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REPORT
TO
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
ON
WASTE DISPOSAL OPERATIONS
CLINTON CREEK MINES LTD.

CLINTON CREEK YUKON TERRITORY

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August 8, 1974

Department of Indian Affairs and Northern Development,
Federal Building,
Whitehorse,
Yukon Territory.

ATTENTION: Mr. C. N. Williams, P. Eng.

Re: Clinton Creek Mines Ltd.
Waste Disposal Operations

Dear Sirs:

At the request of the Department of Indian Affairs and Northern Development, the writer, in company with Mr. C. N. Williams, Water Rights Engineer, made an inspection of the waste disposal operations at the Clinton Creek Mine, Clinton Creek, Yukon Territory, on July 29, 1974. The rock overburden waste pile and the tailings pile were inspected, and discussions were held with Mr. Norm Kelly, Mine Superintendent, regarding Clinton Creek's proposed future waste disposal operations.

Waste materials generated in the course of the mining and milling operations at Clinton Creek consist of waste rock overburden from the open pit operation, and of tailings from the milling operations. The overburden and the tailings piles were photographed at the time of the

site visit on July 29, but film has not yet been processed for inclusion of prints with this letter. Captioned prints of selected photographs will be forwarded at a later date. Also, the mine did not have plans available showing the location and areal extent of the waste disposal piles. For this reason, plans and sections showing the location and the configuration of the waste piles are not included with this letter.

OVERBURDEN WASTE PILE

The open pit mining operations have entailed excavation of several million tons of waste rock to expose, and to permit open pit mining of the asbestos ore. Overburden materials have been consigned to a waste pile located immediately north of the open pit, and west of Clinton Creek. The overburden waste pile has been developed on relatively steeply sloping ground at some locations, the natural topography beneath the overburden dump slopes at slightly steeper than 30 degrees.

The total vertical height of the overburden waste pile is approximately 600 ft. The waste pile has been developed in a series of benches. Each bench has been developed by end dumping, and bulldozing the soil over the crest. The measured angle of repose of the waste overburden is between 37 and 38 degrees.

The surface of the overburden waste pile shows evidence of instability. Shear displacement scarps have developed on the surface of the upper regions of the waste pile, there is evidence of graben development in the midheight regions of the pile as a result of spreading strains at depth below the surface, and the toe regions of the overburden waste pile shows evidence of cracking and differential movements

both in the horizontal and vertical directions.

The toe of the overburden waste pile has crept eastward, and has blocked the natural drainage course of Clinton Creek. As a result, a lake has been formed upstream of the toe of the overburden waste pile. Although elevation data was not available at the time of the July 29 visit, the lake apparently has a maximum depth of 40 to 50 ft.

The mine operators had excavated a channel along the eastern extremity of the toe of the waste dump to maintain drainage from the lake. Water had reportedly been flowing in this channel on July 26, although the channel was not carrying water when inspected on July 29. The western side of the channel showed evidence of active soil movement, as did the surface of the toe regions of the waste dump above the channel. The bottom of the channel appeared to have been raised above the level of the lake surface, by the earth movements within the toe regions of the waste pile.

Mr. Norm Kelly indicated that approximately 3 million tons of overburden will be removed from the pit over the next 2 1/2 months, and that this waste material will be placed within the lower regions of the existing waste pile. At least part of the additional overburden will be disposed of within the region of the waste pile located above the drainage channel from the lake, and above the area where active movements appeared to be occurring within the toe regions of the waste pile.

Placement of the additional waste rock fill within the lower

regions of the existing waste pile will have the effect of increasing the stability of the upper regions of the waste pile, but will decrease the stability of that portion of the waste pile located below the area where the additional waste rock is to be placed. As noted, active movements appear to be occurring within the toe regions of the waste pile at the time of the July 29 inspection. Placement of additional waste rock above the toe will accelerate the movements, and will tend to further raise the invert elevation of the drainage channel from the lake.

Periodic excavation will be required to maintain the invert elevation of the channel, if the lake is to be maintained approximately at its present elevation. No one can predict the time interval required for the toe regions of the waste pile to become stable, nor the amount of the total displacements that will occur before the toe regions of the pile come to equilibrium, and the movements cease.

We recommend that simple surveys will be required to obtain data whereby the rate of change of the movements at the toe of the waste pile can be assessed. Reference points should be established on the surface of the waste pile at a location near to the top of the backslope on the west side of the channel (but far enough back from the top of the backslope so as not be influenced by localized instability as a result of oversteepening of the backslope) and on the natural ground between the channel and the mill access roadway. The distances between

these reference points should be measured periodically. A plot of the measured distance between the reference points vs the date of the observations will indicate the rate of movement, and whether the movements are accelerating or decelerating. Extrapolation of the movement vs time curves over the next year or two will indicate whether the movements can be expected to continue beyond the current anticipated life of the mining operations.

Clinton Creek Mines have indicated that following placement of the additional 3 million tons of additional waste no further waste rock will be consigned to within the lower regions of the existing waste dump. Following completion of the current contract for overburden removal, waste generated in the course of the open pit operations will be placed within an area located to the south of the main waste pile. The height of the waste pile in this area will remain modest, and the pile will be developed by advancing eastward from the face of an existing pile, towards the Clinton Creek channel. Mr. Kelly indicated that the mine proposes to relocate the creek channel to a position east of the proposed ultimate position of the waste pile in this area.

A cursory examination of the foundation area of the proposed waste pile on July 29 indicates that the surface of the area is mantled with typical northern black organic soils. These soils may or may not have sufficient shear strength to maintain stability for this proposed waste pile development. For example, organic soils appeared to be involved in the shear displacements that have occurred at the toe of

the main waste pile, and shear displacement of organic surface soils has occurred at the toe of the tailings pile.

If investigations show that the organic soil mantled within the foundation area of the proposed waste pile do not have sufficient strength to assure stability of the proposed waste pile extension, we suggest that the organic soils be stripped from the area, or alternatively that the foundation area within the proposed extension of the pile be allowed to freeze, and then be covered with a 10 ft. thick layer of waste rock before the subsequent spring thaw. If the organic surface soils are frozen, they will unquestionably have sufficient shear strength. The 10 ft. layer of waste rock should preclude the possibility of thawing and loss of strength during the subsequent summer.

THE TAILINGS PILE

Tailings from the milling operation are being disposed of east of the mill, on the slope above the west side of Wolverine Creek. The difference in elevation between the toe and the crest of the tailings pile was estimated to be of the order of 800 ft. One section of the toe of the tailings pile has become unstable, moved down slope, and has blocked Wolverine Creek, forming a small pond upstream of the toe of the slide. At sometime previous to the July 29 inspection, the pond level had risen to an elevation that permitted surface flow from the pond across the toe of the slide. When this occurred, erosion of the tailings was apparently very rapid. A considerable quantity of

the tailings were transported downstream, and the rush of water from the pond produced flooding in the Wolverine Creek channel downstream of the toe of the slide. As evidenced by white silt and mineral fibre clinging to vegetation, the flood waters rose to a height of several ft. above the normal water levels in the channel.

At the time of the July 29 inspection, Clinton Creek Mines were in the process of bulldozing a channel across the toe region of the slide. The invert of this channel was several feet above the level of the water surface in the pond. Water was seeping from the pond through the tailings and/or the native foundation soils, and was emerging in the form of springs at a location slightly downstream of the downstream limit of the slide depbis. This water was clear, and did not appear to be carrying suspended solids.

The slide at the tailings pile appears to have occurred at a location where solifluction had resulted in the accumulation of organic soils within the lower regions of a micro draw on the west side of Wolverine Creek. Apparently, as the toe of the tailings pile advanced onto this area, the in situ surface soils were incapable of sustaining the imposed shearing stresses. Displacement of organic surface soils was also evident at at least one other location at the toe of the tailings pile.

The measured angle of repose for the tailings (at the crest of the pile) is 39 deg. when deposited at the end of the tailings belt, and when pushed over the crest of the pile by the bulldozer, the

material is relatively loose and compressible owing to the relatively high percentage of fibrous mineral. Settlement of the pile under its own weight, together with shearing strains produce noticable buldging on the face of the pile, approximately midway between the toe and the crest.

In the region where the slide occurred, the surface of the tailings pile is concave upward. At the toe, the slope on the surface of the tailings was (estimated) 10 to 15 deg. The slope increases more or less progressively with increasing elevation to 39 degrees at the crest.

From inspection within the toe regions of the slide, it appeared that the slide is not actively moving at the present time. However, this should be checked by installation of reference points on stable undisturbed ground on the east side of Wolverine Creek, and reference points on the surface of the tailings within the toe regions of the slide. Periodic measurements of the horizontal distance between these reference points will show whether movements are occurring at the present time, as well as the rate of the movement. Reference points should be located sufficiently far back from the top of the cut slope for the channel so as not to be influenced by localized instability, or shearing strains at shallow depth below the backslope.

If the water level in the Wolverine Creek pond on the upstream side of the tailings rises (or alternatively if the invert of the channel is lowered) so that the channel again carries significant surface flows (for example during spring breakup), rapid erosion and downcutting can

be expected to occur. Downcutting will probably result in oversteepening of slopes comprised of the tailings, and localized failures of these slopes into the stream channel can be expected. This will result in additional transport of tailings to downstream areas, and will contribute to suspended solids load in the creek downstream.

To avoid the undesirable effects resulting from downcutting and erosion of the tailings, several alternatives could be employed:

i The channel could be lined with suitably sized rock, to resist erosion by the surface flows.

ii The channel could be equipped with an overflow structure at the downstream end. The purpose of the overflow structure would be to maintain velocities sufficiently slow that erosion of the tailings would not occur, and to dissipate energy at the downstream end of the channel.

iii Installation of a culvert may also be a suitable alternative at this location. The culvert would be installed with a headwall at its upstream end, and the upstream invert of the culvert above the invert of the open channel. The culvert would be designed to carry flood flows only during normal flow periods, water would pass from the upstream to the downstream side of the tailings via seepage through the

tailings and/or the foundation soils. During the winter months, the culvert would be above the phreatic level, and therefore should be free of icing problems.

Clinton Creek Mines have indicated that deposition of tailings is to be discontinued above the area where the slide occurred. The tailings conveyors are to be shifted, and in future the pile will be developed to the northward. The topography within this area has a marked change in slope at approximately the 1625 contour. The slope of the natural ground surface above the 1625 contour is approximately 8 deg., while the slope of the ground surface below the 1625 contour is considerably steeper. To avoid unstable conditions at the toe of the tailings pile as it develops towards the north, the toe of the pile should not be advanced beyond the elevation 1625 contour.

Yours very truly,

GOLDER BRAWNER & ASSOCIATES LTD.

for J.M. Laing

Per: David B. Campbell

DBC/cc

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File Number	

P/75/44

January 10, 1975.

Indian and Northern Affairs,
200 Range Road,
Whitehorse, Yukon Territory,
Y1A 3V1.

Attention: Mr. C.N. Williams, P.Eng.,
Water Rights Engineer,
Northern Natural Resources
& Environment Branch.

Dear Cliff:

In response to your letter of January 3rd, I am enclosing a set of photographs taken at the Clinton Creek mine site on July 29th, 1974.

Kindest regards and Best Wishes for 1975. I shivered when I saw the reported temperatures for Whitehorse this morning.

Yours truly,

GOLDER BRAWNER & ASSOCIATES LTD.

Dave Campbell

DBC:ctr

Per: David B. Campbell, P.Eng.

Encl.

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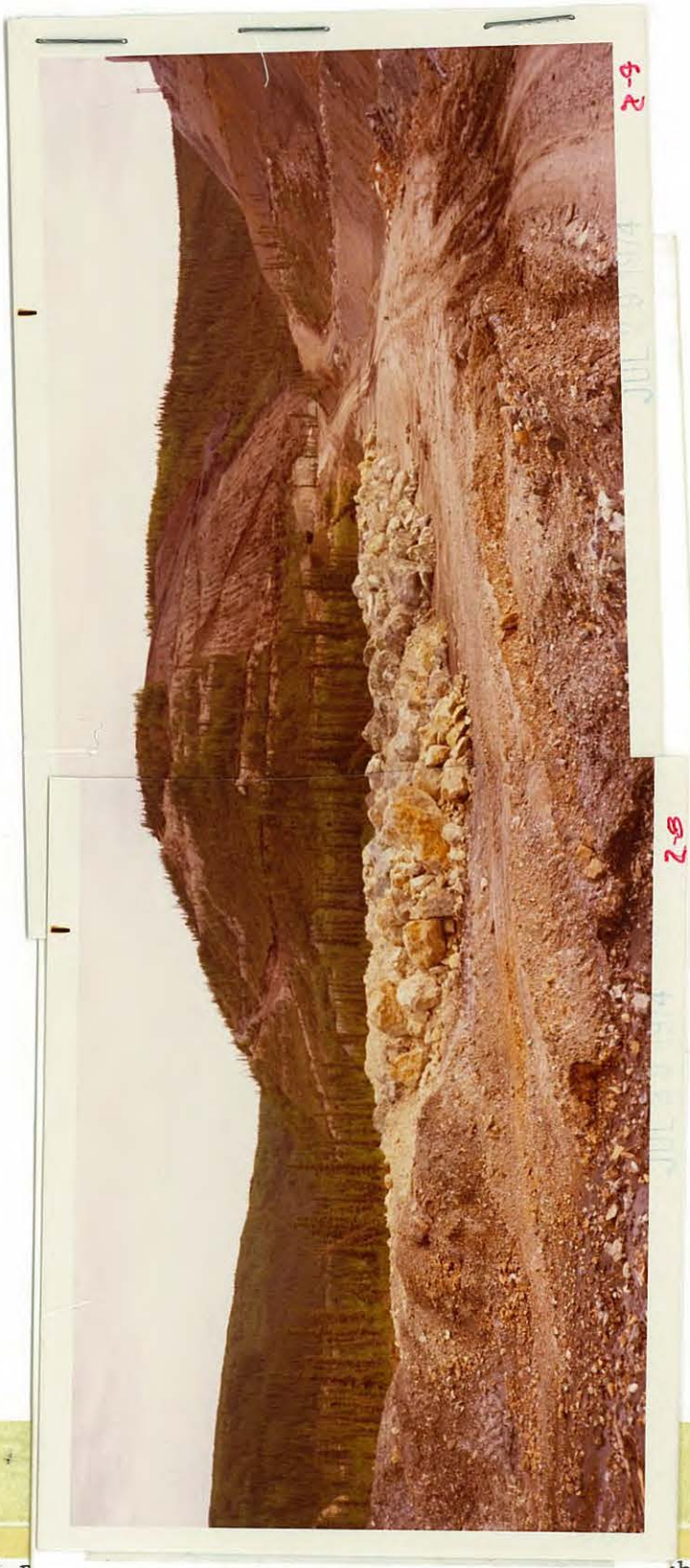
1-8 & 1-7 View of the Clinton Creek tailings pile looking upstream, and showing the toe regions of a massive slide. This slide blocked Wolverine Creek, and formed a small lake on the upstream side. During the spring runoff period of 1974, the pond on the upstream side of the slide overtopped the slide debris. When this occurred, the tailings were downcut very rapidly, resulting in flash flooding in Wolverine Creek downstream. The present flow in the Creek is the result of seepage through the tailings and/or the in-situ foundations soils. At the time of the inspection on July 29, no surface flows were passing from the pond to the downstream side of the slide. The bed of Wolverine Creek as shown in these photographs is comprised of transported tailings. Note the tailings deposited on the far side of the Creek, among the standing black spruce.

1-10 & 1-9 Another view of the Clinton Creek tailings pile looking from the toe toward the crest of the pile. At the time of the inspection on July 29th, Clinton Creek was actively bulldozing a trench at the toe of the slide in an attempt to open the drainage channel from the pond on the upstream side of the toe. Note the Cat work at the toe region of the slide. The photographs show that the slide movements extend uphill almost to the crest of the tailings pile. Note the arcurate slide scarps on the surface of the pile extending uphill to the base of the truncated cone against the skyline. Note also the quasi-ridge below and to the left of the truncated cone. The movements appear to have been initiated within the central portions of the slide, probably beneath the toe. These movements appear to have resulted in loss of lateral support, and retrogressive slide movements in the uphill direction. The central portion of the slide appears to have moved toward Wolverine Creek, but appear not to have involved to the extreme southern limit of the tailings pile, thereby resulting in the formation of a ridge along the southern limit of the active slide movements.

1-11

1-11 Showing the pond that has been developed as a result of damming of Wolverine Creek by the toe of the tailings pile.



2-6-9 incl. A p[illegible]thin the foundation are[illegible]dump den toward the sou[illegible]s located at the ext[illegible]oe development appears within the region between the [illegible]ry of photographs 2-8. Clinton Creek appears to the right of centre of photograph 2-7. The proposed extension of the overburden waste pile is bounded on the east by the powerline, and will extend southward approximately to the face of the Snowshoe pit.

2-10 Photograph showing the general foundation conditions within the area proposed for the extension of the overburden waste pile. Note the ground disturbance by bulldozer in the centre portion of the photograph. The surface soils consist of the typical black organic muck.

2-11-12 Another view of the general area shown in photograph 2-6 to 2-9 the proposed extension of the overburden dump. The tramway or cars appear at the extreme upper right of photograph 2-12. Clinton Creek proposed to extend the overburden waste pile outward from the level terminus of the tramway approximately.

2-13 & 14 View of the tailings pile failure looking downslope from the crest of the tailings pile. Note where the toe of the slide has blocked Wolverine Creek, resulting in ponding on the upstream side of the toe of the slide. Note on the downstream side of the toe, the tailings that have been deposited in Wolverine Creek at the time that the toe of the slide was overtopped. Note the crack pattern on the surface of the slide which suggests flowage of the toe regions, and the formation of the ridge along the right hand side of the zone of active movement.

2-15 Showing the belt conveyor and disposal operations at the crest of the tailings pile. The tailings are deposited from the end of the conveyors, and the materials are then bulldozed over the crest of the tailings pile. The short conveyor in the foreground is to be moved to a position running away from the camera.

2-16 & 17 A view looking down the northeastern slope of the tailings pile. Note the pond that has resulted by blockage of the Wolverine Creek drainage. Note in the left central portion of photo 2-17 disturbance of the natural ground surface. The shearing stresses imposed at the toe of the tailings pile have resulted in shearing displacement, and bulldozing of the active soil layer at the toe of the pile. The active soil layer has been bulldozed ahead of the toe of the tailings, resulting in disturbance and toppling of the natural forest cover.