

Golder Associates Ltd.

500 - 4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone (604) 298-6623
Fax (604) 298-5253



APPENDIX IV

REPORT ON

**TAILINGS DAM INSPECTION
CAROLIN MINES
HOPE, BRITISH COLUMBIA**

Submitted to:

Athabaska Gold Resources Limited
#200 - 1185 West Georgia Street
Vancouver, B.C.
V6E 4E6

DISTRIBUTION:

5 copies - Athabaska Gold Resources Ltd.
Vancouver, B.C.

2 copies - Golder Associates Ltd.
Burnaby, B.C.

October 27, 1995

952-1483

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 INTRODUCTION	1
2.0 GENERAL HISTORY	1
3.0 1989 - 1995 OPERATION	2
4.0 TAILINGS DAM PERFORMANCE	3
4.1 Pond Level and Piezometric Data.....	4
4.2 Seepage Observations	4
4.3 Surface Erosion.....	5
5.0 TAILINGS DAM - FUTURE OPERATION	5
5.1 Design Modification	6
5.2 Future Unattended Operation.....	6
5.3 Future Tailings Storage.....	7
6.0 CURRENT MANAGEMENT TAILINGS POND.....	7
6.1 Pond Levels	7
6.2 Piezometers.....	8
6.3 Spillway Operation	8
FIGURE 1 Key Plan	
FIGURE 2 Air Photo	
FIGURE 3 Plan and Section	
FIGURE 4 Pond and Piezometer Levels	
FIGURE 5 Photographs	

1.0 INTRODUCTION

This report provides the results of our inspection of October 11, 1995, of the Carolin Mines Tailings dam.

This report is intended to form the geotechnical appraisal required by the Ministry of Energy, Mines and Petroleum Resources, and the Ministry of Environment. A brief history of the tailings pond operation as reported by mine personnel is given together with our observations and the results of instrumentation monitoring. This report and our observations deal with geotechnical aspects of the project only. We have not considered environmental elements of the project.

The last previous inspection was carried out in October 1989 and reported in December 1989 to Carolin Mines Ltd.

2.0 GENERAL HISTORY

A brief history of the tailings dam is presented below for background information.

- Alternative sites for tailings storage were studied in the Ladner Creek area and reported in Golder Associates report of May 14, 1979 (7921018).
- Investigation and design for the tailings dam was reported in Golder Associates report of October 1979 (7921018).
- Construction of the tailings dam was carried out in 1980 and 1981 to elevation 3,160 to 3,168 ft. by Emil Anderson Construction Co. Ltd. A temporary emergency spillway was constructed at elevation 3,160 ft.
- Water was stored within the tailings dam to elevation 3,160 ft. in the spring of 1982. The mine mill was closed on April 8, 1982 due to discharge from the mill. Excess tailings pond storage was returned to the mill, treated, and discharged during May 1982 until the pond level was lowered to elevation 3,150 feet.
- Construction of the tailings dam was completed to elevation 3,200 ft. during the 1982 construction season, with an emergency spillway at elevation 3,195. During December 1982 the tailings spigots were discharging at elevation 3,175 feet and the pond level had risen to elevation 3,170 ft.

- The tailings dam crest was raised to elevation 3,210 feet, and an additional downstream rock filter placed, to accommodate high pond storage levels during 1983. The emergency spillway invert was raised to elevation 3,206 feet. These measures were undertaken due to the inability to discharge due to chemical composition of the pond water. This work was completed during 1984.
- The mill effectively ceased operation during 1984 and the final tailings solids beach level is as shown on Figure 3.
- The water storage level behind the dam ranged from 3,190 to 3,203 feet during the period 1984 to 1987 as water quality affected discharge. From mid 1987 to 1989 the pond level was controlled by pumped and siphoned discharge, and was maintained near elevation 3,187 feet.
- The recommended pond level from 1986 to present was to be maintained below elevation 3,192 feet such that a wide tailings solids beach was exposed above free water level.

3.0 1989 - 1995 OPERATION

Golder Associates has not provided inspection during the period of 1989 to 1995. Annual inspection and monitoring of instrumentation was recommended under pond controlled operation.

We understand that some pond water control was provided after 1989 by operation of the syphon. Water level records are not available. During the most recent 2 to 3 years no pond water level control has been exercised, and no inspection provided. The pond water level has risen to 3,206 feet and continuous discharge over the spillway has resulted during 1993 to 1995.

The perimeter runoff control ditch system which minimizes runoff into the pond had become inoperative during the period since 1989. This system when operating discharges by gravity to Fifteen Mile Creek to the south. We understand that repair of the ditch system was completed about October 9, 1995. During our October 11, 1995 inspection general runoff was again being diverted from the pond.

We understand that pumping from a mobile pump was commenced about September 20, 1995. During this period the pond water level has been lowered from elevation 3,206 feet to 3,202 feet on October 11, 1995.

During the recent period of lack of site supervision, severe damage to some of the piezometers due to vandalism has taken place. Where possible the piezometers were repaired during our inspection. However, most of the piezometer leads terminating on the crest of the dam were not repairable, resulting in a lack of data in the upper main upstream section of the dam.

No mill operation has taken place during the period from 1989 to 1995, and therefore the tailings solids stored remain the same as in 1984 and as shown on Figure 3. The beach is currently inundated but ranges from elevation 3,194 to 3,199.5 feet at its intercept with the upstream dam slope.

The pump return barge is located on the east side of the pond but is inverted.

Plastic syphon pipes of 2.5 inches and 4 inches diameter are located at the spillway. We understand that the 2.5 inch pipe is operative but the 4.0 inch pipe is not.

4.0 TAILINGS DAM PERFORMANCE

The tailings dam has performed well during the period of 1989 to 1995 and without incident. The pond water control has been inadequate during this period and the emergency spillway has been required to provide continuous discharge.

It is understood that the pond water is of suitable quality for discharge. The discharge flows to Ladner Creek as a result of pumping or syphoning.

The upper perimeter runoff diversion ditches had become inoperative generally allowing runoff to discharge into the pond, further increasing the spillway flow.

4.1 Pond Level and Piezometric Data

The fluctuation of the pond water level during the 1989 to 1995 period is not well known. The levels shown on Figure 4 indicate that the pond has been at full emergency spillway level since 1993. The available piezometer readings taken on October 11, 1995 are shown on Figure 4 and the seepage phreatic surface based on these results is given. Due to the destruction of several piezometer leads on the dam crest the assumed phreatic surface may not be accurate.

The piezometer readings and phreatic surface are considered indicative of full pond storage to elevation 3,206 feet. The results indicate that seepage is discharging through the upper core section into the upper rock drain. This indicates a high phreatic surface in the central section of the dam core. Additional piezometers are required to replace those destroyed, in the central section of the dam, in order to provide a reliable appraisal.

4.2 Seepage Observations

The seepage observations during our inspection of October 11, 1995 indicate an increase in seepage and downstream flow. This is considered due to the increased pond level and also due to heavy precipitation in the period preceding inspection. The overall seepage is however low.

As encountered in previous years, seepage was observed along the downstream west abutment with cumulative flows of about ½ litre per second. This seepage is believed associated with spillway and natural infiltration. No loss of fines resulting in deposition of silt or sand sizes was noted.

Wet conditions were observed at the downstream rock fill bench level of 3,195 feet. No sloughing, loss of fines, or deposition of fines is associated with this and it is considered due to precipitation and runoff.

Seepage was observed on the downstream glacial till bench at elevation 3,139 feet on the western side of the dam. This seepage appears to be continuous, based on vegetation growth, and may be associated with pond seepage at the west abutment. Total flows of

up to 1 litre per minute were observed. No loss of fines or soil movement is associated with the seepage.

Seepage through the downstream rock toe drains is estimated to be in the order of 1 litre per second. No soil movement or loss has been observed. The total downstream dam seepage and abutment runoff observed below the north sediment control pond is estimated to be 2 litre per second.

4.3 Surface Erosion

Only minor surface erosion due to weathering has occurred on the downstream slopes. The slopes are in good condition and do not require maintenance.

The upstream slopes have been exposed to pond water up to elevation 3,206 feet. Only minor erosion has resulted and maintenance is not required.

The emergency spillway at elevation 3,206 feet is lined and coarse rock covered. No erosion was observed due to overflow conditions.

The surface perimeter ditches which divert runoff from the pond area to Fifteen Mile Creek are currently in satisfactory condition. They have however, been recently cleaned and require annual maintenance following spring thaw.

Photographs of the site are given on Figure 5. A comparison of these photographs with those of previous years indicates satisfactory surface performance.

5.0 TAILINGS DAM - FUTURE OPERATION

It is understood that a feasibility study is currently in progress to determine if the mine and mill should reopen. If the mill commences discharge to the existing pond this will require operating water levels to be maintained as discussed under Section 6.0. The pond water level should be maintained below the tailings solids beach.

The above pond control will require that stored water is of a quality suitable for discharge to Ladner Creek, or returned to the mill and discharged to Ladner Creek. As shown in the history of the project, Section 2.0, excess water storage has previously been a problem in dam operation, where water unsuitable for discharge is stored. Further the bypass ditches must be maintained to minimize runoff water impounding and storage.

5.1 Design Modification

The dam has been designed such that an ultimate crest elevation of 3242 may be considered. The final design cross section of the dam will require some modification from that originally considered as a result of the rock fill placed during 1983 and 1984 as a safety consideration due to high pond water level storage.

Future construction to raise the crest level will require placement of compacted glacial till and rock fill. The rock fill may be obtained from mining and quarrying. Further exploration for suitable borrow materials will be required due to depletion of the glacial till in the former borrow pit. We recommend that the exploration proceed during the summer of 1996. Due to the site conditions borrow materials, other than rock, are scarce.

Previous storage analyses, by others, showed a 6 to 10 year operating mill capacity for a 3242 crest elevation.

5.2 Future Unattended Operation

If the feasibility study indicates that the tailings dam will not be utilized for future storage, we recommend that temporary or permanent abandonment conditions be developed for the pond. This is required due to the lack of pond level storage control without mine personnel attention. It would therefore be recommended that the emergency spillway currently at elevation 3,206 ft. be lowered to provide an abandonment operational spillway at elevation 3,190 ft. This would require excavation at the dam crest only on the west abutment. The dam could be maintained in this drawdown condition either temporarily for several years, or permanently.

5.3 Future Tailings Storage

If the mill is reopened and discharge of tailings resumes, the tailings should be discharged from the dam face utilizing a series of spigots. Discharge from the dam in an upstream direction will create a tailings solids beach adjacent to the dam. The spigots should be raised in about 5 feet intervals as the pond is utilized. Ultimately the tailings discharge may be relocated to the south end of the pond in order to utilize the full storage capacity of the pond.

The pond water level should be maintained below the beach intercept with the dam face as the storage levels are increased. Periodic temporary pond surges due to storm water storage can be accommodated but the water level should subsequently be lowered.

6.0 CURRENT MANAGEMENT TAILINGS POND

6.1 Pond Levels

Pond management under the current condition of the non-operating mill and therefore no active discharge to the tailings pond is required. The pond water is understood to be suitable for discharge to Ladner Creek. The tailings solids beach at the upstream dam slope ranges from elevation 3,194 to 3,199.5 feet.

It is recommended that the pond water level be lowered to elevation 3,187 feet by present pumping operations. If pumping is then discontinued the water storage level may fluctuate between elevations 3,187 and 3,192 feet. Pumping should be recommenced if the pond level reaches a maximum of 3,194 feet. It is desirable to expose a minimum beach width of about 300 feet from the dam face.

The perimeter diversion ditches should be maintained in order to avoid general runoff entering the pond. Control of the pond would also be assisted by reactivating the 4 inch siphon to operate on a continuous basis.

6.2 Piezometers

There is presently insufficient piezometric detail to fully define the seepage conditions within the dam. This has resulted because of the destruction of piezometer leads on the dam crest. We recommend that four additional piezometers be installed at this time from the dam crest. This work would be undertaken by means of a percussion drill rig using casing and drilling fluid. The piezometers would be installed to replace piezometers numbered 5825, 5827 and 5828.


6.3 Spillway Operation

It is intended that the emergency spillway at elevation 3,206 feet only discharge water to prevent overtopping of the dam. Overflow of the spillway does not endanger the spillway itself nor does it cause downstream erosion but it does result in excessive water storage in the pond. High water levels above beach level results in seepage flow into the rock fill surface drain. This is an undesirable condition and results in an excessive phreatic surface and seepage within the dam.

We trust that this report contains the information required. We would be pleased to assist in the installation of piezometers and borrow materials determination as required. Please call us if you have any questions regarding this report.

Yours very truly,

GOLDER ASSOCIATES LTD.

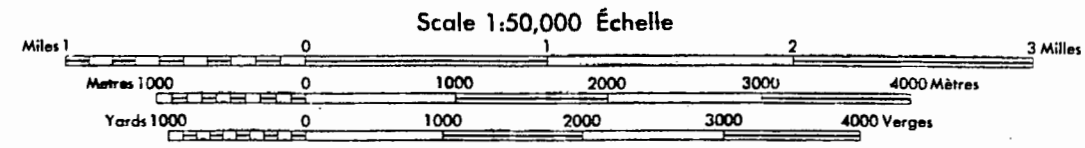
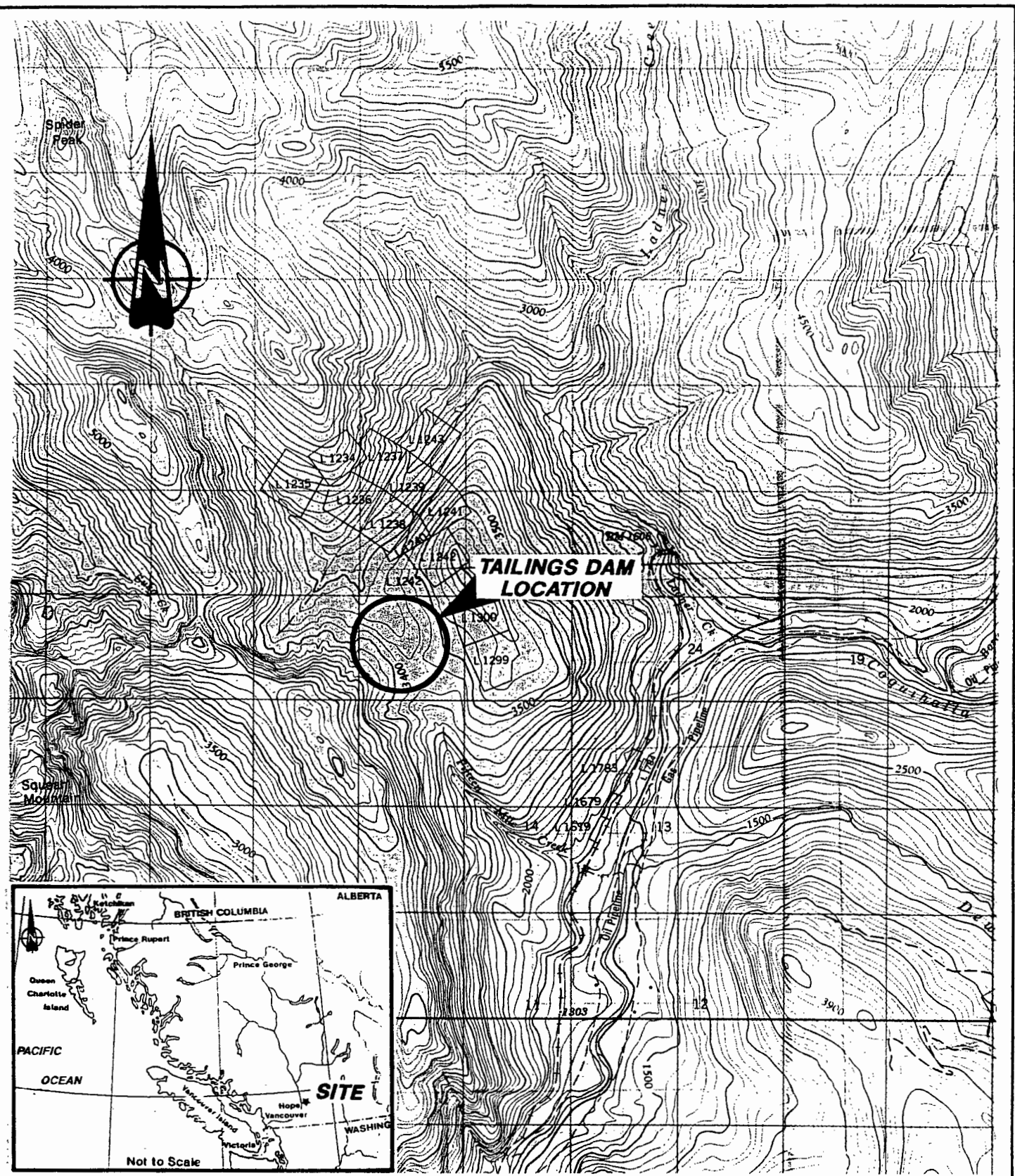

T.L. Eldridge, P. Eng.


R.M. Wilson, P. Eng.

TLE/RMW/lc/tb
952-1483

JARPT-95\OCT\RMW-1483.DOC

Project No. 952-1483 Drawn B.A.D. Reviewed R.N.K. Date Oct. 95



KEY PLAN

Figure **1**

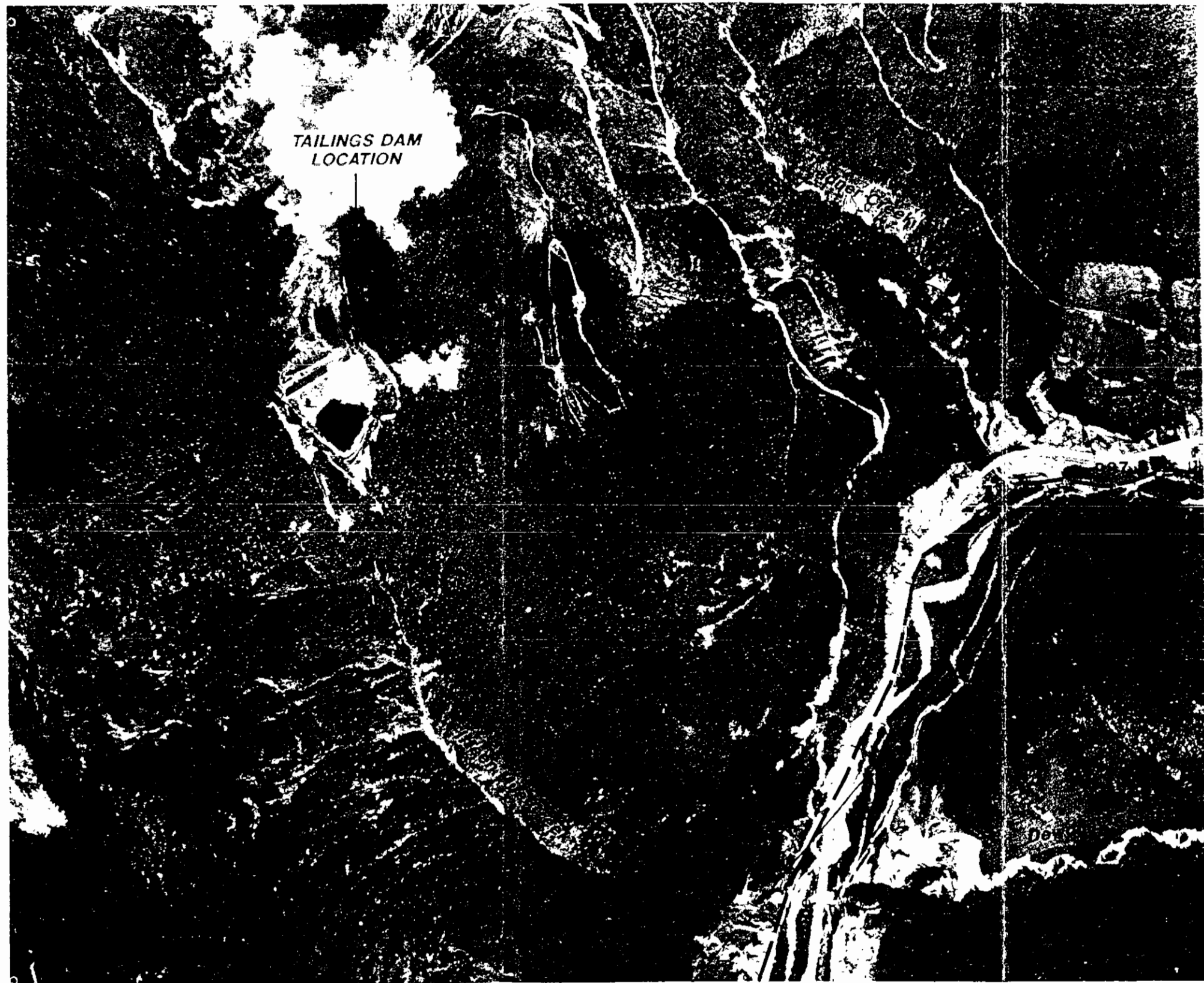
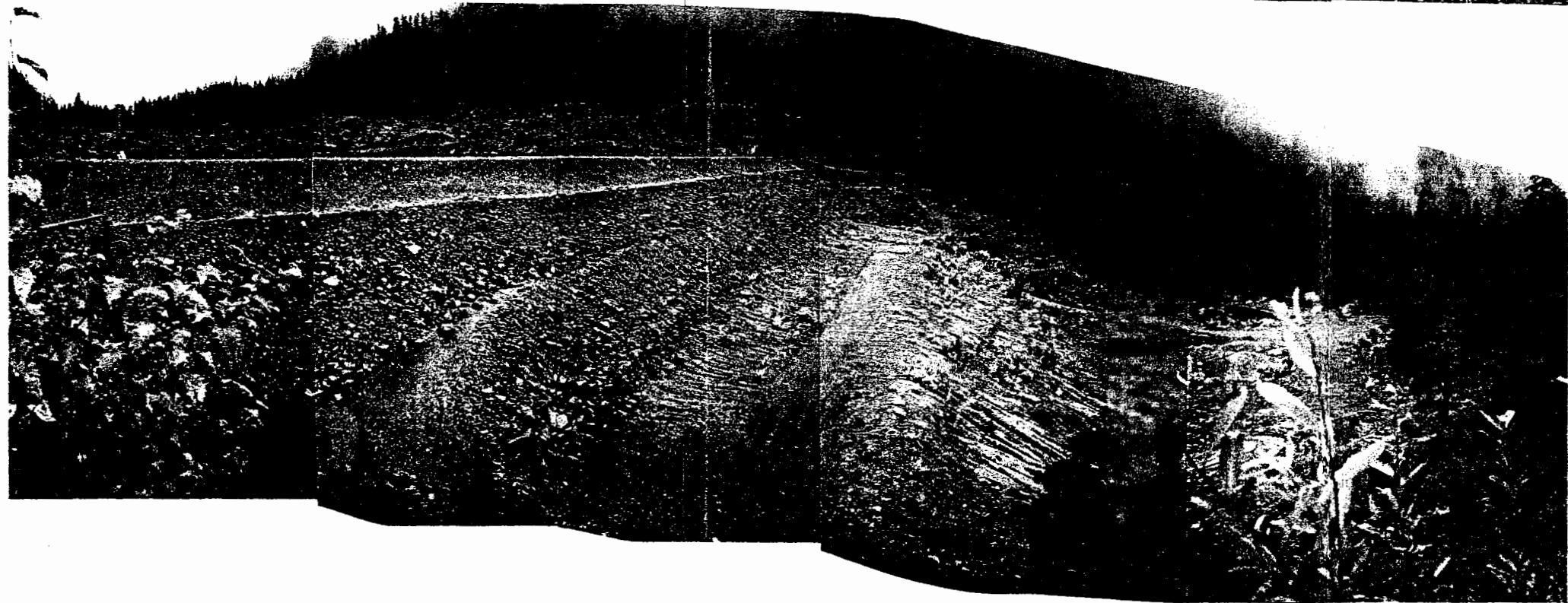
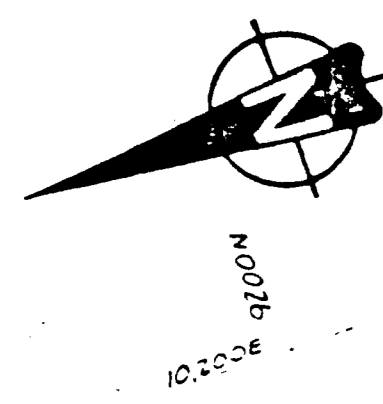
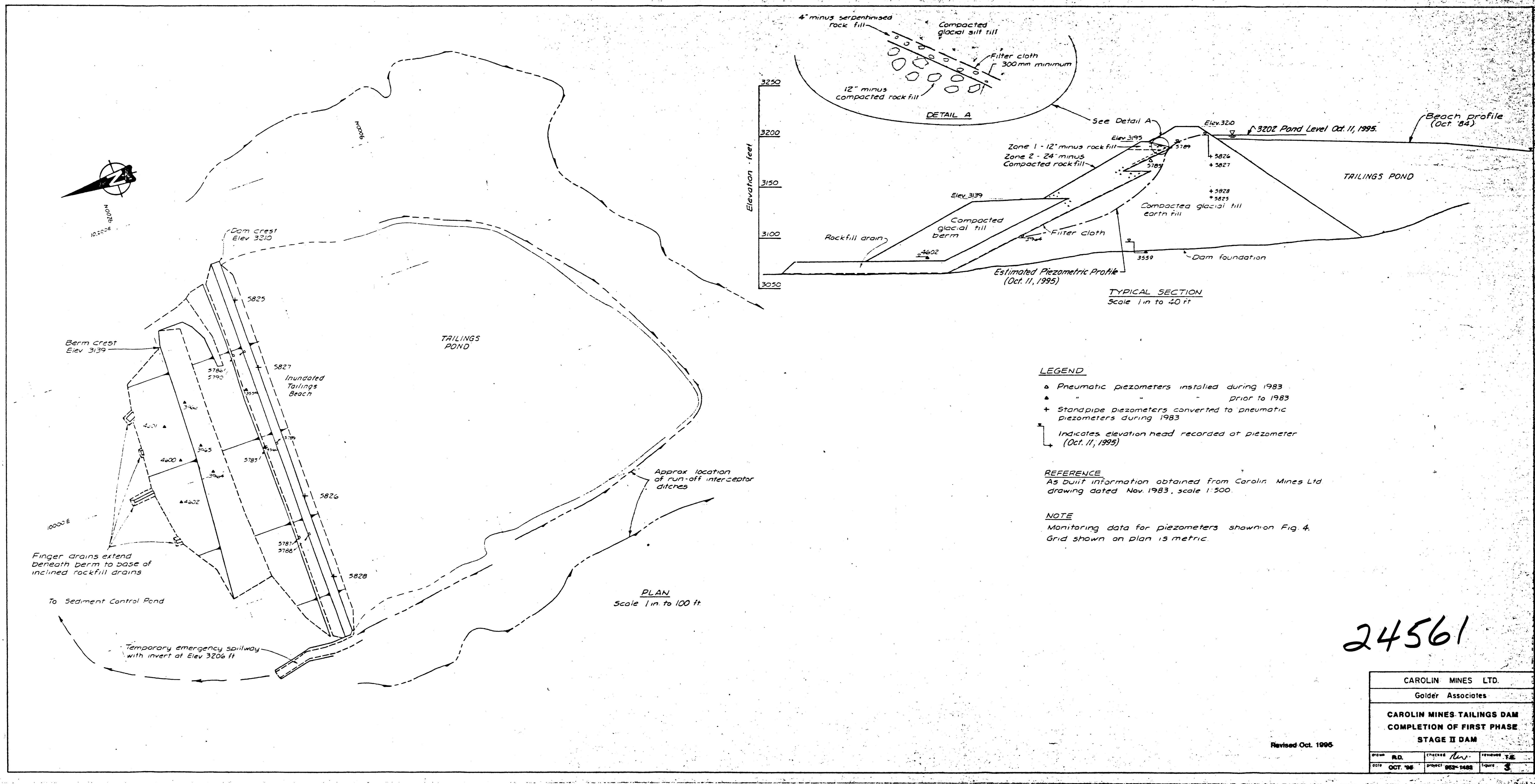


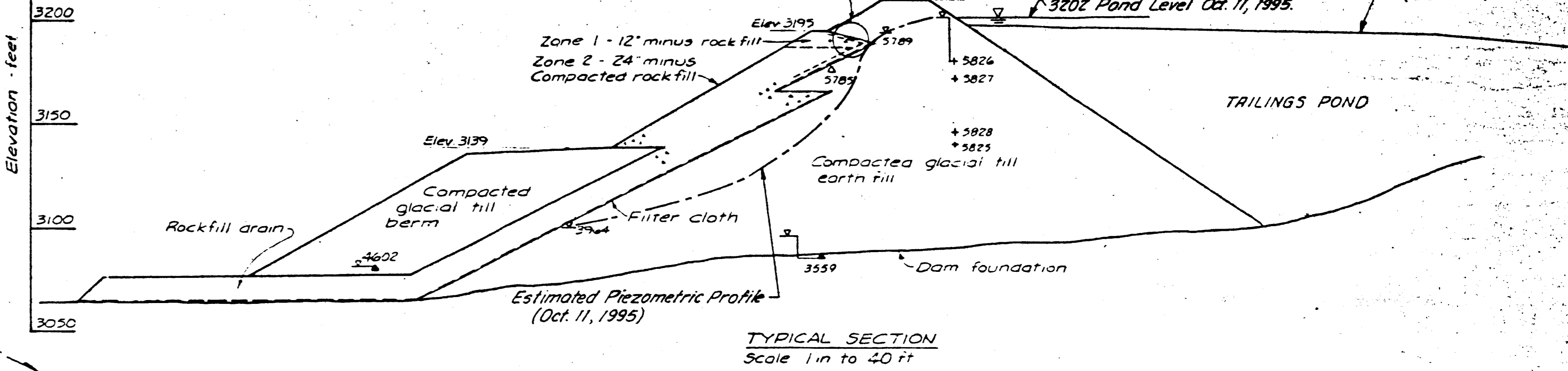
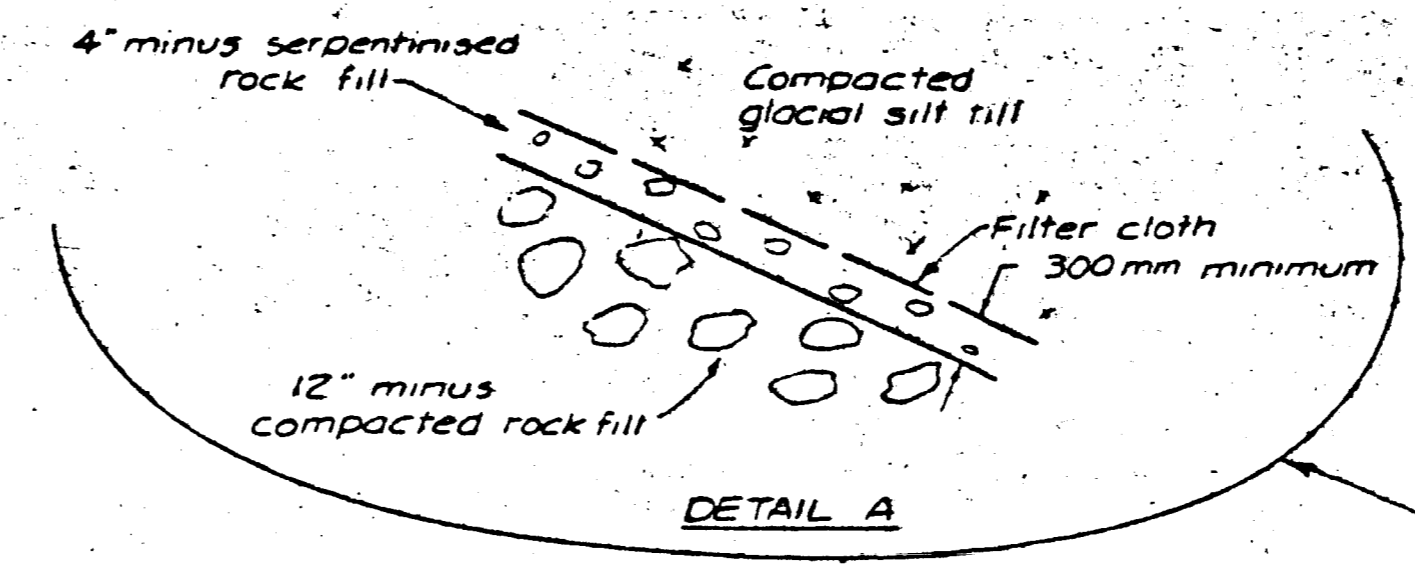
Figure 2
AIR PHOTOGRAPH 1992

Figure 5 PHOTOGRAPHS OCT. 11, 1995





Elevation - feet
3250
3200
3150
3100
3050



LEGEND

- ▲ Pneumatic piezometers installed during 1983
- ▲ " " " " prior to 1983
- + Standpipe piezometers converted to pneumatic piezometers during 1983
- Indicates elevation head recorded at piezometer (Oct. 11, 1995)

REFERENCE

As built information obtained from Carolin Mines Ltd drawing dated Nov. 1983, scale 1:500.

NOTE

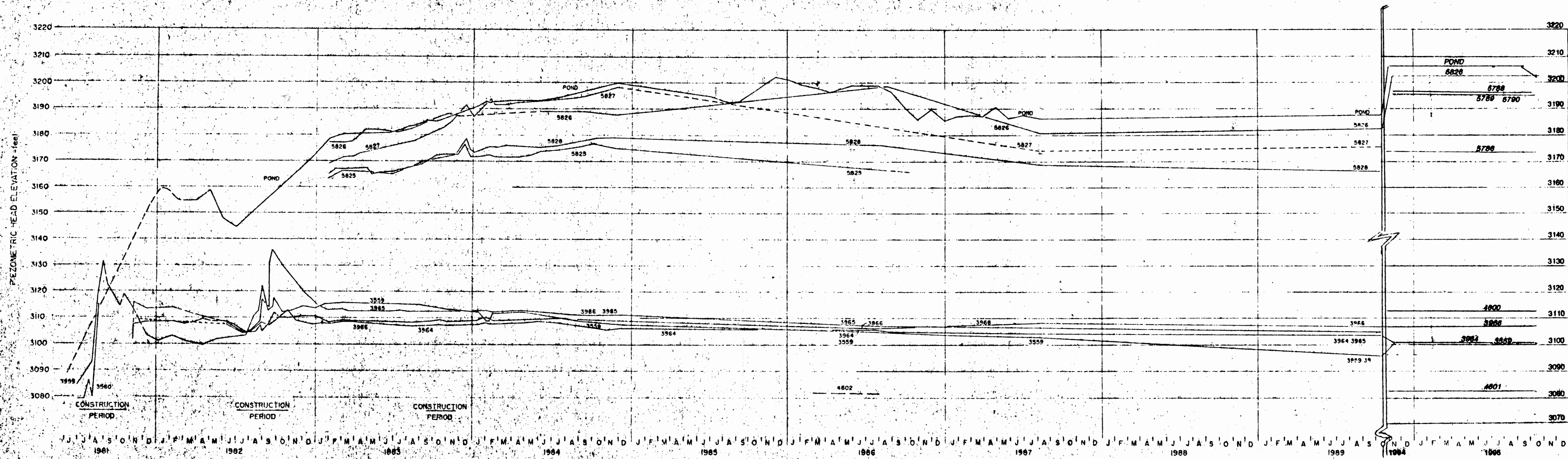
Monitoring data for piezometers shown on Fig. 4. Grid shown on plan is metric.

PLAN
Scale 1 in. to 100 ft

24561

CAROLIN MINES LTD.			
Golder Associates			
CAROLIN MINES TAILINGS DAM COMPLETION OF FIRST PHASE STAGE II DAM			
Drawn	R.D.	Checked	Reviewed
2019	OCT. '95	PROJECT 9524-5482	Figure 3

Revised Oct. 1995



NOTES

- 1) Unit locations shown on Figure 3.
- 2) Unit 3560 ceased to function on Aug 20/81.
- 3) Units 4600, 4601 & 4602 located in toe berm do not register significant pressure.
- 4) Units 5785, 5786 & 5787 located beneath rock drain at elev 3173 ft do not register significant pressure.
- 5) Units 5788, 5789 & 5790 located in fill core at elev 3195 ft do not register significant pressure.
- 6) Units 5825, 5827 and 5828 inoperative 1995.

24561