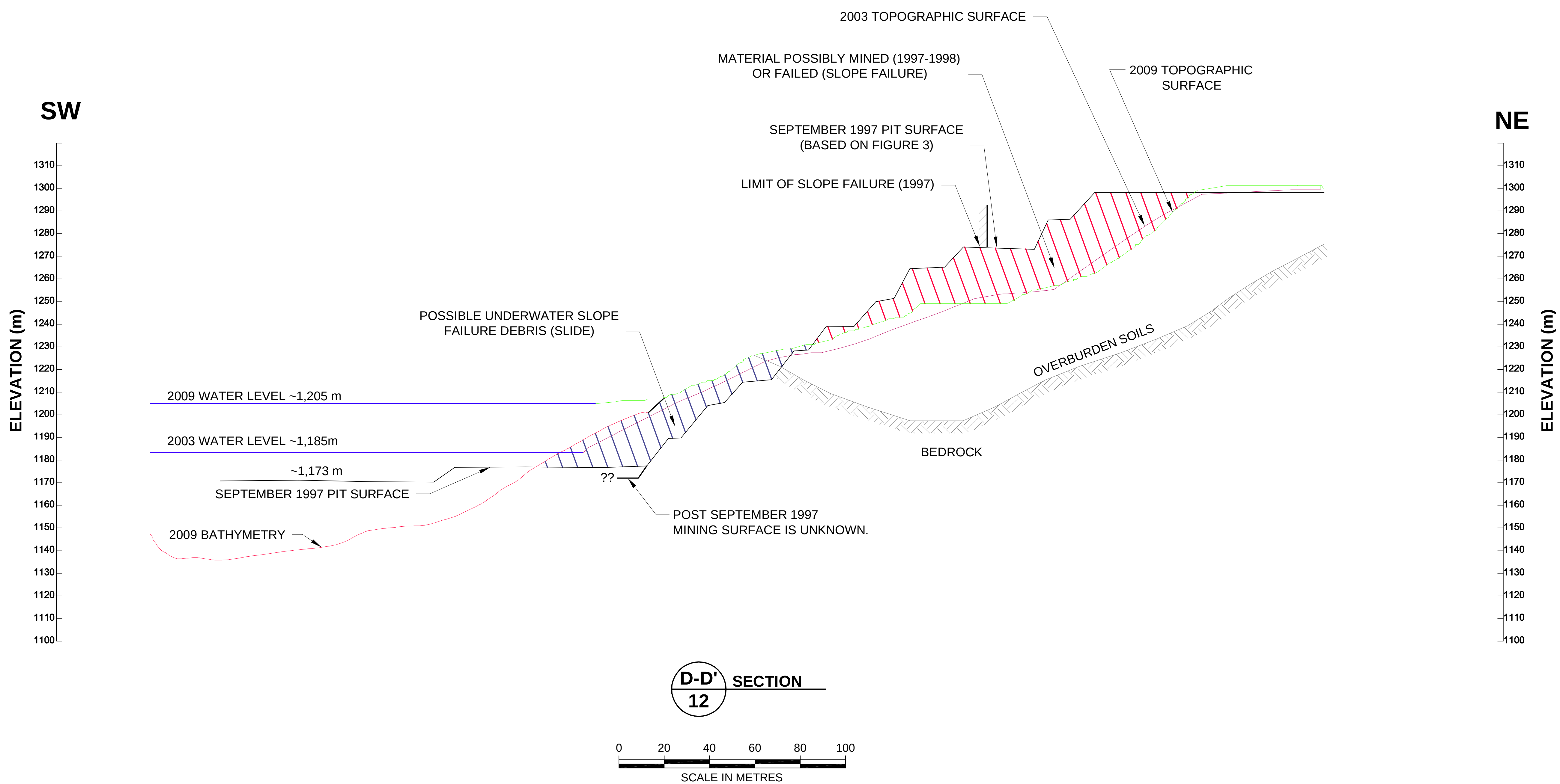


PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON
TITLE	**CROSS SECTION C**

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	04NOV09	SCALE AS SHOWN	REV. –
CADD	NS	04NOV09	**FIGURE 13**	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig_13.DWG Thursday, November 19, 2009 11:46:14 AM By: NSmirnova



PROJECT
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

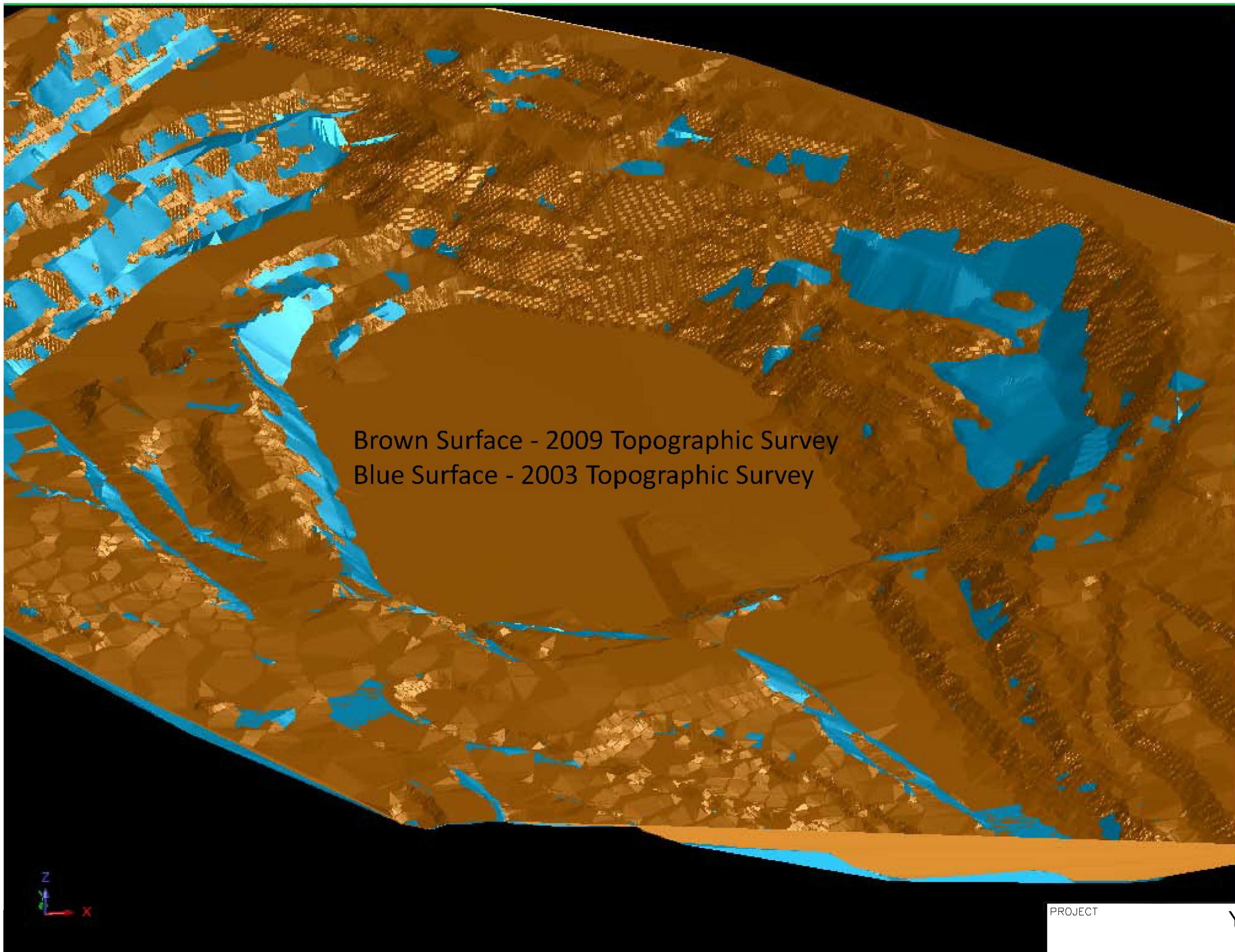
TITLE
CROSS SECTION D

Golder Associates

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	04NOV09	SCALE AS SHOWN	REV. –
CADD	NS	04NOV09	FIGURE 14	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		

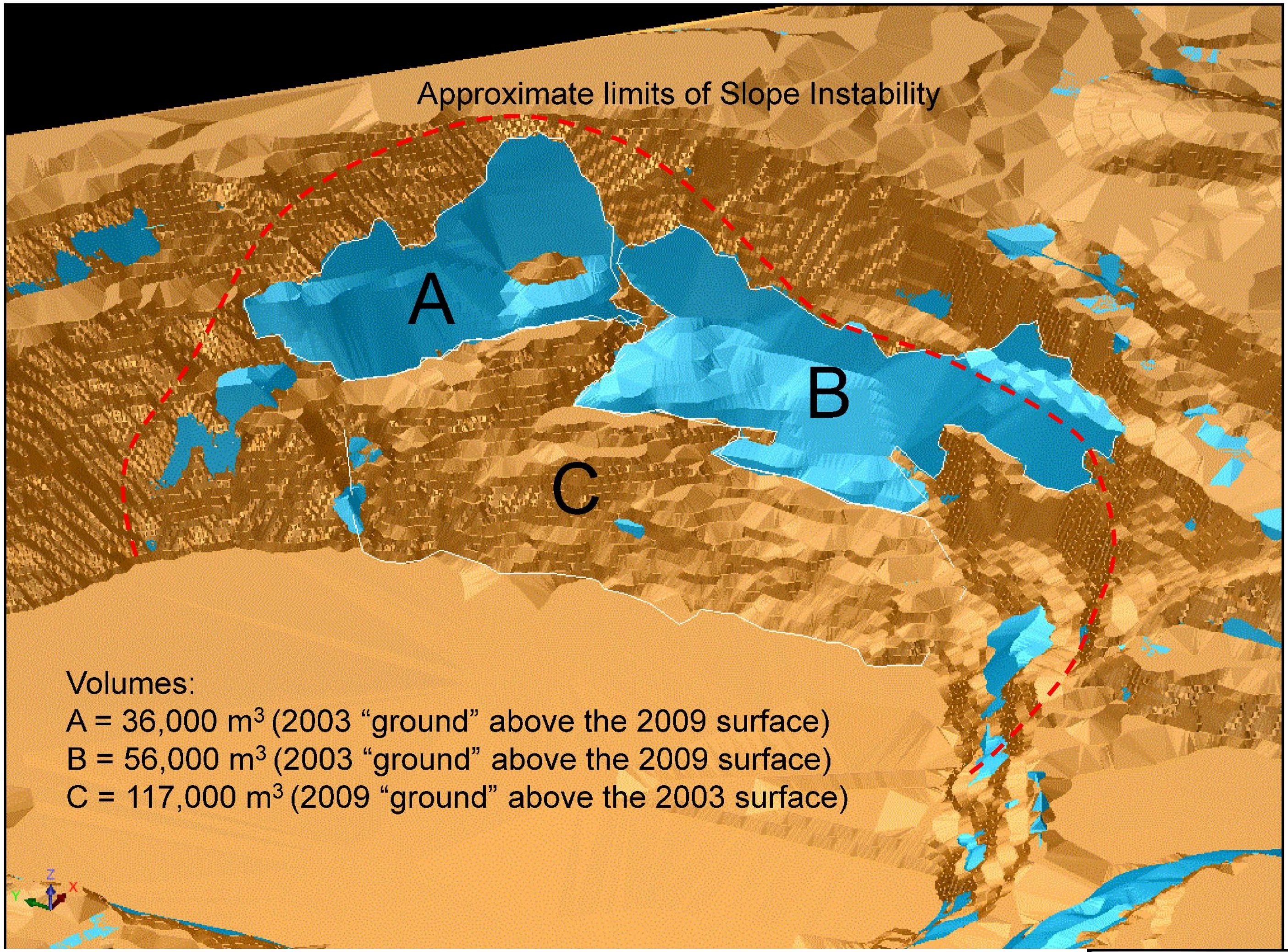
Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.14.dwg Thursday, November 19, 2009 11:47:54 AM By: NSmirnova

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 05, 2009 4:28:00 PM By: NSmirnova



PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON				
TITLE	**2003 AND 2009 TOPOGRAPHIC SURFACES**				
Golder Associates Greater Vancouver Office, BC	PROJECT No. 09-1426-0021			PHASE No. 2000	
	DESIGN	LP	05NOV09	SCALE NTS	REV. –
	CADD	NS	05NOV09	**FIGURE 15**	
	CHECK	AVC	23MAR10		
	REVIEW	AVC	23MAR10		

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 05, 2009 4:28:00 PM By: NSmirnova

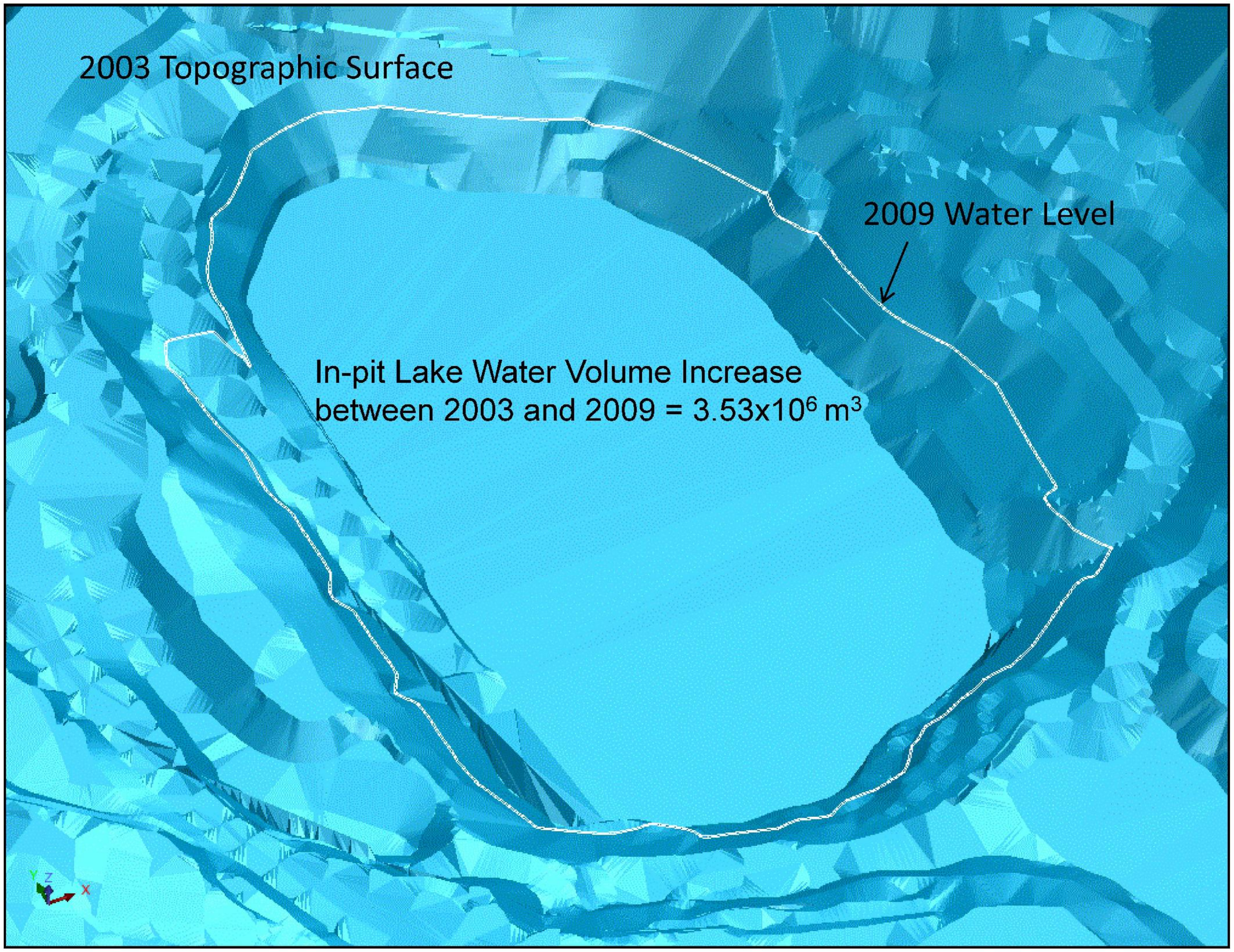


PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON
TITLE	**COMPARISON OF 2003 AND 2009 TOPOGRAPHIC SURFACES**

Golder Associates
Greater Vancouver Office, BC

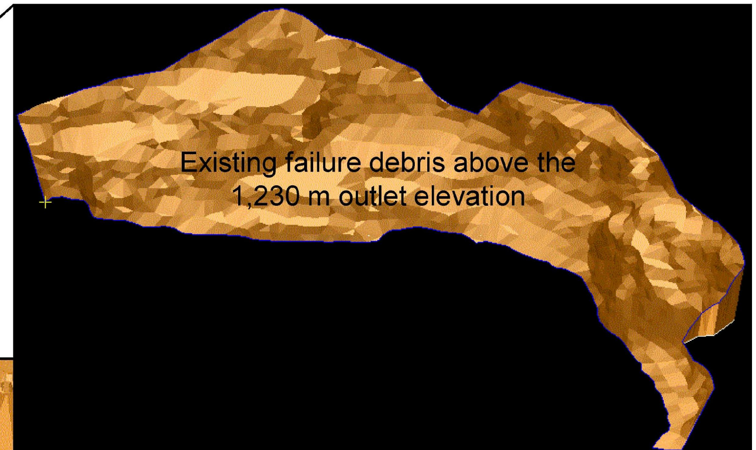
PROJECT No. 09-1426-0021			PHASE No. 2000
DESIGN	LP	05NOV09	SCALE NTS REV. –
CADD	NS	05NOV09	
CHECK	AVC	23MAR10	**FIGURE 16**
REVIEW	AVC	23MAR10	

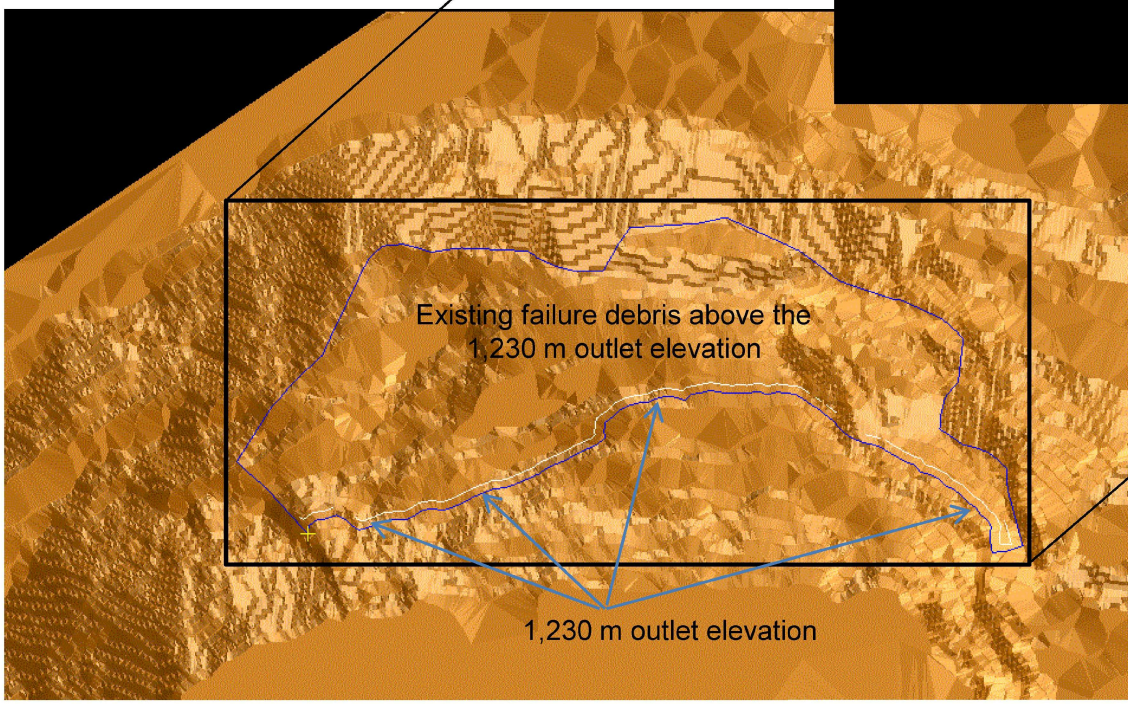
Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.3,5,7,9,10,15-16.dwg Thursday, November 05, 2009 4:28:00 PM By: NSmirnova



PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON				
TITLE	**IN-PIT LAKE WATER VOLUME INCREASE (2003 - 2009)**				
Golder Associates Greater Vancouver Office, BC	PROJECT No. 09-1426-0021			PHASE No. 2000	
	DESIGN	LP	05NOV09	SCALE NTS	REV. –
	CADD	NS	05NOV09	**FIGURE 17**	
	CHECK	AVC	23MAR10		
	REVIEW	AVC	23MAR10		

Volume of existing failure debris above the 1,230 m outlet elevation = 483,969 cubic meters





PROJECT

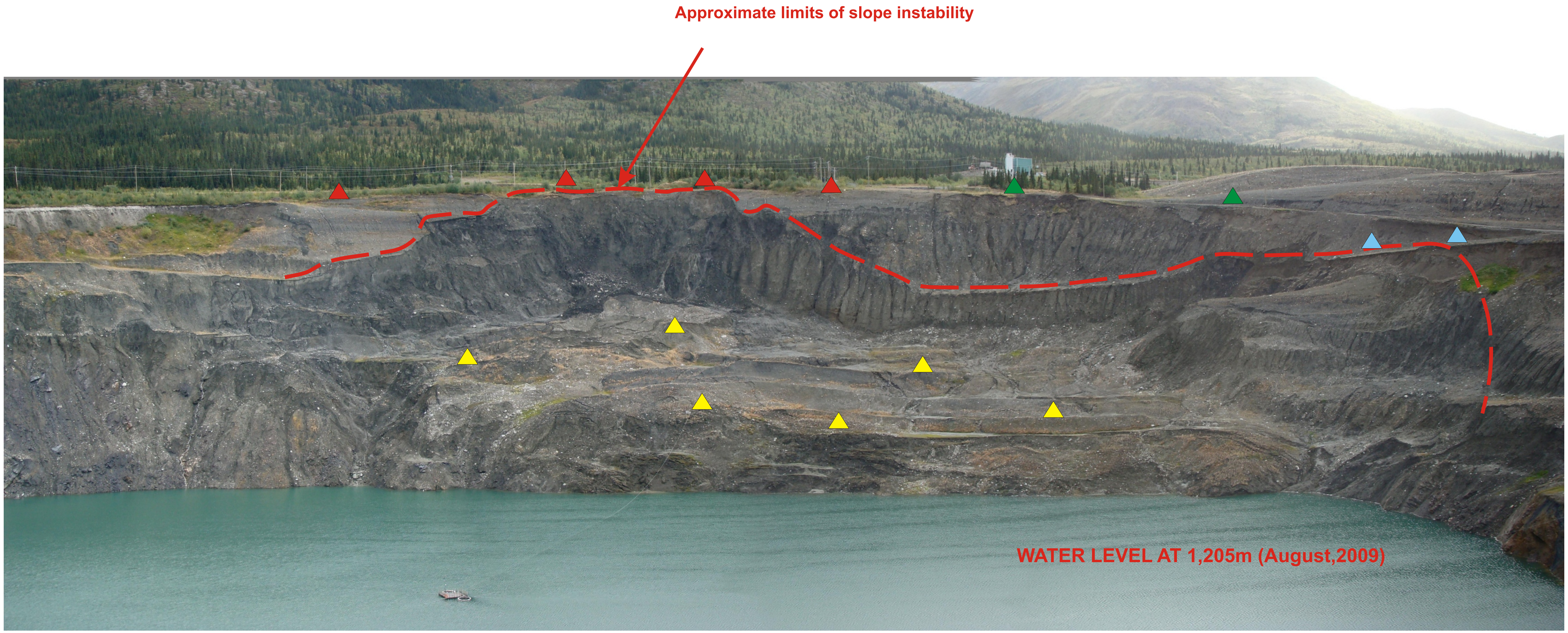
YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE

VOLUME OF EXISTING FAILURE DEBRIS ABOVE THE 1,230 M OUTLET ELEVATION

Golder Associates
Greater Vancouver Office, BC

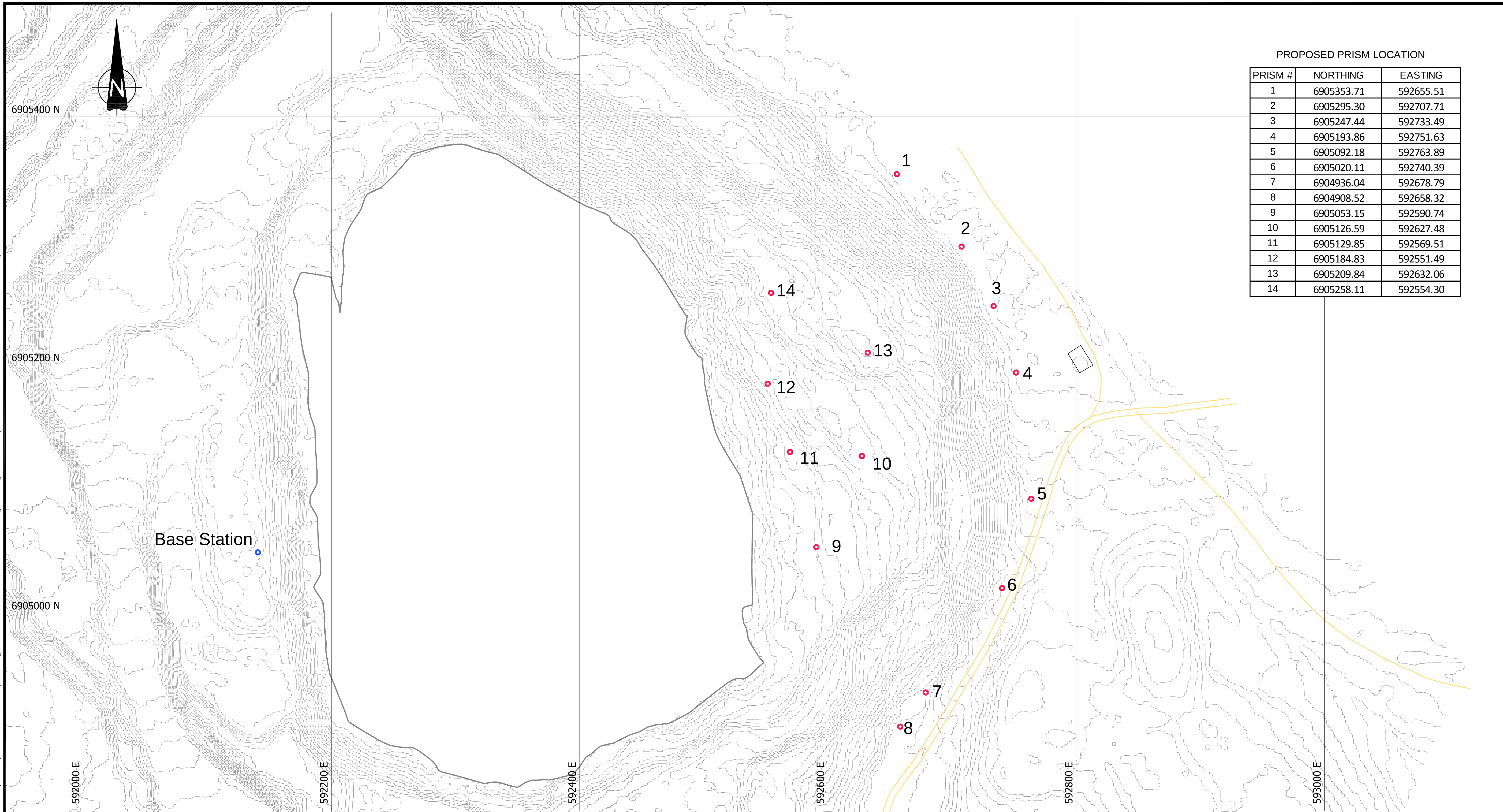
PROJECT No. 09-1426-0021			PHASE No. 2000	
DESIGN	LP	05NOV09	SCALE NTS	REV. –
CADD	NS	19NOV09	FIGURE 18	
CHECK	AVC	23MAR10		
REVIEW	AVC	23MAR10		



LEGEND

- ▲ (red) Prisms behind the crest of the East wall
- ▲ (green) Prisms along the access road behind the crest of the wall
- ▲ (yellow) Prisms within the Failure Zone
- ▲ (blue) Prisms on the ramp behind the crest of the slope

PROJECT	YUKON GOVERNMENT GRUM PIT FARO, YUKON			
TITLE	LOCATIONS OF RECOMMENDED SLOPE MONITORING PRISMS			
Golder Associates	PROJECT No. 09-1426-0021		PHASE No. 2000	
	DESIGN	LP	03NOV09	SCALE NTS	REV.
	CADD	GG	03NOV09	FIGURE 19
	CHECK	LP	03NOV09	
	REVIEW	AVC	23MAR10	



PROPOSED PRISM LOCATION

PRISM #	NORTHING	EASTING
1	6905353.71	592655.51
2	6905295.30	592707.71
3	6905247.44	592733.49
4	6905193.86	592751.63
5	6905092.18	592763.89
6	6905020.11	592740.39
7	6904936.04	592678.79
8	6904908.52	592658.32
9	6905053.15	592590.74
10	6905126.59	592627.48
11	6905129.85	592569.51
12	6905184.83	592551.49
13	6905209.84	592632.06
14	6905258.11	592554.30

LEGEND

- PROPOSED SLOPE MONITORING PRISM

- PROPOSED BASE STATION

NOTES

1. PROPOSED PRISM LOCATIONS ARE APPROXIMATE. ACTUAL LOCATION TO BE ADJUSTED ACCORDING TO FIELD CONDITIONS.

0 30 60 90 120 150

SCALE IN METRES

PROJECT

YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE

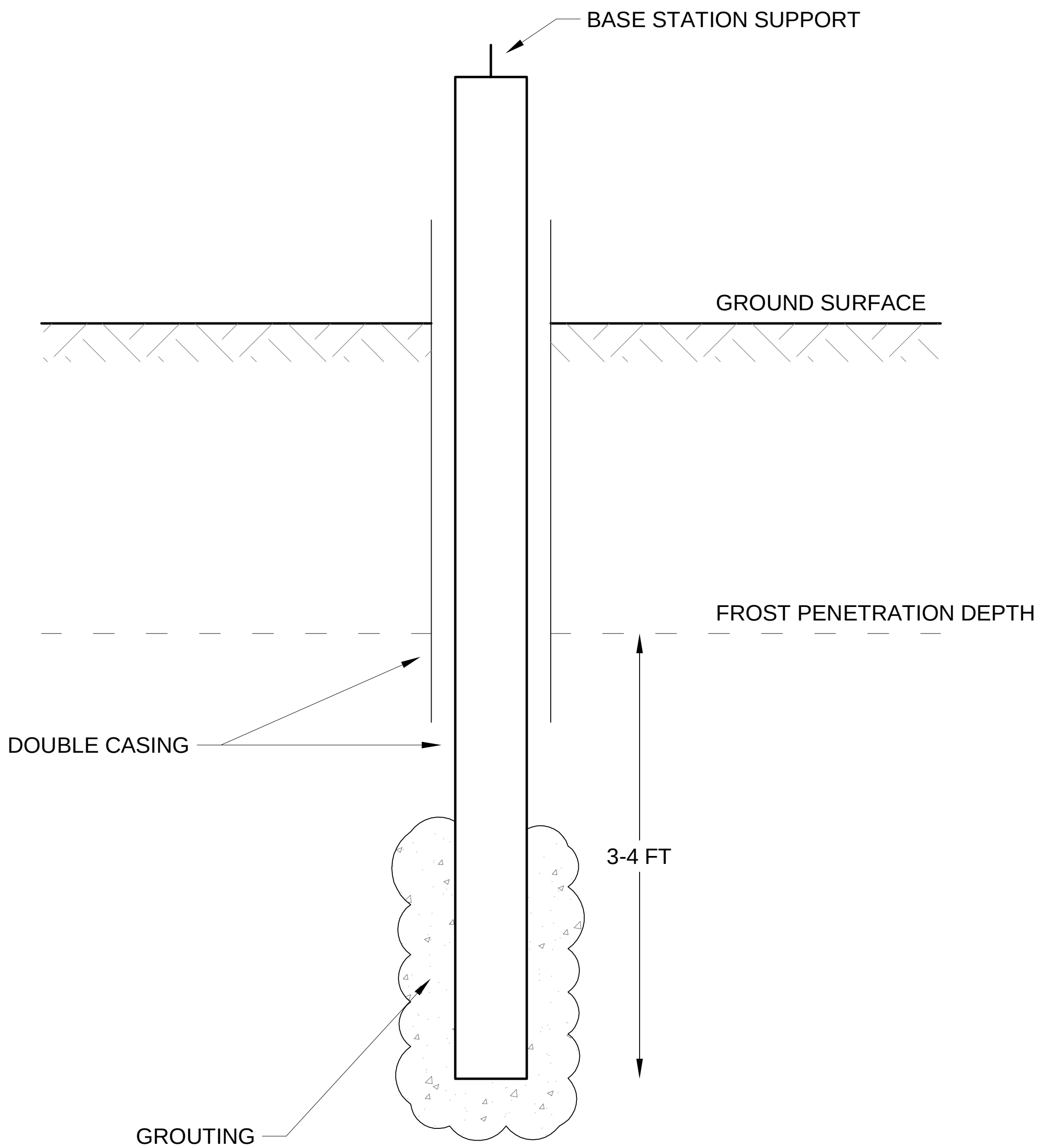
PROPOSED MONITORING PRISM LOCATIONS

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No. 2000
DESIGN	LP	04NOV09	SCALE AS SHOWN REV. –
CADD	NS	19NOV09	
CHECK	AVC	23MAR10	**FIGURE 20**
REVIEW	AVC	23MAR10	

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.20.dwg Thursday, November 19, 2009 10:58:58 AM By: NSmirnova

Drawing File: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\0914260021-2000-A_Fig.21.dwg Thursday, November 19, 2009 9:24:29 AM By: NSmirnova



PROJECT

YUKON GOVERNMENT
GRUM PIT
FARO, YUKON

TITLE

SURVEY BASE STATION MOUNTED ON DOUBLE CASING SUPPORT

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 09-1426-0021			PHASE No.	2000
DESIGN	LP	05NOV09	SCALE NTS	REV. –
CADD	NS	18NOV09		
CHECK	AVC	23MAR10	**FIGURE 21**	
REVIEW	AVC	23MAR10		

APPENDIX I

Photographs

DRAWING DATE: 17-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 1\0914260021-2000-A_01.cdr

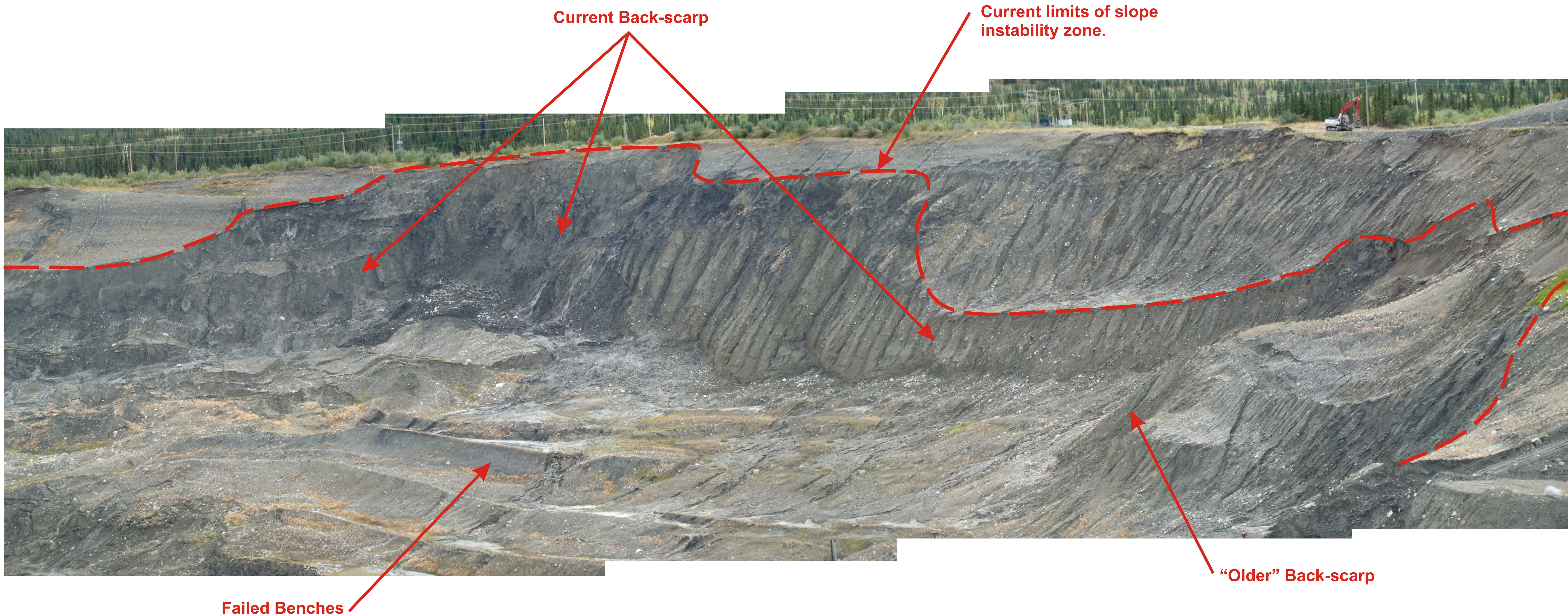
Photograph 1 : Grum Pit (August 2009)

DRAWING DATE: 17-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 1\0914260021-2000-A_01b.cdr

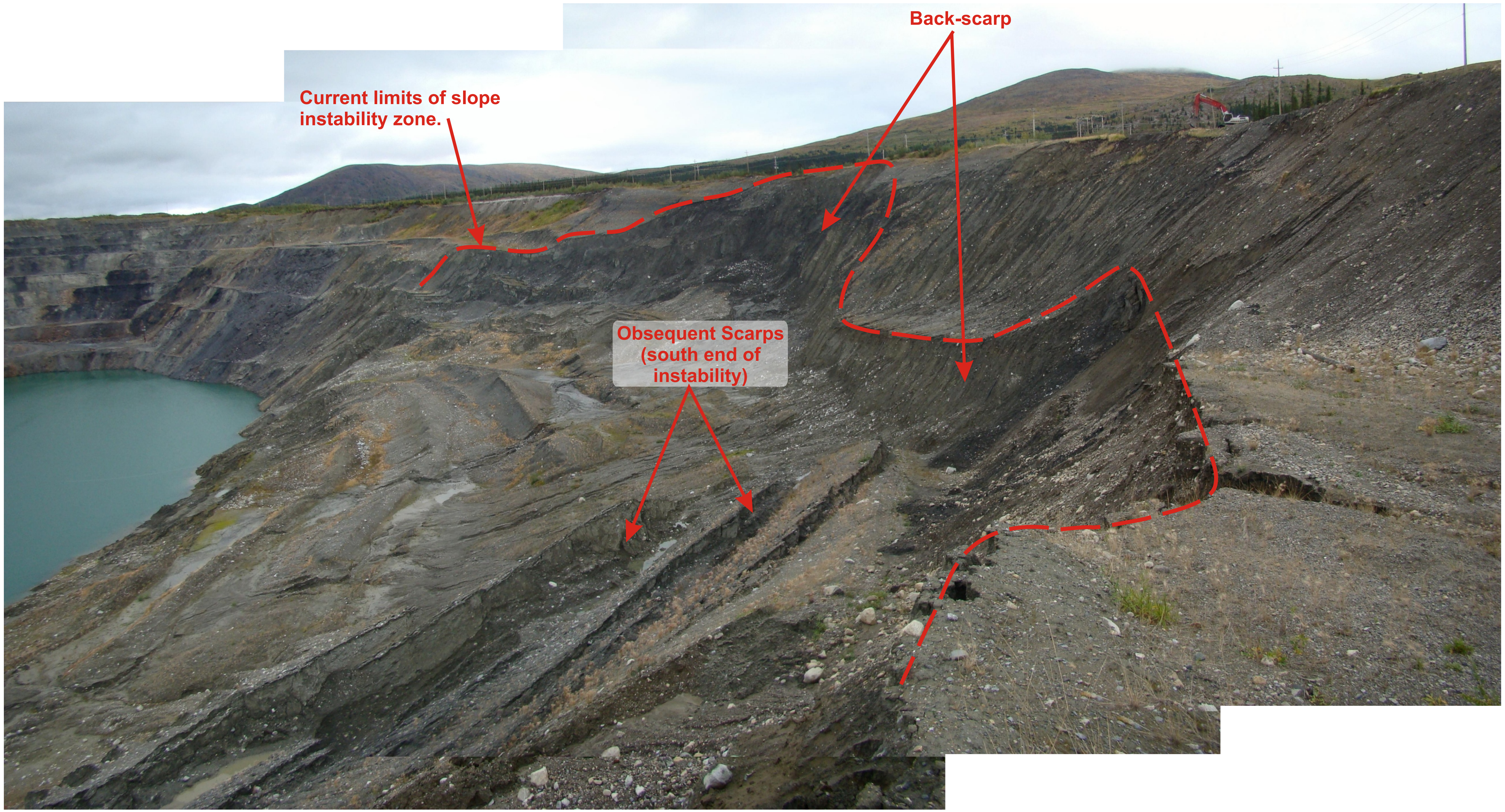
Photograph 2 : East Wall.

Photograph 3 : East Wall Instability.

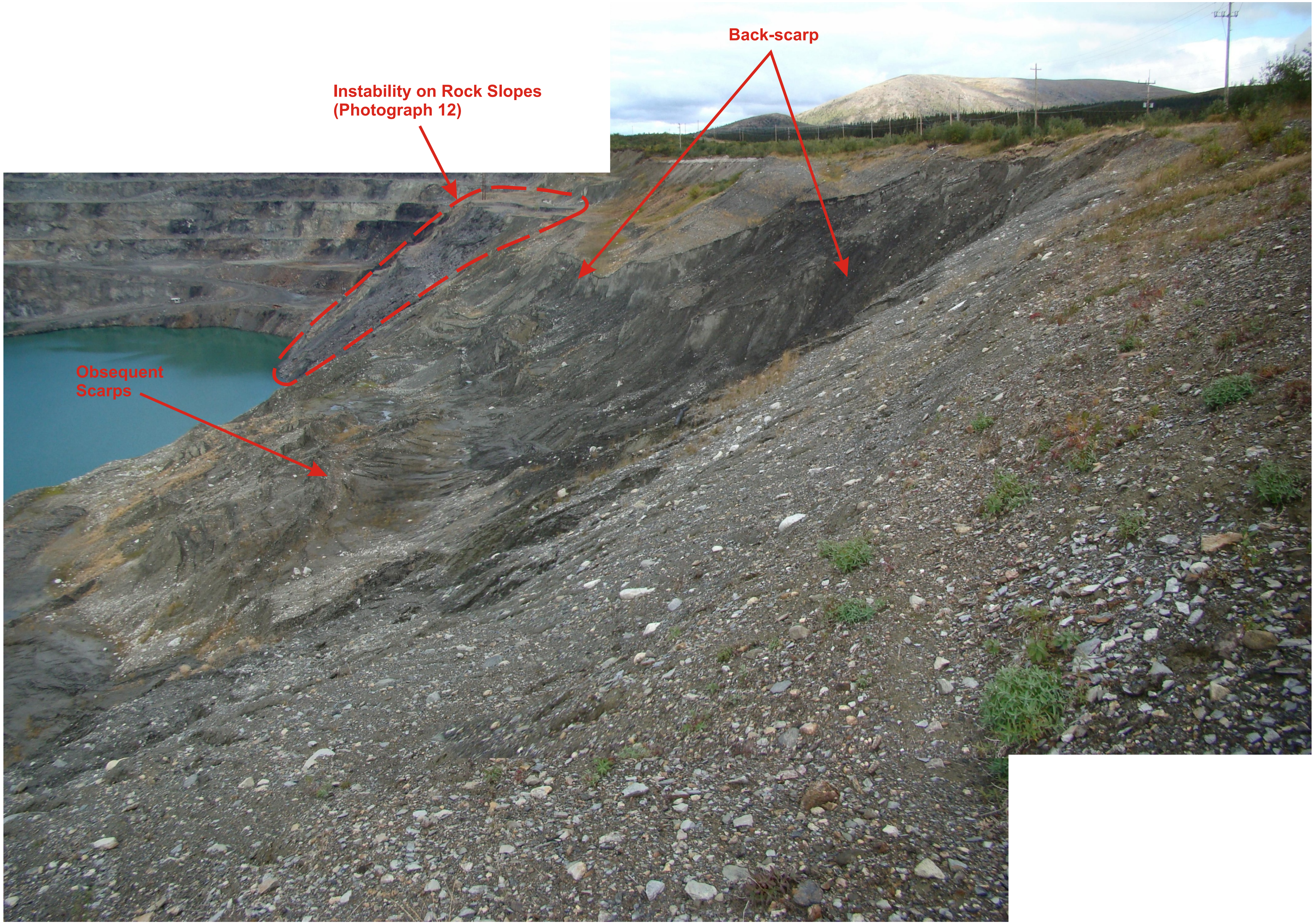
DRAWING DATE: 17-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 1\0914260021-2000-A_02.cdr



Photograph 4 : East wall instability (August, 2009)



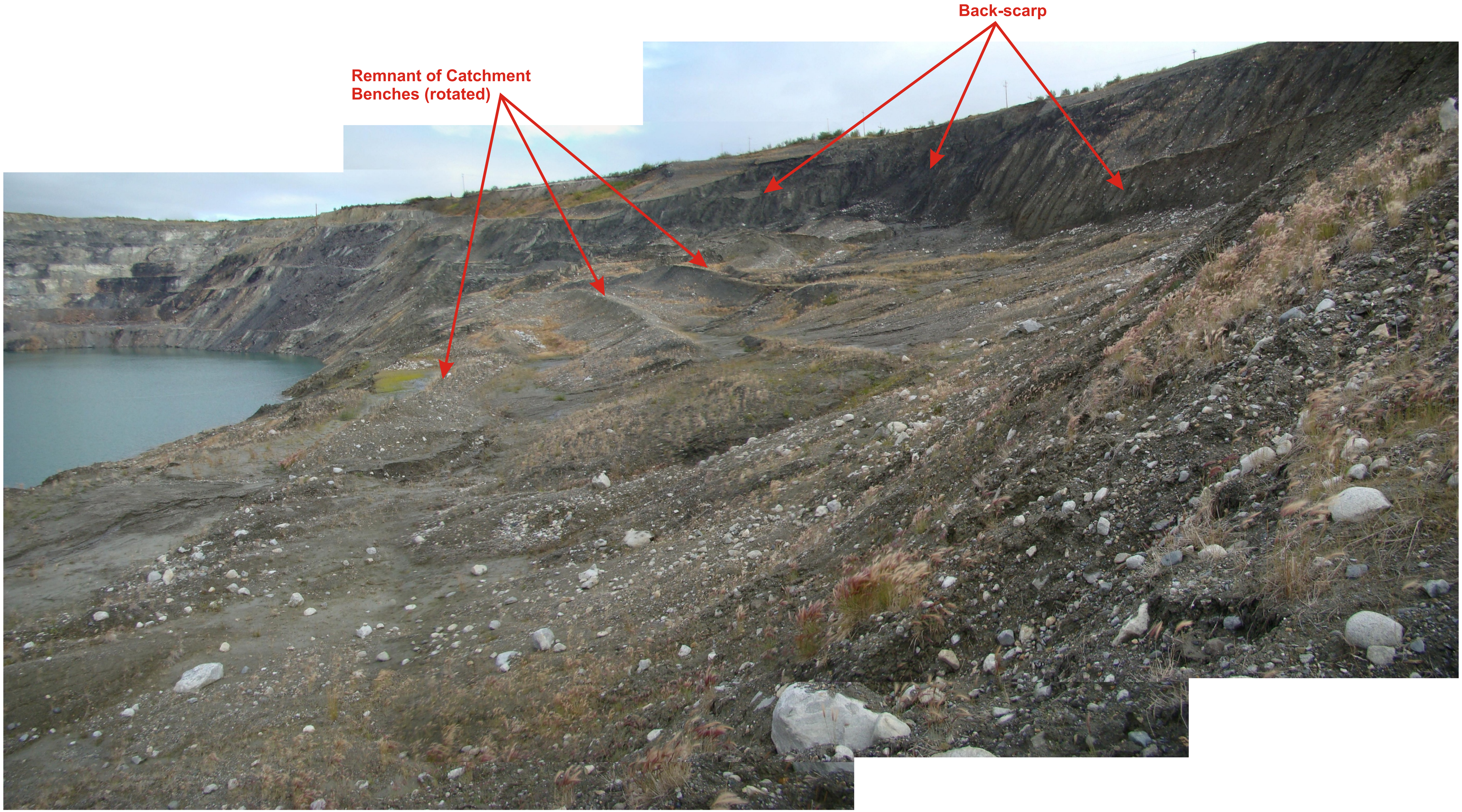
Photograph 5 : East wall instability looking north (August, 2009).



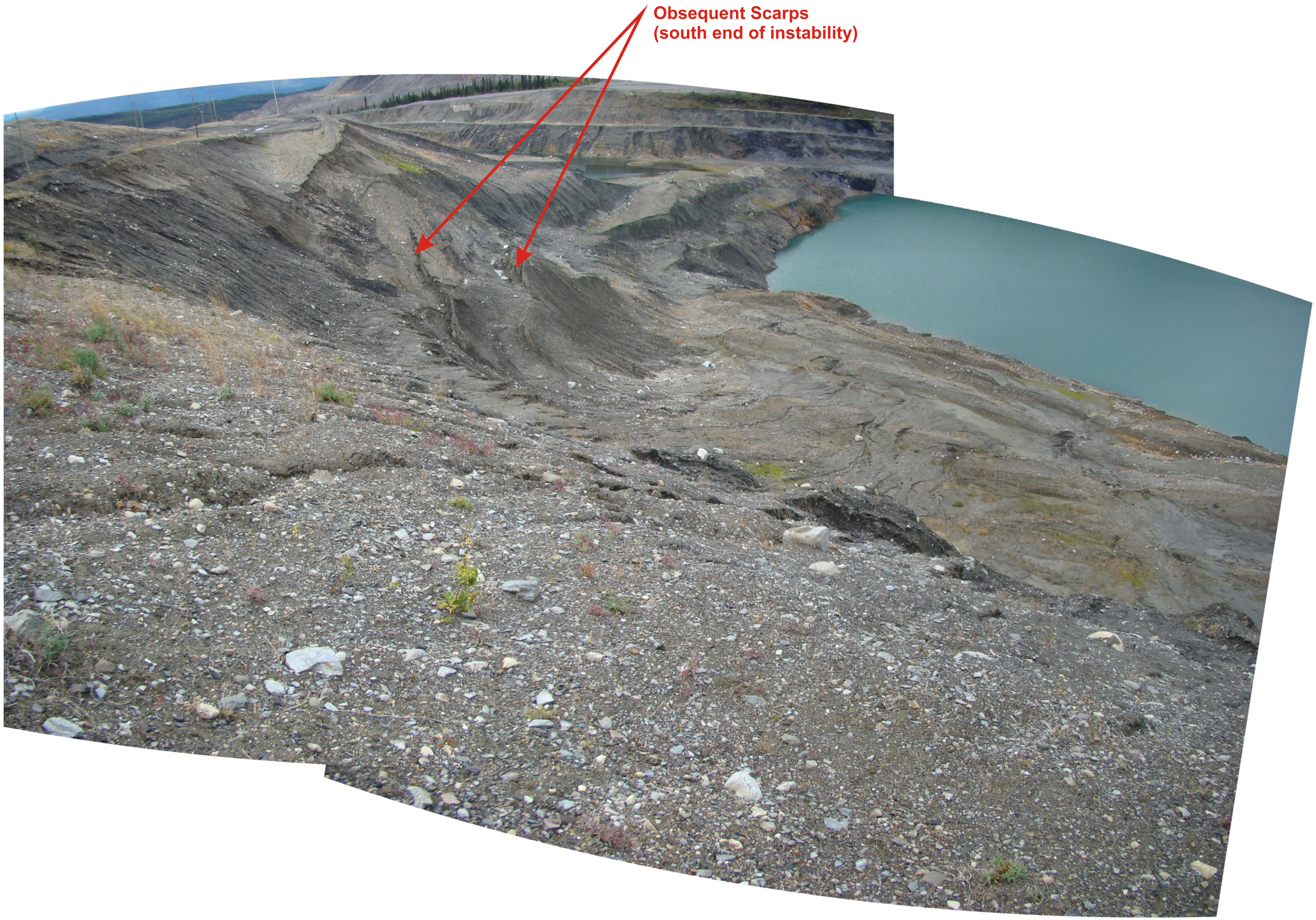
Photograph 6 : Back-scarp looking north (August 2009).

Photograph 7 : Crest of east wall looking north (August, 2009).

DRAWING DATE: 17-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 1\0914260021-2000-A_04.cdr

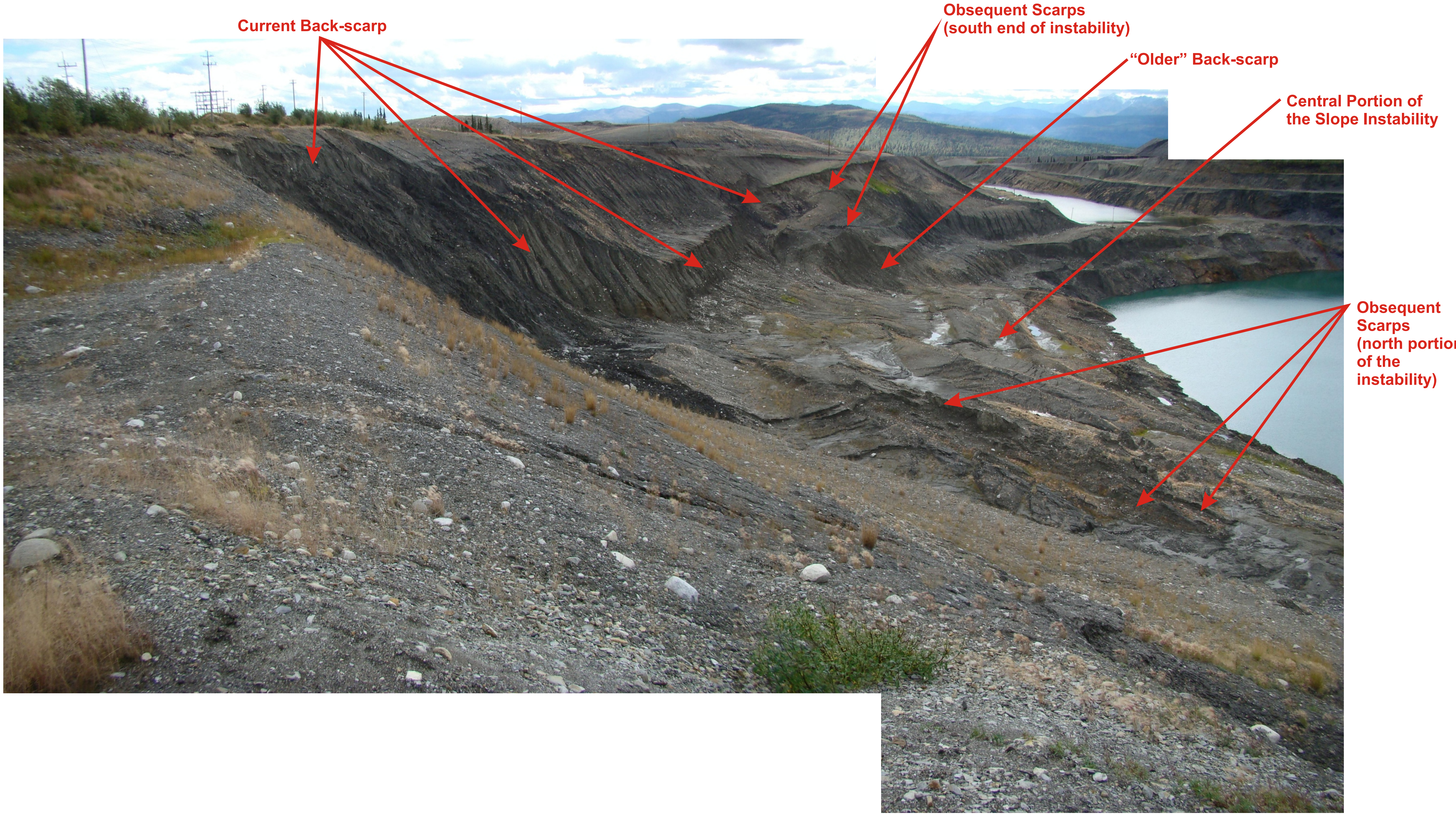


Photograph 8 : East wall instability (August 2009).



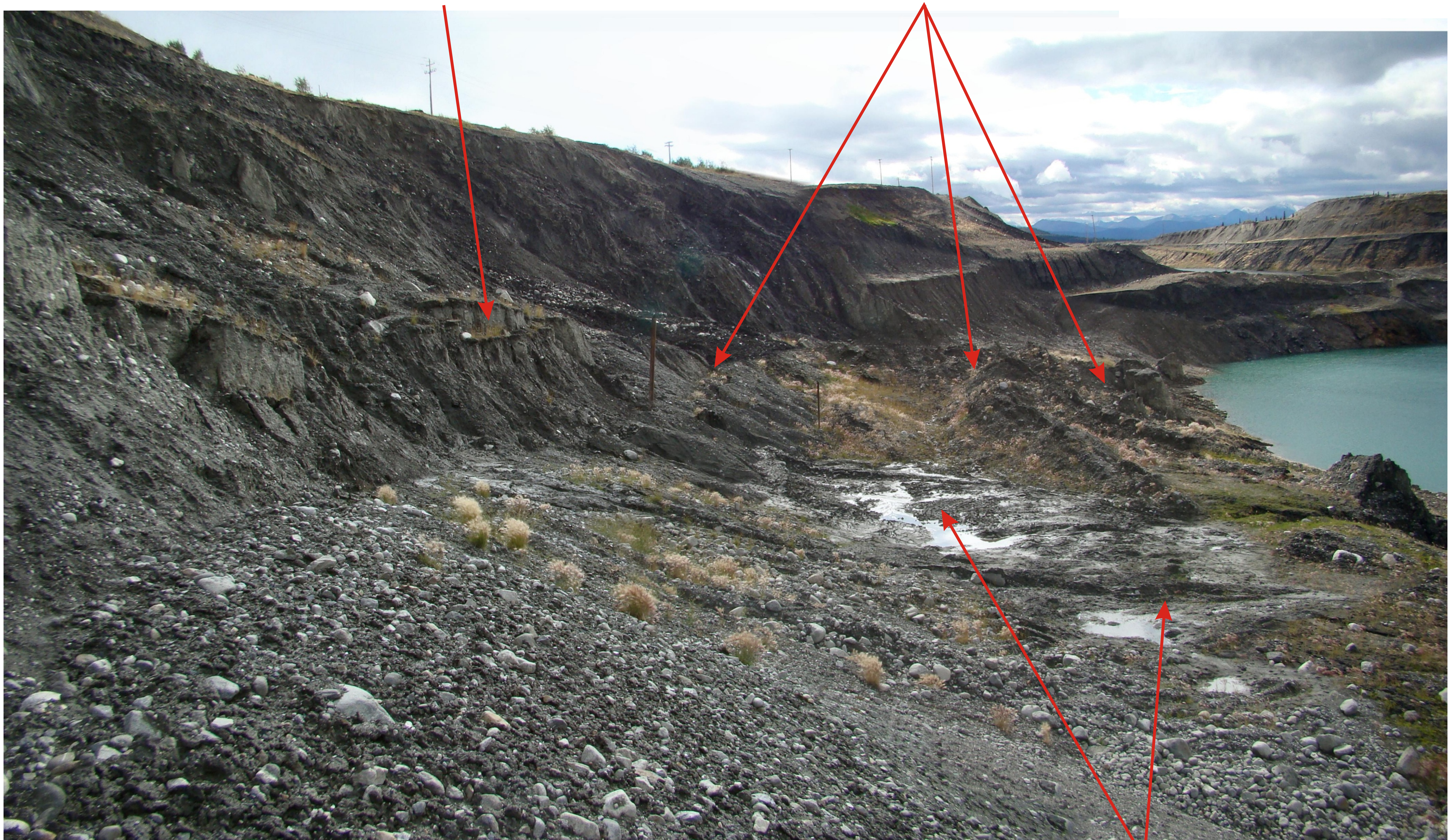
Photograph 9 : East wall instability looking south (August, 2009).

DRAWING DATE: 17-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 1\0914260021-2000-A_05.cdr

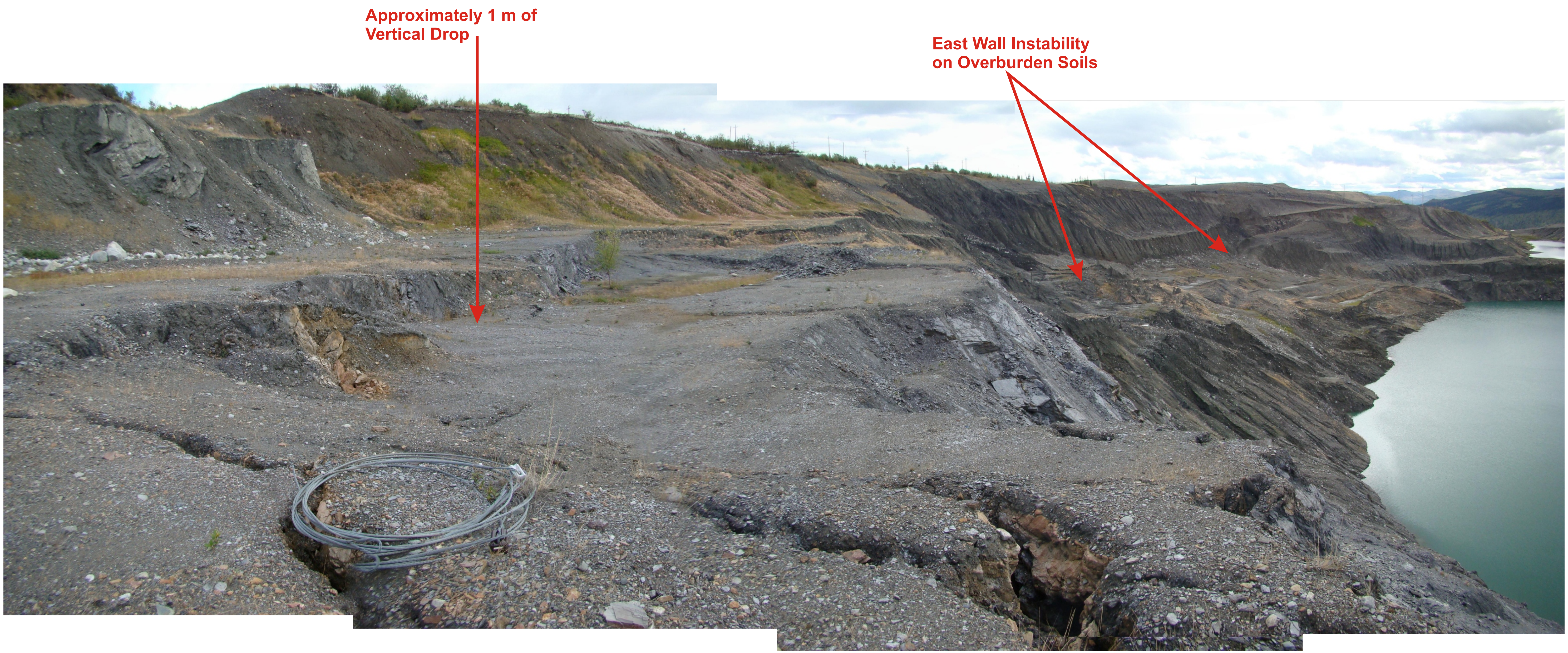


Photograph 10 : Crest of east wall looking south (August, 2009).

DRAWING DATE: 17-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 1\0914260021-2000-A_05.cdr



Photograph 11 : East wall instability looking south (August, 2009).



Photograph 12 : Instability on rock slopes in the north portion of the east wall (August, 2009).

Photograph 13 : Glacial Till.

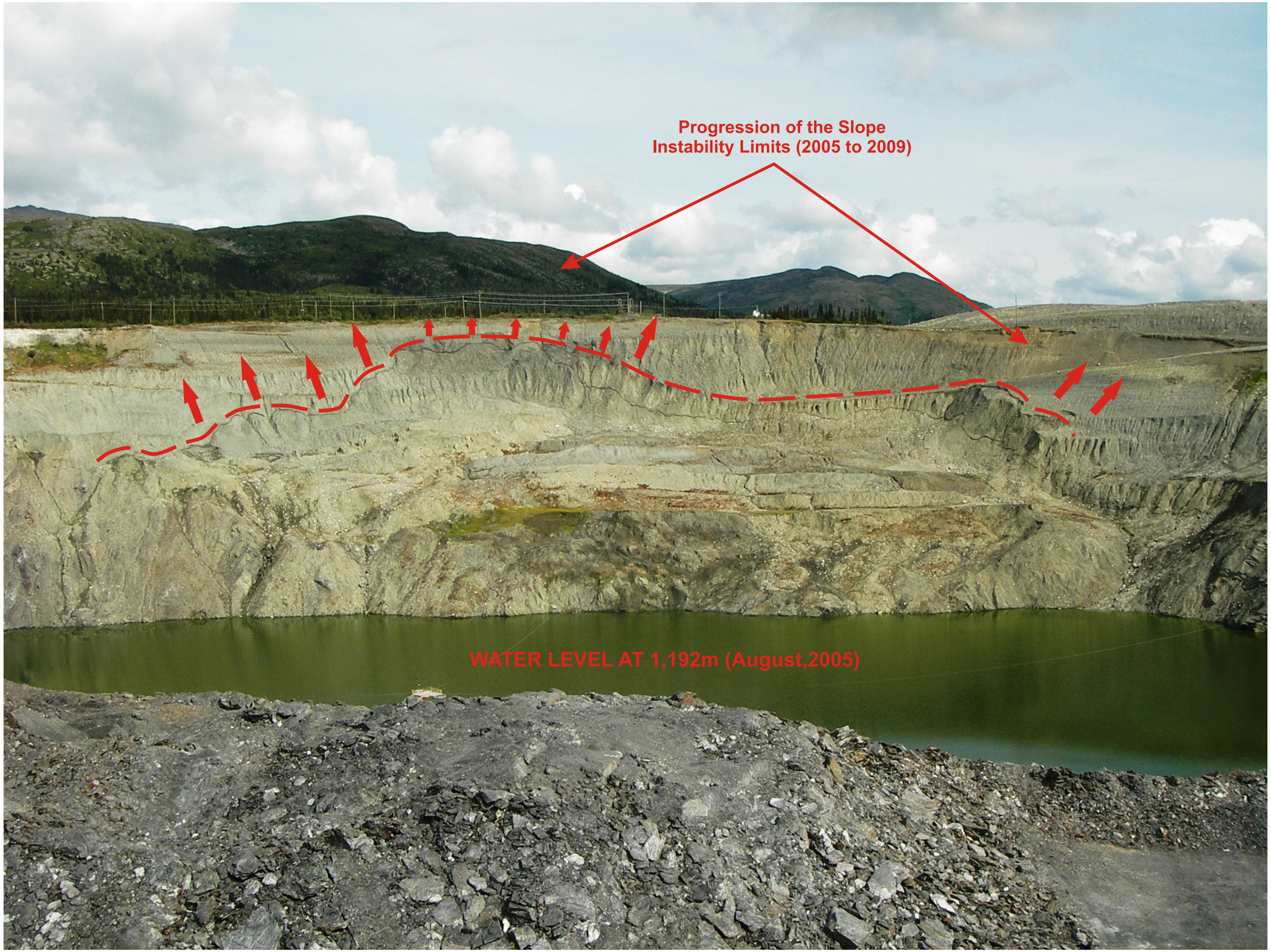
Photograph 14 : Sand and gravel.

Photograph 15 : Sand and gravel layer overlaid by glacial till.

Photograph 16 : Rock exposed on the lower wall at the north limit of instability.

APPENDIX II

Comparison of 2005 and 2009 Photographs



Photograph 1 : East wall instability (2005).

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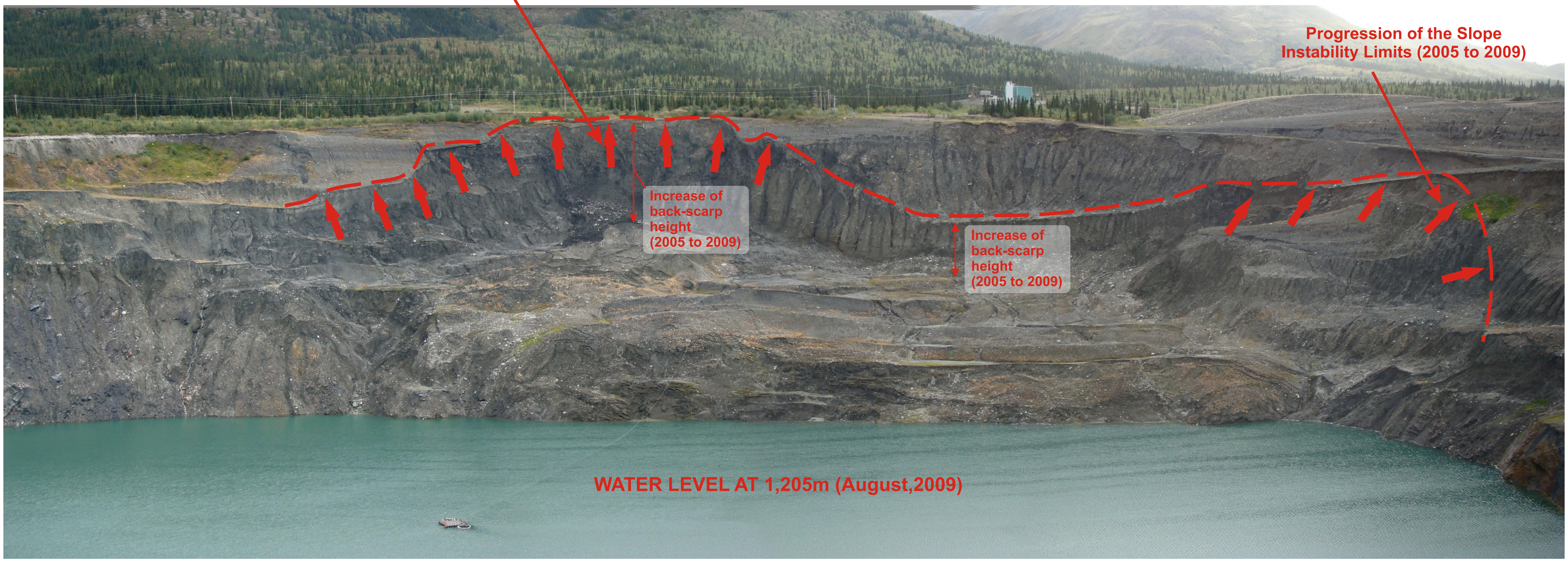
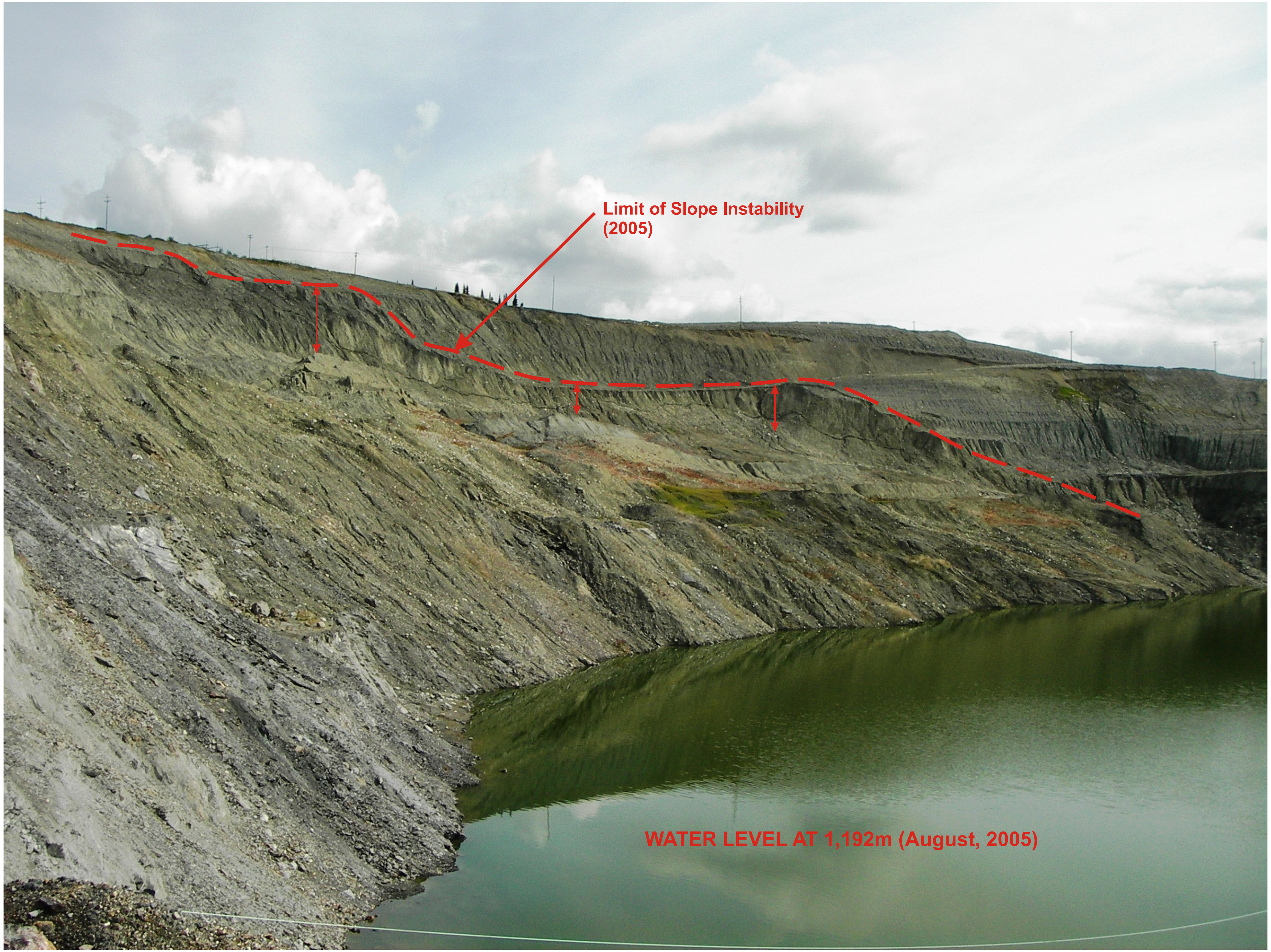
Progression of the Slope Instability Limits (2005 to 2009)



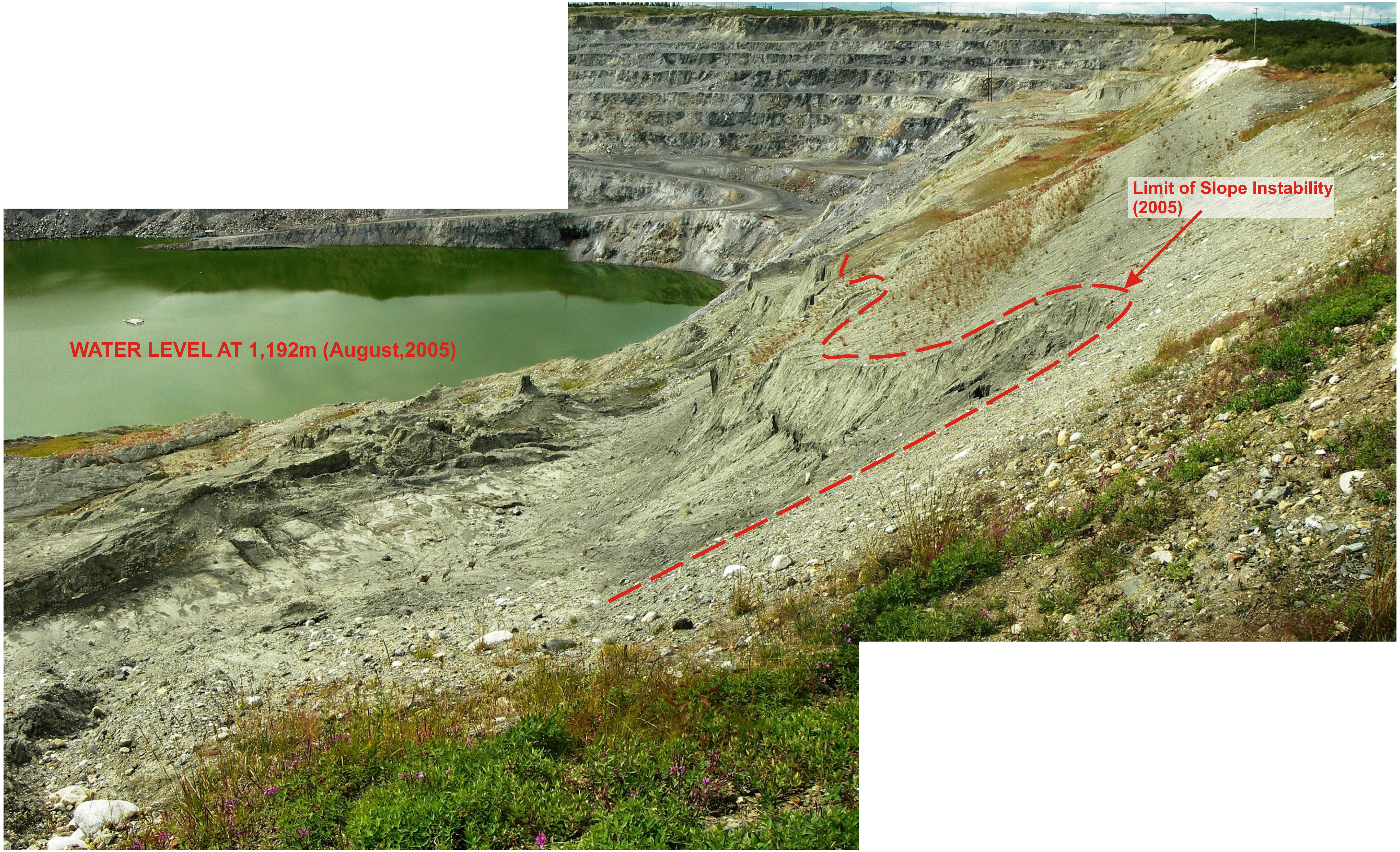
Photograph 2 : East wall instability (2009).



Photograph 3 : East wall instability looking south (2005).

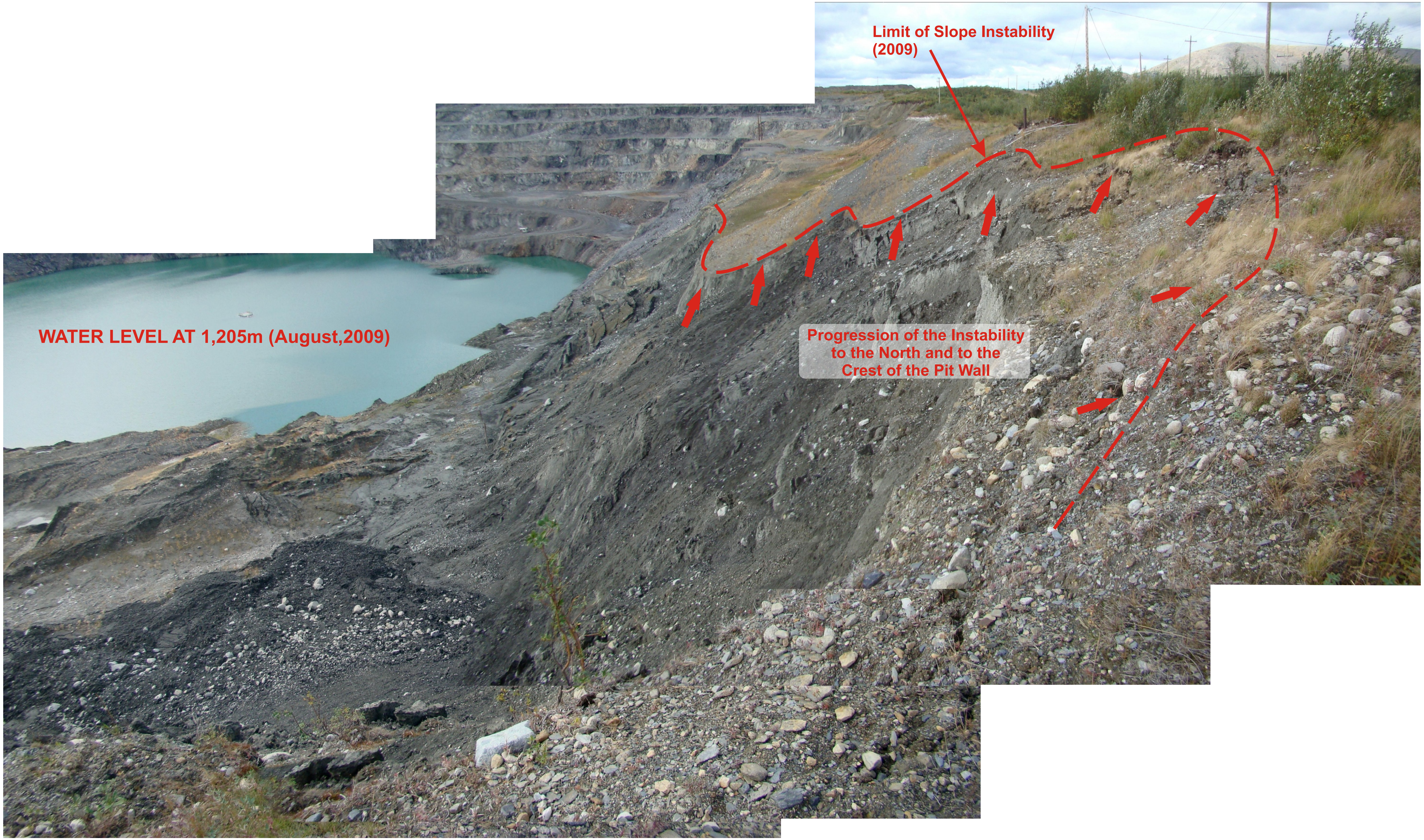
Photograph 4 : East wall instability looking south (2009).

DRAWING DATE: 18-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 2\0914260021-2000 - A_03.cdr

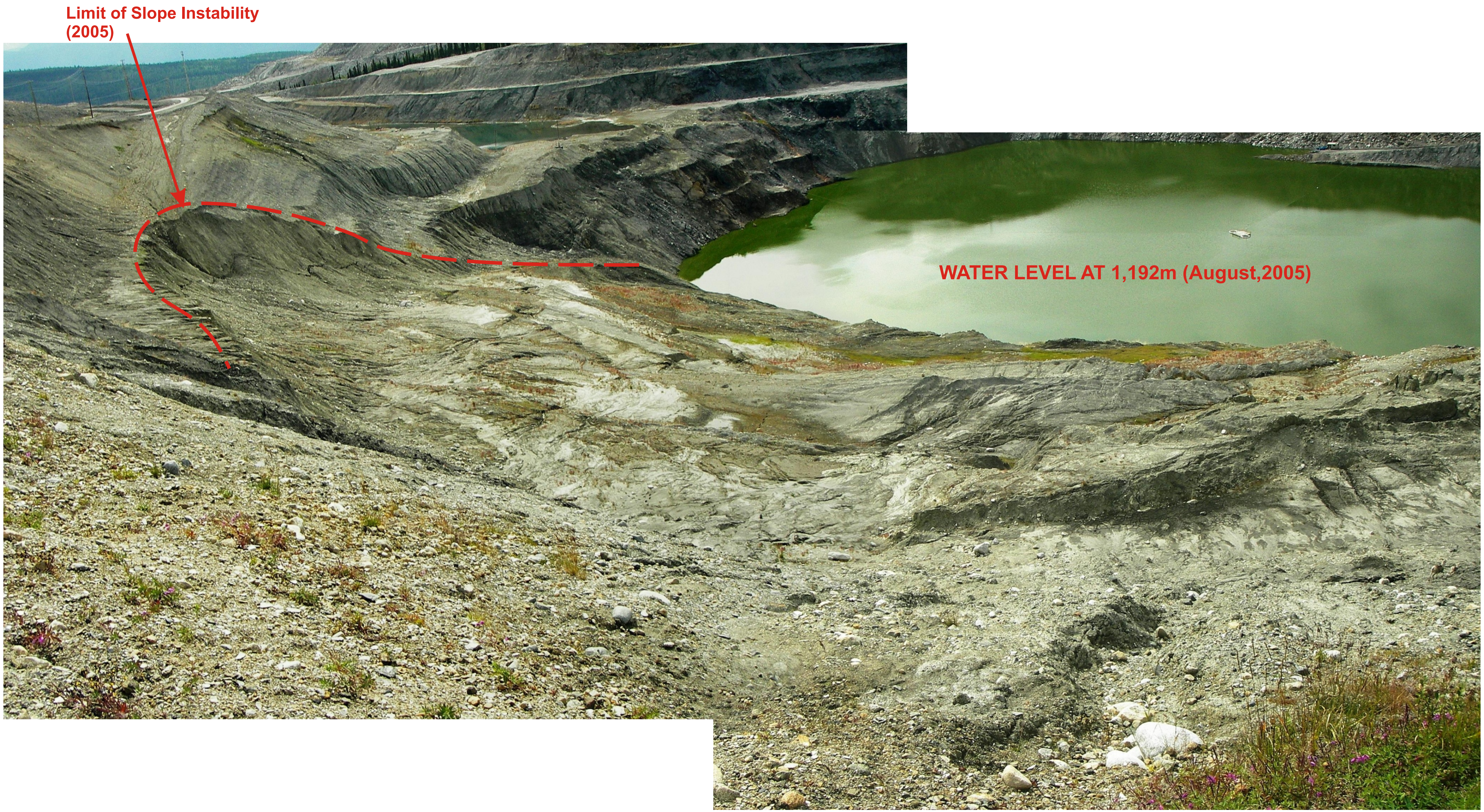


Photograph 5 : East wall instability. Crest of the pit wall looking north (2005).

DRAWING DATE: 18-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 2\0914260021-2000 - A_03.cdr



Photograph 6 : East wall instability. Crest of the pit wall looking north (2009).



Photograph 7 : East wall instability. Crest of the pit wall looking south (2005).

DRAWING DATE: 18-Sep-09 COREL FILE: N:\Bur-Graphics\Projects\2009\1426\09-1426-0021\Drafting\2000\Photo's-Set 2\0914260021-2000 - A_04.cdr

Photograph 8 : East wall instability. Crest of the pit wall looking south (2009).

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