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1984/50. A brief outline of slope stability problems at Savage River Mines

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Abstract

Geological advice on slope stability problems has been provided to the Inspector of Mines for a two year period between May 1982 and April 1984. An overall summary of the present situation (July 1984) at the mine is presented for the benefit of those geologists who may be required to give advice in the future. Stability problems associated with the open pits, the waste dumps, and the dams are discussed. It is emphasised that worthwhile geological advice can only be given in the future if the geologist involved has a good field knowledge of the site.

INTRODUCTION

For a two year period between May 1982 and April 1984 geological advice was provided to the Inspector of Mines during site visits to Savage River Mines. Regular visits by geologists from the Engineering Geology Section are not planned to continue. The purpose of this report is to provide an overall summary of the present situation (July 1984) at Savage River Mines in those areas where geological advice has been sought in the past. This should be a useful guide to Departmental geologists who may visit the mine in the future.

The terminology used to describe different features (*e.g.* Main Pit, North dump *etc.*, see fig. 1) within the mining lease may change. As far as possible I have used currently used terms but it is clear from old reports that, for example, several different names have been used to refer to the same unstable areas in the Main Pit. Other name changes may cause confusion during future visits.

BACKGROUND AND ROLE OF THE GEOLOGIST

Prior to 1982 the Mines Inspectorate had occasionally called for geological advice at Savage River Mines. The principal cause for concern was major stability problems in the Main Pit. In 1981 the Senior Mining Engineer at Burnie (E.C. Leyland) suggested that regular visits of a geologist with the Mines Inspector would be desirable. Regular visits began in May 1982. Apart from the writer, both P.C. Stevenson and W.R. Moore have visited the mine.

The role of the geologist has been to assist the Mines Inspector. The main activity has been to give advice and opinions on slope stability problems affecting all parts of the mining lease. Savage River Mines employs a slope stability engineer (David Tan) and most of the time at Savage River has been spent in his company. Although not having the legal responsibility of the Mines Inspector (A. Christianson) the geologist could be considered as an unofficial 'Inspector of Slope Stability'.

In practice, David Tan has been helpful and co-operative. Most developments on the mining lease (*e.g.* roads, dumps, dams *etc.*) involve stability problems. These have often been discussed and examined on site prior to the preparation of a formal submission to the Department. In these cases I have usually been able to tell David Tan that I am satisfied with the slope stability aspect of the proposal and that I will give that opinion to the Mines Inspector and the State Mining Engineer (R.C. Thomas). When formal submissions reach Hobart, Mr Thomas often seeks advice on

geological and stability aspects. The Chief Inspector of Mines has the final responsibility and makes the final decisions. Details of formal correspondence with Savage River Mines are in the appropriate files.

OPEN PITS

Slope stability in the Main Pit

There have been major stability problems in the Main Pit for many years. The mine is located in an area of complex geology and high rainfall. Several different rock types occur, some of which are highly to extremely weathered, resulting in a wide range of material strengths. Major faults, continuous joints and, in places, the unfavourable orientation of schistosity all contribute to major slope failures. Details of the geology and the stability problems are outside the scope of this report. They are discussed in several of the reports listed in Appendix 1.

The largest face in the Main Pit is the East Wall. The major slope failures on this wall are, from north to south, currently referred to as:

(1) the North-East Slide,

(2) the Siren Slide, and

(3) the Crusher Ramp Slide

In the past two years remedial works have been carried out in all of these areas. Failed areas have been cleaned up by bulldozers and overall slopes have been flattened. All active slide areas on the East Wall are regularly monitored and dewatering programmes continue. Blasting is kept to a minimum in sensitive areas below slides, with as much material as possible being removed by free digging.

Major slope failures have, in the past, affected the West Wall of the Main Pit. There has been little mining activity on the West Wall during the last two years. During the next couple of years mining will restart and new stability problems can be expected. David Tan and the management personnel at the mine are aware that major slope failures are possible. Specific problems will be anticipated where possible and responded to with appropriate remedial measures and redesign if necessary.

Monitoring

Monitoring of movement by repeated survey and of water levels in boreholes is being carried out on a regular basis. In actively moving areas the monitoring is carried out more often. Alarm systems, consisting of flashing lights and sirens which are triggered by crack opening, have been set up where slope failures could cause immediate safety problems.

Dewatering

The purpose of dewatering is to improve the stability of the pit slopes. The principal method of dewatering is by drilling horizontal drainholes into the pit walls. This approach was recommended to the Mine by Australian Groundwater Consultants. Extracts from some of their reports are referred to in Appendix 1. The horizontal drainholes are judged to be having a beneficial effect on stability and the programme is continuing.

As far as surface water is concerned, mine personnel are aware of the

twin objectives of:

(1) keeping as much surface water as possible out of the pit, and

(2) getting water in the pit drained out as quickly as possible.

Slope stability of the North Pit

At present slopes in the North Pit are limited to one bench in height as the top of ridge is being removed. Preliminary pit design is being carried out and, as Slope Stability Engineer, David Tan will have a continuing input.

WASTE DUMPS

Existing dumps

The locations of major waste dumps are shown on Figure 1. Of the eight dumps shown, North Dump, 'A' Dump, and 'B' Dump have been completed. No major stability problems are anticipated with these completed dumps. Surface drains prevent water from 'B' Dump entering the southern end of the Main Pit and these drains should be regularly maintained.

New dumps

The remaining five waste dumps are either planned or in progress.

The North Pit Dump occupies relatively flat land east of the North Pit. There should be no stability problems with this pit.

The Main Creek Dump involves the dumping of waste in Main Creek downstream of Main Creek Dam. It is potentially a large dump but there should be no stability problems because it is confined in a valley. The spillway from Lake Shepherd will run along the eastern edge of this dump.

The East Dump is located close to the mine works and office. The unusual feature of this dump is that it is planned to partly overlap the shallow end of the Emergency Tailings Storage. Care should be taken in this area as stability problems may be caused by local settlement and liquefaction.

It is planned to build up the South-West Dump from sloping ground close to Savage River. The access road to the dump from the West Wall of the Main Pit is currently under construction. The road cuts across steep slopes and three gullies, and construction difficulties and stability problems must be expected. Another problem is that dumping above the planned access road, immediately south-west of the Main Pit, was carried out in the past. Some of this waste material is marginally stable and slides have occurred into the gullies which have to be crossed by the access road. The South-West Dump area and access road are areas where stability monitoring is likely to be required in the future. Regular maintenance of the road may be required in problem areas.

The Broderick Creek Dump is planned for Broderick Creek gully close to the North Pit access road. Water from Broderick Creek is to be diverted around the dump by a dam and a spillway through a low saddle (discussed later). The dump itself will be confined in a valley and no stability problems are expected.

DAMS AND STORAGES

Main Tailings Dam and North Slot

The Main Tailings Dam is located about two kilometres east of the Main Pit (fig. 1). The Main Dam is complete and the storage is filled to capacity with tailings. Water overflow is currently through the North Slot rockfill dam. It is understood that the H.E.C., who designed this dam, recommended that on completion of the Main Tailings Dam and storage, a permanent spillway should be constructed through a low saddle west of the North Slot Dam.

Emergency Tailings Dam

The Emergency Tailings Dam stores tailings and water for use by the mine works. I am not aware of any problems with the dam itself. The dam has been effectively strengthened recently by the construction of the access road to the Main Creek Dam. This road acts as a buttress to the dam.

The storage is crossed by a causeway which carries the tailings pipeline from the mine works towards Lake Shepherd. The causeway consists of mine waste dumped upon the tailings. Settlement occurred during construction but the causeway should now be relatively stable.

The Department of Mines has given permission for waste rock to be dumped over part of the shallow end of the storage (East Dump). Savage River Mines wanted to extend East Dump over the storage downstream as far as the causeway. This was discouraged because of the dangers of liquefaction and dump failure caused by high pore pressures in the tailings during dump construction. I am not sure of the current position but I understand that there has been no dumping of waste rock on the tailings in the storage in the past year.

Main Creek Dam

Main Creek Dam is currently under construction. This storage will be used for tailings disposal, probably for the remaining life of the mine. It is planned to keep the tailings covered with water and to call the storage 'Lake Shepherd' in honour of a former general manager. Lake Shepherd will flood the existing road linking the mine with Savage River town and the new access road is planned to cross the Main Creek Dam. Waste rock is being used to construct the dam and it can also be dumped downstream of the dam when the dam is complete (Main Creek Dump). Thus it is clear that the dam is a key structure to the future of the mine.

At present (July 1984) the dam is about half finished. There are problems of leakage through the dam. Most of the leakage is occurring near a penstock designed to divert water through the dam during the final stages of construction. Savage River Mines have sought the advice of a consultant (Glen Truscott of Gutteridge, Haskins and Davey). Details of the extent of the problem and the possible remedies are not known. The appropriate files and the Inspector of Mines can be consulted for more information.

Broderick Creek Dam

The purpose of Broderick Creek Dam is to divert water around the proposed Broderick Creek Dump. Construction of the dam had not started during the last site visit (April 1984), although excavations for the

spillway were nearly complete. The spillway has been cut through a narrow saddle. There may be stability problems in the extremely and highly weathered rocks. Care will have to be taken to ensure that cutting failures do not block the spillway.

Details of the design and construction schedule of Broderick Creek Dam are not known.

OTHER STABILITY PROBLEMS

There is potential for stability problems to be associated with any civil engineering project associated with the mine. Steep slopes and high rainfall are the main causes of the problem.

Roads, such as the North Pit access road and the South-West Dump access road, involve deep cuttings and large fills. Care should be taken to avoid major stability problems in all these undertakings but minor problems must be expected. Monitoring of critical areas and maintenance (including regularly clearing drains and minor remedial measures) should be considered standard practice.

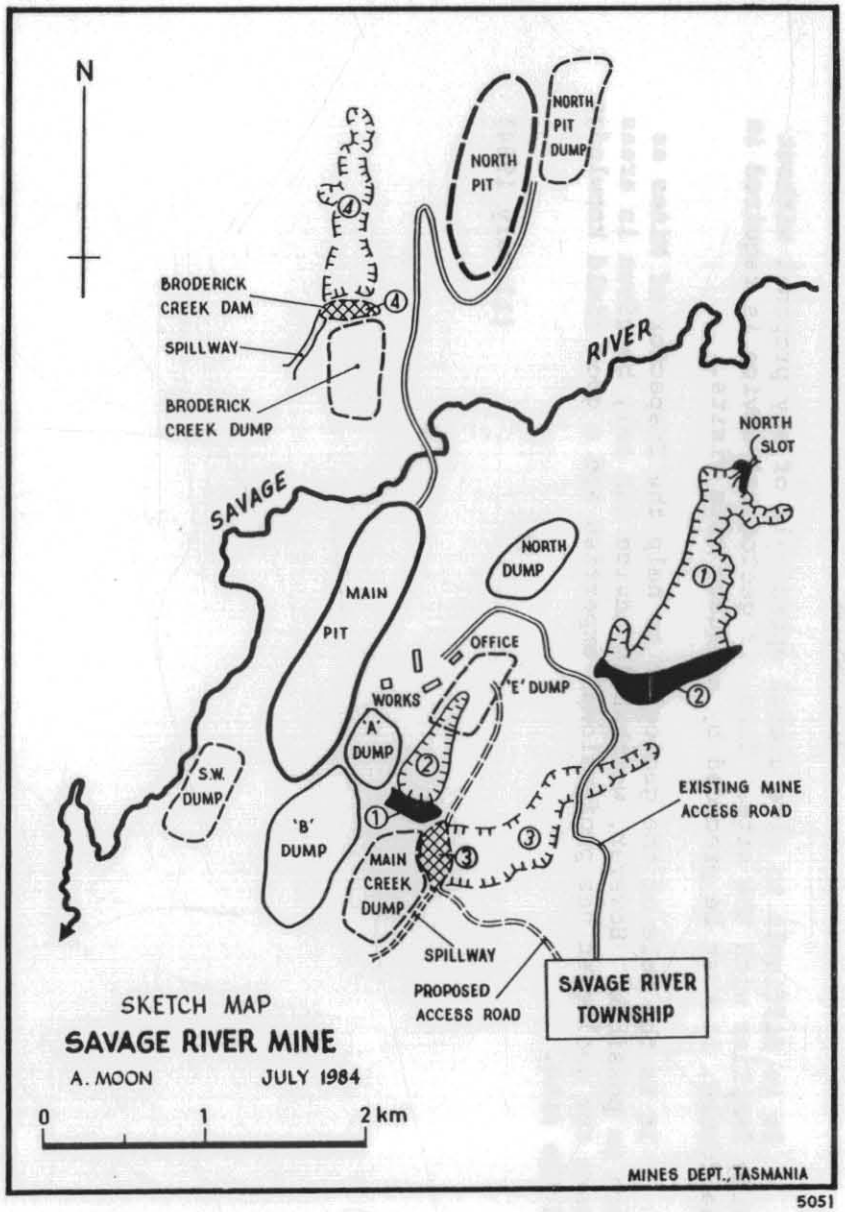
The pipeline to Port Latta appears to have been remarkably free of stability problems. A landslide occurred several years ago about 18 km (11 miles) from the mine. A monitoring system is now in operation at the site.

DISCUSSION

It is difficult to give useful appraisals of any proposal without being familiar with the site. Thus, if geological advice is required in the future, it must be preceded by adequate site visits.

It is the role of the geologist to help the Inspector of Mines as much as possible. However, worthwhile advice can only be given in areas where the geologist has professional expertise and a good field knowledge of the site.

[13 July 1984]



LEGEND

(Solid lines indicate work largely completed and broken lines indicate work planned or in progress.)

- Open pit
- Dump
- Dam
  - ① Emergency tailings dam
  - ② Main tailings dam
  - ③ Main Creek dam
  - ④ Broderick Creek dam
- Storage
  - ① Main tailings storage
  - ② Emergency tailings storage
  - ③ Lake Shepherd (water & tailings)
  - ④ Lake Broderick (?)

5 cm

Figure 1.

APPENDIX 1

Overall list of available reports and documents

The following is a list of reports and other documents which I assembled while working on the Savage River Project. Unless otherwise stated the items listed below have been given to the Supervising Geologist, Engineering Geology Section. A detailed list of maps is given in Appendix 2.

A copy of a report by Piteau, Martin and Stewart entitled "Savage River Mines, Slope stability analysis and design of the open pit slopes" (two volumes and a folder of maps).

Extracts from two reports by MacMahon on slope stability at the Savage River Mine.

Three extracts from reports by Australian Groundwater Consultants on dewatering at Savage River Mines.

A copy of an Unpublished report by Moon and Moore entitled 'Savage River Mines open-cut: notes for the guidance of Inspectors of Mines' (Unpublished Report 1980/6).

Results of direct shear testing of residual soil and extremely weathered rock from the north-east corner of the Main Pit at Savage River Mines. Atterberg limits and XRD tests were also carried out.

A set of aerial photographs of the Savage River area. The scale is 1:25 000. They were taken in 1979 and 1980 and were used for the production of the orthophotos.

A set of ten polaroid prints taken during construction of the Main Creek Dam (6 October 1983).

A set of 38 colour slides taken in the Main Pit at Savage River Mines in December 1979. These slides (numbered 2450-2487) are held in the Publications Section slide collection.

APPENDIX 2

Detailed list of available maps

The following listed maps have been given to the Supervising Geologist, Engineering Geology Section.

1. Savage River Mines - General area map - GS-33-02. 1:4000
2. Savage River Mines - General area - GS-7. 1:5000
3. Savage River 43, 33, 23, 13 (3440-43, *etc.*) Dyeline prints of orthophotographs 1981. 1:5000
4. Savage River Mines - South-West Dump access road. 21.4.1982. 1:600. FD-11
5. Savage River Mines - 29.7.1981. 1:2000. SS 003. Location of monitoring points and observation wells.
6. Savage River Mines - East Dump design. 8.12.1981. 1:1000. FD-9.
7. Savage River Mines - Emergency tailings dam and Main Creek area. 1:1000. GS-19-01.
8. Savage River Mines - Northern deposit - ultimate pit. Plan 2. December 1981. 1:1000.
9. Main Creek tailings dam and road alignment. 1:2000.
10. Long Plains - Mt Cleveland. 1:20 000.
11. Savage River - Rocky River area (geological). 1964. 1:39 600.
12. Savage River - North area (geological). 1:6000.
13. Geological cross-section at 7000 mN. 1:600.
14. Geological cross-section at 6960 mN. 1:600.
15. Savage River Mines - representative geological cross-section 6831 N. 1:600.
16. Geology of Savage River Mine at 16th Lift, R.L. 175 m. June 1978. 1:1500.
17. Savage River Mines. 29.7.1981. 1:2000. SS-004. "A" Dump.
18. Savage River Mines - Location of monitoring points and observation well - "A" Dump. 29.7.1981. 1:2000. SS-003.
19. Savage River Mines - General pit area. 20.12.1981. 1:2000. MS-1-01.
20. Savage River Mines - General area map. 18.4.1978. 1:1000.

21. Savage River Mines - General area. 1:10 000. GS-17.

22. Savage River Mines - Geological cross-section - Section 22 270 N. 1:480. Received 1.10.1969.

23. General area maps. 1:5000. Transparencies and dyelines (enlarged from 1:15 840 Corinna and 1:20 000 Long Plains).