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November 6, 1991

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Mr. Jim Burt
The Aurora Partnership
P.O. Box 1628
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Dear Jim:

Re: Geotechnical Review of Aurora Pit

As per your request, Mr. A. Stewart of Piteau Associates Engineering Ltd. (PAEL) visited the mine on October 29, 1991 to review specific geotechnical concerns, as follows:

- i) South wall failure below 7100 ft elevation (west failure)
- ii) South wall failure at pit crest (east failure)
- iii) North wall failure in clay horizon
- iv) Stability of north wall in general

During the site visit, visual inspections of all of the areas of concern were made, and discussions were held with mine personnel regarding the mine plan, geology, etc. A pit progress plan was obtained, along with the prism monitoring data.

GENERAL

The present mine plan is somewhat different than that discussed in our original and updated design reports of February 1988 and November 1988, respectively. The most significant changes to the ultimate pit plan are about a 300 ft pushback of the eastern end of the pit, and a lowering of the pit bottom at the eastern end of the pit from the 6980 ft elevation to the 6860 ft elevation. Completion of this pit is scheduled for February 1992. Additional mine expansion, by extending the east end of the pit even further (and possibly deeper to about the 6800 ft elevation) and by developing a small pit above the western end of the present pit, is also planned, but will not be addressed in this report.

The plan for mining the remaining ore contained within the present pit depends to a large degree on the two areas of instability on the south wall (i.e. i and ii above). If both of these areas can be stabilized immediately, then continued mining according to the existing plan can be carried out. A more likely scenario, however, is one in which the eastern failure (i.e. ii above) is stabilized immediately (i.e. by removing much of the unstable material at the head of the failure) and the western failure (i.e. i above) is not stabilized in the short term. In this case, the haulroad switchback would be relocated to



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just east of the western failure, resulting in the ultimate pit bottom at the east end of the pit temporarily reaching only about the 6900 ft elevation, rather than the planned 6860 ft elevation. An attempt to stabilize the western failure and mine the ore under this area would be made during retreat mining. The remaining ore at the eastern end of the pit between the 6900 and 6860 ft elevations would then be mined during the future eastward expansion of the pit.

DISCUSSION AND RECOMMENDATIONS

Based on the review of site conditions and monitoring results, a number of comments can be made with regard to the specific geotechnical concerns listed above. The comments are summarized in the following:

i) South Wall Failure Below 7100 Ft Elevation (West Failure)

This failure is located between the 7100 and 7020 ft elevations in the vicinity of 14125N and 9500E, just east of the north wall failure discussed in our report of May 17, 1991 (see Photo 1). The failure appears to be an extension of the May 1991 failure. That is, the rock that is failing is part of or immediately in front of a major fault zone that strikes approximately N80E and dips near vertical, intersecting the south wall at a slightly oblique angle. The extent of the failure along the wall is about 125 ft. At the time of the site visit, a few rockfalls and general ravelling were occurring from the area. Cracks were observed on the 7100 safety berm within about 6 ft of the toe of the berm. One monitoring prism had been installed near the western end of the failure on the 7100 ft safety berm. Monitoring results indicated that for about the last month, the average movement rate of this portion of the slope has been 16mm/day (as opposed to prism movement rates of about 1mm/day). The results also indicated that this movement has tended to occur in a series of short spurts of greater magnitude, followed by relatively stable periods of little or no movement. These spurts of movement are thought to be related to blasting in the pit and possibly to weather (i.e. such as periods of heavy rainfall).

Based on the above, it is concluded that the failure area is unstable and could either continue to slowly break up or could fail as a relatively large mass. Furthermore, prism monitoring indicates that movement of the failure has increased in the last month and that blasting in the pit is probably related to the recent increased movement. Thus, given that it does not appear possible to remove the failure mass safely with the existing mining equipment, and it is considered unsafe to extend the ramp past this area, it is recommended that the area beneath the failure be bermed off and that the mining scenario described above that would allow ramping to a 6900 ft elevation pit bottom be implemented. Notwithstanding



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this recommendation, it is felt that there is a strong likelihood that the failure mass will collapse on its own, and thus will be able to be removed/stabilized before mining is completed, possibly allowing the original mine plan to be accomplished (i.e. to reach the 6860 ft elevation) in the present mining phase. While it is not recommended at the present time, it may be possible to lower surface charges into the cracks at the back of the failure to try to accelerate failure of the mass. This should only be attempted if conditions are such that it can be carried out safely, and there is a high probability of success without causing further damage to the wall.

To better assess the state of stability of this area, it is recommended that a second prism be established on the 7100 safety berm towards the east end of the failure. This should only be done once safe access to this area of the 7100 berm has been re-established (i.e. after the east failure discussed below has been stabilized). Prisms should be monitored and results assessed at least every second day. Visual inspection of the failure area should be carried out on a daily basis and personnel should not be allowed in the pit bottom in the vicinity of the failure.

ii) South Wall Failure at Pit Crest (East Failure)

This failure area is located just east of the west failure (see Photo 2). It appears to involve primarily bench scale planar sliding on joints of Joint Set E, with lateral release/sliding on joints of Joint Sets B and D (see PAEL reports of February and November 1988 for description of joint sets). While joints of Joint Set E are observed in other areas of the south wall, they are usually relatively discontinuous and only result in breakback of bench crests. However, in this area, the joints are more frequent and more continuous, with a few being as long as about 50 ft.

At the time of the site visit, the failure had broken back to the pit crest at the 7280 ft elevation, with some cracking appearing near the toe of the 7280 berm. Most of the berm width below the crest in this area had either been filled with rubble or had been lost due to breakback of the individual bench crests. Rockfall and raveling activity was occurring sporadically from above the 7160 ft elevation.

While the above described failure represents an immediate hazard to men and equipment operating underneath it, in that any rockfalls are likely to reach the pit bottom, it is concluded that the slope should be able to be stabilized to an acceptable level. In this regard, and as there is ready access to the top of the slope, it is recommended that an initial 20 ft high cut be taken from the crest of the slope between the 7280 and 7260 ft elevations. This will remove a significant amount of unstable fractured



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and loosened rock from the crest area. The slope should then be inspected and, if necessary, a second, and possibly a third, 20 ft high cut of rock should be removed. At each step, any loose material should be scaled from the slope with the backhoe (which can reach about 20 ft below the level on which it is working). Once this is completed, the slope should be inspected to determine if there are any potential rockfalls that are still hanging up on the slope. If such potential rockfalls exist, and assuming that they can be safely accessed, it would be advisable to attempt to hand scale them from the slope. Such work should be done from the top of the slope downward, and only if the slope above where men are working has been satisfactorily scaled of all loose material. Extreme caution should be used at all times when carrying out this work.

As soon as possible following the above remedial work, at least three prisms should be established on the 7280 ft level, with at least one prism being installed behind the crack on the 7280 level. At least daily visual inspections should be carried out in this area while men and equipment are working on or below the slope. Depending on the results of such monitoring and inspection, additional scaling or the installation of additional prisms or possibly crack monitors may also be required.

iii) North Wall Failure in Clay Horizon

The recent failure in the clay horizon (see PAEL reports of February and November 1988 for description of clay) occurred toward the east end of the north wall below the main haulroad. In this area (see Photo 3), a second clay horizon, striking approximately normal to the wall and dipping subvertically, appears to have intersected the main clay horizon that has always been present on the north wall. The failure, which has effected a slope height of up to about 120 ft, apparently was comprised of two or three different stages, including bulging and squeezing of the clay and collapse of the overlying bedrock onto the clay horizon. Remedial measures instituted by the mine involved pushing the slope back slightly by re-establishing the safety berm at the 7040 ft elevation and excavating the bench face below the 7040 ft level at an angle of about 55°. No ore has been lost during re-establishment of the slope and the 55° bench face appears to be stable. It is noteworthy that stable benches with bench face angles of about 70° have been established in clay in other areas of the north wall. Based on discussions with mine personnel, it would appear that the clay horizon will not be present on the north wall below the present pit bottom (i.e. the 6980 ft level), and will be left on the wall.

The exact reason for the above slope failure is unclear; however, it is likely that the presence of the second clay layer, probably representing a shear zone, has had an influence on the slope behaviour. Also, the



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constant heavy traffic on the haulroad immediately above the failure may have helped to initiate movement. Furthermore, it is suspected that water pressure behind the clay (i.e. possibly from natural groundwater or water from the small pond behind the slope) may have contributed to the failure.

While the remedial resloping appears to have been effective in re-establishing the slope, it is recommended that drainholes be drilled into the slope from the haulroad and, if possible, from below the haulroad on the 7040 bench. Once the 6980 level is mined out, it would also be advisable to drill a few drainholes from this bench level. Lateral spacing of the drainholes should depend on their effectiveness. However, a nominal spacing of 50 to 100 ft and a similar depth (or to whatever depth is possible with available equipment) would likely be appropriate.

To conduct ongoing monitoring of this portion of the north wall, prisms should be installed on the slope. In this regard, it is recommended that two prisms be installed on the haulroad north of the switchback, with an additional two on the 7040 ft safety berm below. Depending on monitoring results, it may be advisable in the future to add further prisms on the 6980 safety berm. Because of the importance of the haulroad, these prisms should be monitored regularly (i.e. at least twice a week). Visual monitoring of this area should also be conducted regularly.

iv) Stability of North Wall in General

Based on a brief inspection of some of the safety berms, it is concluded that the north wall of the pit, including the area of instability discussed in our letter reports of March 8 and May 17, 1991, is performing reasonably well. Notwithstanding this, some rockfalls, ravelling and bench scale sloughs have occurred on the slope and further slope movement, rockfalls, etc. can be expected. Thus, operating procedures that have been used in the past when working close to the slope should be continued.

With respect to the prism monitoring results for the north wall, most of these prisms appear to be moving <1.0mm/day. However, the movement rates of Prisms L, N and O, located in the immediate area of the instability discussed in our March 8 and May 17 letter reports, all appear to have increased from about 1.0mm/day to about 1.5 to 2.0mm/day in the last one to three months. Continued regular monitoring and visual inspections of the north wall, particularly in this area, is recommended. Installation of an additional one or two prisms on the 7100 and 7040 level berms is also recommended.



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I hope the above is sufficient for your needs at this time. If you have any questions or comments concerning this letter report, please do not hesitate to contact me.

Yours very truly,

PITEAU ASSOCIATES ENGINEERING LTD.

Alan F. Stewart, P.Eng.

AFS/ef

Att.



PHOTO 1. West failure on south wall. Note cracks on 7100 berm.

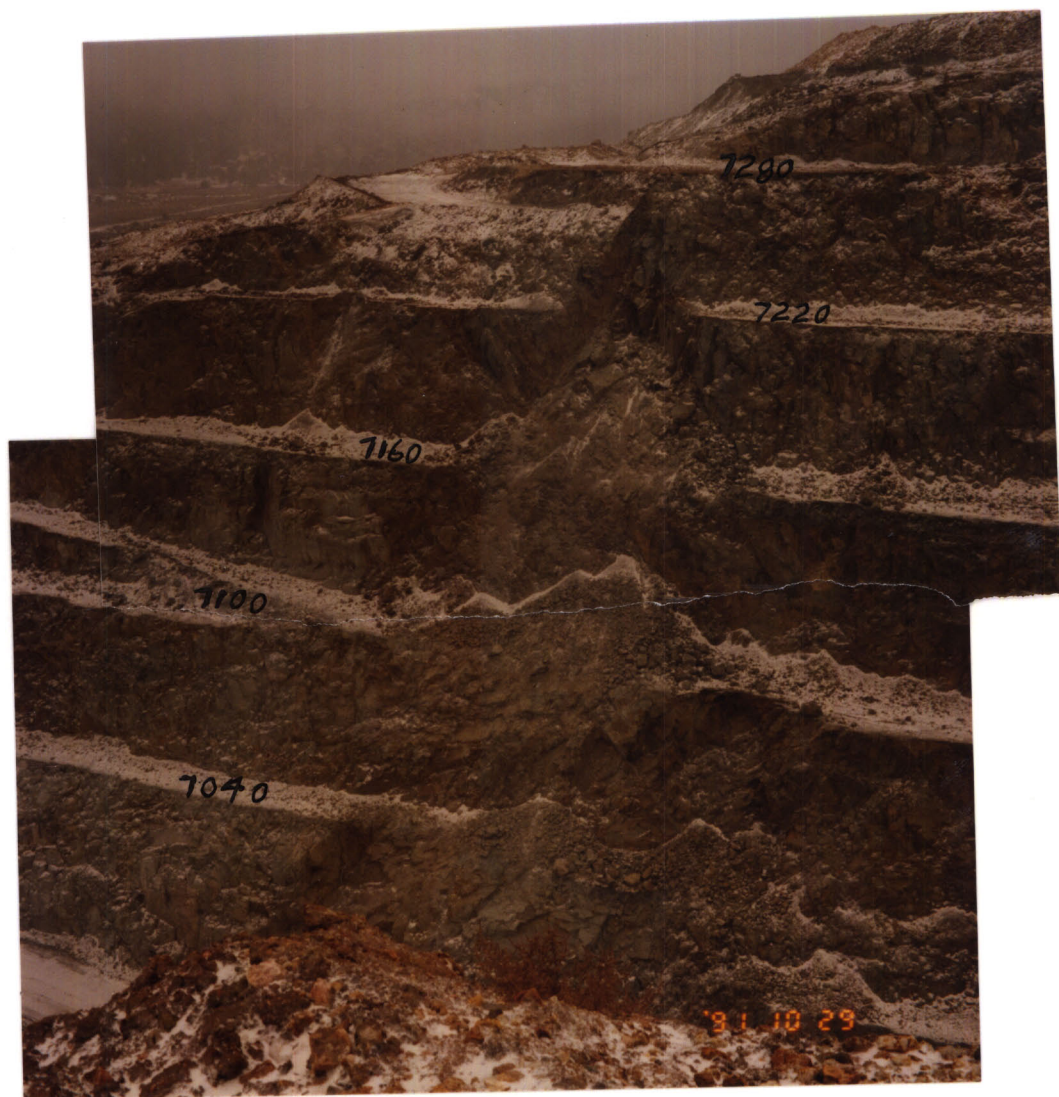


PHOTO 2. East failure on south wall.

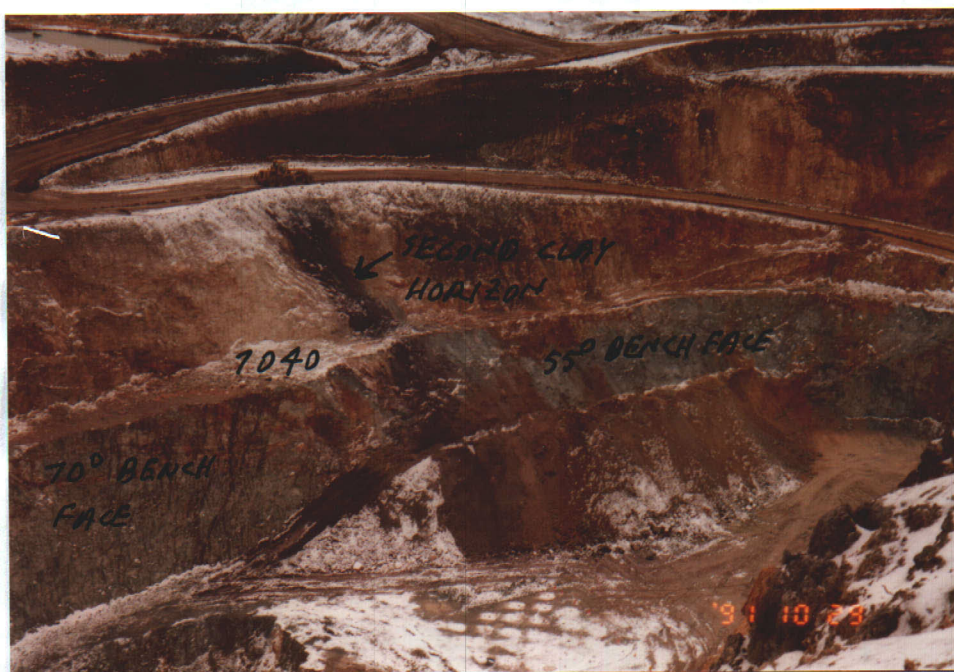


PHOTO 3. North wall failure in clay horizon following re-establishment of the slope. Note second, near vertical clay horizon.