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Cyprus Mines Corporation
Uranium Division

1790 30th Street
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Boulder, Colorado 80301
Telephone 303) 447-0781

May 29, 1980

80-20.17-680

Mr. Eugene Trager
Uranium Recovery Licensing Branch
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Trager:

RE: Hansen Project
Responses to Questions & Comments

Enclosed are five (5) copies of our responses to questions and comments numbered 4, 7 and 17, as discussed at the April 17, 1980 meeting in your offices. Our responses to comments 1, 2 and 3 will be sent to you directly from W. A. Wanler and Associates. This will complete our responses to all of the questions and comments raised at the April 17, 1980 meeting. If you have additional questions, please contact me.

Very truly yours,

M. A. Thompson

M. A. Thompson
Principal Licensing Engineer

MAT:lrf

Encl.

cc: Terry Howard, University of Idaho
Mark Jewett, Fred C. Hart & Associates
Richard Gamewell, Colorado Department of Health

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May 27, 1980
Project CUC-106A

Cyprus Mines Corporation
1790-30th Street, Suite 232
Boulder, Colorado 80301

Attention: Mr. Milt Thompson

Gentlemen:

Transmitted herewith is the response to NRC Action Item 4. We are working on the remaining items, Items 1, 2, and 3.

Very truly yours,
WAHLER ASSOCIATES

Dennis Buranek

Dennis Buranek
Project Engineer

DB:w

ITEM 4: Further characterize the landslide potential for the three cell option.

Large landslides and slump blocks are included in the mass-wasting deposits mapped by C. Chapin on the slopes bordering Salt Creek Valley. These deposits have been lumped together and given the symbol, Ql, on Chapin's map and on subsequent maps, (see Figure 1, Site Exploration and Geology) and also include talus and colluvium.

The landslides are ancient, mid-Pleistocene features which were described by Chapin as "composite aggregate of several associated slides and slump blocks." Field evidence from the 1978-1979 geotechnical investigation for definitive design of the single head-of-valley impoundment (W. A. Wahler & Associates, 1979), supports the argument for the antiquity of the slides and for their present stability. Geologic site work performed in April and May, 1980, in response to Item 4, further confirmed this argument.

The 1980 investigation focused upon obtaining sufficient general information about the geometry and nature of the landslides to be responsive to Item 4. The investigation included aerial photo analysis, reconnaissance mapping, excavation and logging of a number of trenches, and drilling and logging of two core holes. The locations of test holes and trenches used in this response are shown on Figure 1, Site Exploration and Geology. Logs of trenches and test holes used in response to Item 4 are included in Appendix A, attached.

Chapin, Charles E., "Geology and Petrologic Features of the Thirtynine Mile Volcanic Field, Central Colorado," Doctoral Thesis, Colorado School of Mines, 1964, pp 47-48.

"Environmental Report, Hansen Project, Fremont County, Colorado, Cyprus Mines Corporation/Wyoming Mineral Corporation," June 1979.

The landslides were discernable on the aerial photos as several large, lobate areas roughly coinciding with the "Ql" mapped by Chapin. (See Figure 2, Aerial Photograph, Salt Creek Valley). Head-of-slide, scarp-like features and sub-concordant terraces were also discernable in the aerial photos, particularly on the east side of the valley. A reconnaissance of the area verified the presence of these features, including a swale-like surface on some of the terraces.

Bulldozer trenches were located and excavated at the typical landslide features in an effort to expose structural and stratigraphic relationships and slip planes which would help define the geometry of the landslides.

Major, head-of-slide, slip planes were exposed in trenches TP-26, TP-32, TP-34, and TP-44 on the east side of the valley. With one exception, TP-26, the slip planes dip towards the valley; dips vary from 30° in TP-34 to 60° in TP-32. In TP-34, old colluvium and red claystone (Echo Park) have dropped down dip and adjacent to a alternating sequence of red claystones and greenish grey clayey sandstones of Echo Park age.

A head-of-slide, graben-like feature was exposed in TP-26; the dip of the headward slip plane was 70°--away from the valley. However, the presence and thickness of an old colluvium which in-filled the graben behind this slip plane strongly suggests the presence of another major slip plane to the east of the trench excavation. Slip planes with relatively minor offsets were exposed in trenches TP-22 and TP-34. These minor features dip 60° to 70° toward the valley; offsets vary from 0 5 foot to 3. In TP-34, cumulative offset of these minor slips as measured against alternating claystones and sandstones is on the order of 10 feet.

Subhorizontal slip planes were encountered in trenches TP-31 and TP-25 on the east side of the valley. The amount of displacement on these planes could not be determined. In TP-31, Echo Park claystone has moved over old colluvial deposits for a 6 foot minimum horizontal distance. The slip planes in TP-31 and TP-25 are well above the apparent base of the landslides which suggests that movements may have occurred at different locations during the various stages of development of the landslides.

Two core holes were drilled on the east side of the valley. Each hole was cored continuously. In hole 3-CH-1, a zone of disturbed material was encountered bewteen 93.3 feet and 98.3. The zone had, at its upper limit, 0.6 foot of crushed, varicolored clayey sand of apparent low density. The remainder of the zone consisted of a clayey siltstone which contained a 1/2-inch-thick horizontal clay seam and closely spaced fractures with slickensided surfaces. The fractures dip 40° and vertically. About 30 feet of undifferentiated colluvium and Older alluvium overlie a 60-foot-thick block of Echo Park material which appears to be relatively intact. The Older alluvium and the block of Echo Park are considered to have slumped as a unit on the disturbed zone. The rock core recovered from below the apparent base of the disturbed zone at 98.3 feet was of relatively intact claystone, siltstone and sandstone of the Echo Park formation. Water was encountered at 81.5 feet.

In hole 3-CH-2, an interval of unindurated material was encountered between 19.7 and 32.2 feet beneath Recent alluvium and colluvium. The unindurated material resembled a mixture of the old colluvium found at higher elevations on the terraces on the east side of the valley, and soft, friable Echo Park formation. This material was considered to be a landslide deposit. Core recovery was poor in the unindurated zone, thus there was no direct evidence of movement. A closely fractured interval occurred between 37.4 feet and 42.0 feet, a short distance below the unindurated interval. The fractures dip 45° to 70° in the same direction with but one exception; evidence for movement, e.g., slickensides, is poorly developed. These fractures may have resulted from frictional and compressional forces generated at the time of movement of the overlying landslide.

Cross-sections (Figures 3, 4, 5, and 6) drawn through the east side of the valley incorporating test hole and trench data indicate that a number of discrete blocks have moved within the larger landslide mass. This interpretation correlates closely with features previously identified through photogeologic analysis and geologic reconnaissance.

In contrast to the discrete slump-block type of movement which took place on the east side of the valley, the movement on the west side appears to be a result of more or less continuous creep which took place over a long period of time. This ancient landslide is less deep seated than those on the east side, but it appears to have comparable areal extent. Large blocks of Wall Mountain Tuff occur on the ground and imbedded in colluvium at shallow depth. The colluvium consists of reworked Echo Park mudstone. Both TP-41 and TP-42 encountered internally sheared and brecciated Echo Park and Wall Mountain Tuff, the tuff sometimes occurring as polished pebbles. A sub-horizontal, slickensided clay seam encountered in TP-42, is believed to represent one plane of movement within a larger disturbed zone. The disturbed zone overlies a friable sandstone with undisturbed bedding. The sandstone may be intact Echo Park formation.

The information obtained to date indicates that the excavations required for the three cell option (Alternative 2, Wahler Associates December 1979) would undercut, and/or unload, the projected toe of the landslide masses on the east side of Salt Creek Valley. Superposition of the proposed cut slope for the three cell option on cross-sections (Figures 3, 4, 5, and 6) drawn through this side of the valley show that in two of the cells, the projected slide plane would be daylighted by the excavation. It appears that the excavations required for the three-cell option would also undercut and/or unload the toe (lowest known portion) of the landslides on the west side of the valley. (See Figure 7 for locations of the cross-sections with respect to the three cells.)

Reference: Wahler Associates, "Hansen Project-Evaluation of Alternative Tailings Management Methods", December 1979.

It also appears that the excavation for the large diversion facilities required by the three cell option would similarly remove the toe of a large slump block in that area south of the southern-most cell.

Our investigation indicates that large, deep excavations, such as required for the three-cell option, would destabilize the large landslide masses which border Salt Creek Valley. This destabilization would be caused by removing lateral support at the toe(s) of the slide(s) with the strong potential for resumption of movement of the mass(es) along pre-existing planes. Movement along pre-existing slide planes has been known to take place with suprising ease, once the stable condition has been disturbed.

In addition to removing toe support from the existing landslides, the cell excavations would remove substantial amounts of in-place Echo Park material. Laboratory testing on these materials indicated that the undisturbed claystone is relatively strong. However, deep excavations into the in-place Echo Park would be recreating some conditions similar to those which caused the instability of the valley sides during the wetter Pleistocene period.

The investigations indicated that, as might be deduced, the slide planes of the landslide masses do not extend below the bottom of the existing Recent alluvium in the valley floor. However, excavations which are deeper than Alternative 2, but with the same slope geometry, would also result in valley slope destabilization.

Excavations with slopes steeper than 4:1 (horizontal to vertical) would increase the potential for resumption of movement of the landslide mass(es) because more of the lateral support at the toe(s) of the slide(s) would be removed and the same amount of materials would be left in-place at the top or head of the slide(s) if the beginning of the cut slopes remained at the same place.

Because of the variability of materials and in-situ conditions along the old failure planes and also because of the geometry of the failure planes, it would be impossible to accurately determine representative strength parameters and critical failure planes for input to a realistic stability analysis. These conditions are common to large, poorly defined failures on natural slopes, which, in the past, have proved that attempted analyses are not accurate. Therefore, additional testing and analyses are not warranted, and the best guide for selecting excavation slopes and depths of cut is experienced judgement.