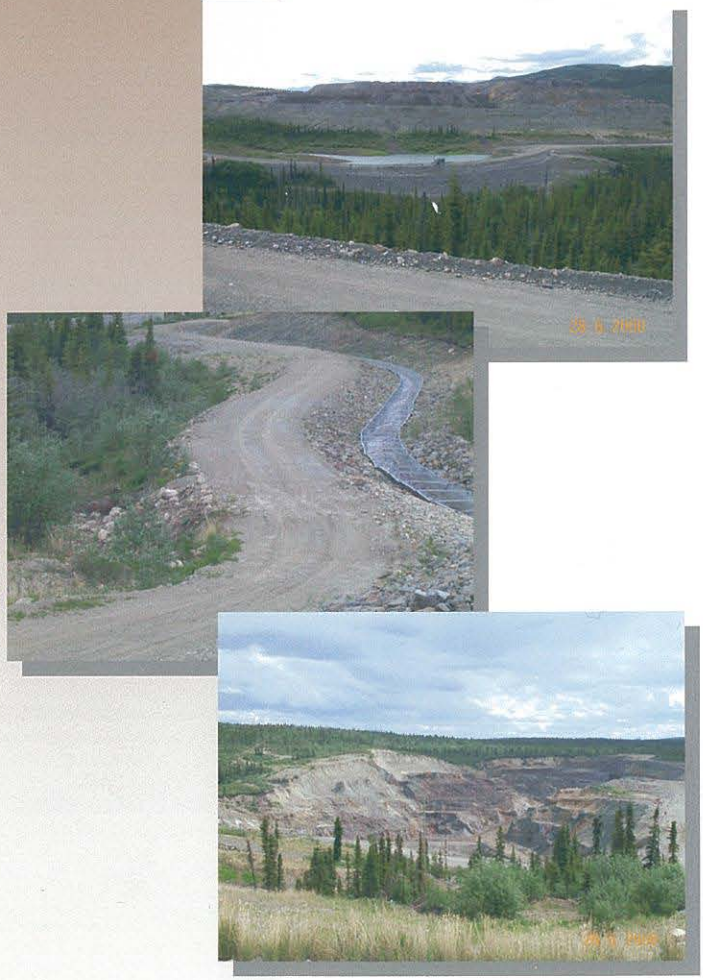
Deloitte & Touche

2000 Annual Inspection
Waste and Water Management Facilities Vangorda Mine
Yukon Territory



Prepared for:

DELOITTE & TOUCHE
Suite 1100, 1 City Centre Drive
Mississauga, Ontario
L5B 1M2

Prepared by:

SRK Consulting
Engineers and Scientists

Steffen Robertson and Kirsten (Canada) Inc.
580 Hornby Street, Suite 800
Vancouver, BC CANADA V6C 3B6
(604) 601-8425 Voice
(604) 687-5532 Fax

Web Address: http://www.srk.com
e-mail: vancouver@srk.com

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2000 ANNUAL INSPECTION
WASTE AND WATER MANAGEMENT FACILITIES
VANGORDA MINE
YUKON TERRITORIES

Prepared for:

DELOITTE & TOUCHE
Suite 1100, 1 City Centre Drive
Mississauga, Ontario
L5B 1M2

Prepared by:

STEFFEN ROBERTSON AND KIRSTEN (CANADA) INC.
Suite 800, 580 Hornby Street
Vancouver, B.C.
Tel: (604) 681-4196 ● Fax: (604) 687-5532
E-mail: vancouver@srk.com Web site: www.srk.com

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VANGORDA MINE
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1. Introduction

At the request of Deloitte and Touche (DT) Mr. Peter Healey of Steffen Robertson and Kirsten (Canada) Inc. (SRK) completed an inspection of the waste and water management facilities at Vangorda Plateau Mine on June 28 and 29, 2000. The Vangorda mine is located 16 km south of the Faro Mine, Yukon Territory as shown on Figure 1. The purpose of this inspection was to evaluate the geotechnical performance and stability of the following structures:

- Vangorda Waste Rock Containment Facility (Photo 1) including the seepage collection system ;
- Little Creek Dam;
- Vangorda Creek Diversion;
- Sludge Pond Embankments at the Water Treatment Plant,
- Grum Waste Rock Piles;
- The Grum Interceptor Ditch; and
- The Sheep Pad Sediment Ponds below the Overburden Stockpile.

A plan of the Vangorda Plateau area and the above components are shown in Figure 2.

This report presents our observations and comments on the performance and stability of the structures and provides recommendations, where appropriate.

2. Vangorda Waste Rock Pile

2.1 Observations

2.1.1 Seepage Collection System

2.2.1.1 Channel Berm

At the outlet of the seepage channel and at the south abutment of the Little Creek Dam, a small depression still exists which provides the opportunity for ponding of water. The remaining sections of the dyke show no signs of settlement, cracking or sloughing.

2.2.1.2 Transverse Drains and Weirs

During construction of the original till berm, six transverse drains were installed beneath the berm to allow seepage to drain from the waste dump. These drains were connected to the seepage collection channel during the 1994 upgrading.

During the inspection, minor seepage was observed at Drains 2, 3 (Photo 2), 5 (Photo 3) and 6 (Photo 4) only. The silt that was observed in behind the weir at drain 6 had been removed but during construction of a diversion ditch along the crest of the till Starter dyke, material had been pushed over the bank causing unstable conditions as shown in Photo 4.

The weir at Drain 5 is functioning adequately, however there is a large boulder located in behind the weir, which should be removed.

2.2.1.3 Starter Dyke Diversion Ditch

In an attempt of control runoff and instability of the area above the weir at Drain 6, a ditch was excavated within the crest of the till starter dyke along the north side of the Vangorda Waste dump in September 1999. The depth of the excavation varied from about 1 to 4 m. The sideslopes of the ditch were vertical in most places and had sloughed in at several locations causing water to pool in the ditch. The excavated material had been placed on the downstream slope of the starter dyke resulting in an oversteepening of the upper section of the slope (See photos 5 to 9). Figure 3 shows a

plan view of the excavated ditch developed from a survey completed last year by Yukon Engineering Services.

2.2.1.4 Seepage Channel

No instability of the sideslopes of the seepage channel was observed. Seepage from the transverse drains at Weir 3 and Weir 2 is entering the channel but there was no noticeable flow in the channel.

2.2.2 Starter Dyke and Till Cover

The sideslopes of the till starter dyke remain susceptible to erosion. There is one area that lies just below the 1994 resloping and till cover placement that is particularly eroded. Runoff concentrates in-between the till cover and the resloped rock causing erosion gullies and silt spill into the seepage channel at the toe of the dyke.

Adjacent to Weir 3, till was removed from the toe of the starter dyke in 1992 by the mine to construct an adjacent sump. This remains a potential risk to the stability of the dyke with the possible loss of the piezometers above (P94-01A and 01B). Erosion gullies that have formed below P94-3A and 3B pose a threat to these piezometers also.

2.2.4 Instrumentation

DT has been taking water level readings from the nine piezometers and four of the five groundwater wells around and within the facility. A summary of the water level readings taken to date in both the piezometers and the groundwater wells is presented in Table 1. Water levels, as recorded on May 31, 2000 in Piezometers P94-01A, 01B, 02A and 02B, are shown in Figures 4 and 5. A plot of the historical readings for these piezometers is shown on Figure 6. The water levels in the piezometers continue to remain generally static with minor fluctuations. Figure 7 presents a plot of the levels in the groundwater wells around the dump.

2.2.5 Rock Pile

Tension cracks are still evident in places along the crest at the northeast end of the dump. The cracks have not widened since SRK last inspected the rock pile in 1999.

TABLE 1 Water Levels in Piezometers and Groundwater Wells - Vangorda Rock Pile

Measured Static Water Level (meters)

underlined readings (begin in 1998) indicate that no water was identified (hole was dry or frozen).
readings post Sep/98 given as metres below top of plastic piezometer pipe.
readings prior to Nov/98 could be metres below to top of piezo. pipe or steel casing.

Date	V34 GW-94-01	V35 GW-94-02	V36 GW-94-03	V37 GW-94-04	V38 GW-94-05*	V39 P-94-01A	V40 P-94-01B	V41 P-94-02A	V42 P-94-02B	V43 P-94-02C	V44 P-94-03A	V45 P-94-03B	V46 P-94-04A	V47 P-94-04B
3-May-94	8.28	14.33	11.28	14.33	11.56	12.37	6.05	10.57	6.12	13.08	14.10	9.80	12.17	8.99
21-Jun-94	7.45	8.65	9.15	9.65										
30-Jun-95						7.79	5.62	8.02	6.11	9.02	13.91	9.80	11.35	8.99
13-Jul-95						7.80	5.59							
30-Jul-95						7.86	5.48	7.99	6.12	8.81	13.68	9.80	11.83	8.99
26-Aug-95	6.89	8.47		9.05										
31-Aug-95	7.36					7.93	4.85	7.97	6.06	8.66	13.62		12.60	
17-Oct-95	7.14	8.26		9.37		7.90	4.23	8.70	5.76	8.54	13.41		11.88	
20-Nov-95	7.10	8.18		9.19										
13-Mar-96	7.44	9.23		9.39										
28-May-96	7.50	9.34	10.00	10.25		8.34	5.38	9.94	6.12	9.37	14.12		12.77	
24-Sep-96	7.50	7.43	7.95	9.17		10.40	5.30	8.30	6.12	8.66	13.68	9.88	12.80	8.99
13-May-97	6.84	9.42	9.96	9.53		9.17	5.67	7.74	6.40	9.51	12.78	9.96	12.78	9.62
11-Jul-97						9.80	5.90	7.92	6.12	8.97	14.10	9.80	9.97	9.00
11-Aug-97	6.75	8.38	8.41	8.81	1.99	9.59	5.25	8.10	6.25	8.77	12.84	9.96	12.62	9.21
14-Oct-97	6.76	8.58	9.15	8.99		9.51	4.96	7.99	6.23	8.94	12.96	9.96	12.73	9.21
23-Dec-97	6.70	9.05	9.53	9.13		9.25	4.76	7.68	6.07	8.95	12.70	9.81	12.66	9.02
31-May-98	6.72	8.60	9.73	9.59	1.86	9.52	5.25	8.05	6.24	9.20	12.87	9.95	12.77	9.20
25-Jul-98						10.20	5.22	8.04	6.20	9.11	12.58	9.92	12.79	9.18
15-Sep-98	6.67	8.85	9.52	9.10	2.40	10.02	5.22	7.98	6.20	9.22	12.54	9.92	12.83	9.19
16-Nov-98						10.32	5.11	7.93	6.11	9.06	12.45	9.78	12.70	8.99
31-Dec-98	6.70	9.06	9.91	9.23										
18-Jun-99	6.88	9.24	10.24	10.18		9.96	5.09	8.35	6.11	9.48	12.48	9.77	12.70	8.99
12-Oct-99	6.61	7.58	8.81	8.79		10.01	5.10	8.16	5.73	8.82	12.49	9.78	12.71	8.97
31-May-00	5.75	8.68	8.26	9.33	1.84	10.20	5.10	7.85	5.93	8.97	12.48	9.78	12.66	8.88
5-Sep-00	6.66													
9-Oct-00	4.98	3.96	6.90	8.35	0.93									

*: depth to bottom of hole GW-94-05 (V38) checked as 14.7m on Sep 15/98.

Top of Pipe Elevations (masl)

V34 GW-94-01	V35 GW-94-02	V36 GW-94-03	V37 GW-94-04	V38 GW-94-05	V39 P-94-01A	V40 P-94-01B	V41 P-94-02A	V42 P-94-02B	V43 P-94-02C	V44 P-94-03A	V45 P-94-03B	V46 P-94-04A	V47 P-94-04B
1117.445	1117.405	1118.431	1116.165	1101.673	1136.555	1136.493	1138.41	1138.332	1129.84	1134.373	1134.459	1134.609	1134.327

Piezometric Elevation (masl)

Date	V34 GW-94-01	V35 GW-94-02	V36 GW-94-03	V37 GW-94-04	V38 GW-94-05	V39 P-94-01A	V40 P-94-01B	V41 P-94-02A	V42 P-94-02B	V43 P-94-02C	V44 P-94-03A	V45 P-94-03B	V46 P-94-04A	V47 P-94-04B
3-May-94	1109.165	1103.075	1107.151	1101.835	1090.113	1124.185	1130.443	1127.84	1132.212	1116.76	1120.273	1124.659	1122.439	1125.337
21-Jun-94	1109.995	1108.755	1109.281	1106.515										
30-Jun-95						1128.765	1130.873	1130.39	1132.222	1120.82	1120.463	1124.659	1123.259	1125.337
13-Jul-95						1128.755	1130.903							
30-Jul-95						1128.695	1131.013	1130.42	1132.212	1121.03	1120.693	1124.659	1122.779	1125.337
26-Aug-95	1110.555	1108.935		1107.115										
31-Aug-95	1110.085					1128.625	1131.643	1130.44	1132.272	1121.18	1120.753		1122.009	
17-Oct-95	1110.305	1109.145		1106.795		1128.655	1132.263	1129.71	1132.572	1121.3	1120.963		1122.729	
20-Nov-95	1110.345	1109.225		1106.975										
13-Mar-96	1110.005	1108.175		1106.775										
28-May-96	1109.945	1108.065	1108.431	1105.915		1128.215	1131.113	1128.47	1132.212	1120.47	1120.253		1121.839	
24-Sep-96	1109.945	1109.975	1110.481	1106.995		1126.155	1131.193	1130.11	1132.212	1121.18	1120.693	1124.579	1121.809	1125.337
13-May-97	1110.605	1107.99	1108.476	1106.635		1127.385	1130.823	1130.67	1131.932	1120.33	1121.593	1124.499	1121.829	1124.707
11-Jul-97						1126.755	1130.593	1130.49	1132.212	1120.87	1120.273	1124.659	1124.639	1125.327
11-Aug-97	1110.695	1109.025	1110.021	1107.355	1099.683	1126.965	1131.243	1130.31	1132.082	1121.07	1121.533	1124.499	1121.989	1125.117
14-Oct-97	1110.685	1108.825	1109.281	1107.175		1127.045	1131.533	1130.42	1132.102	1120.9	1121.413	1124.499	1121.879	1125.117
23-Dec-97	1110.745	1108.355	1108.901	1107.035		1127.305	1131.733	1130.73	1132.262	1120.89	1121.673	1124.649	1121.949	1125.307
31-May-98	1110.725	1108.805	1108.701	1106.575	1099.813	1127.035		1130.36		1120.64		1124.509	1121.839	1125.127
25-Jul-98						1126.355		1130.37		1120.73			1121.819	
15-Sep-98	1110.775	1108.555	1108.911	1107.065	1099.273	1126.535		1130.43		1120.62			1121.779	
16-Nov-98						1126.235		1130.48		1120.78				
31-Dec-98	1110.745	1108.345	1108.521	1106.935										
18-Jun-99	1110.565	1108.165	1108.191	1105.985		1126.595		1130.06		1120.36				
12-Oct-99	1110.835	1109.825	1109.621	1107.375		1126.545		1130.25		1121.02				
31-May-00	1111.695	1108.725	1110.171	1106.835	1099.833	1126.355		1130.56	1132.402	1120.87			1121.949	1125.447
5-Sep-00	1110.785													
9-Oct-00	1112.465	1113.445	1111.531	1107.815	1100.743									

2.3 Recommendations

2.3.1 Seepage Collection Channel

SRK recommends that DT backfill the depression at the south abutment of Little Creek Dam with locally available till and compact with several passes of a dozer. Monthly monitoring of the area should be conducted for any signs of further settlement.

2.3.2 Transverse Drains and Weirs, Starter Dyke Diversion Ditch

The excavated ditch along the crest of the starter dyke that was completed in 1999 has done little to minimise the instability of the bank above the Weir 6 and the siltation potential. Furthermore the bank above the weir is now steeper than before the ditch was excavated and is less stable.

SRK was asked to inspect the ditch during the site visit. SRK prepared an action plan for the ditch, which was presented to DT in a memo dated July 4, 2000. The recommendations included the following:

1. Runoff should not be allowed to pond in the ditch behind the sloughed material and any accumulation should be monitored;
2. Survey a profile along the bottom of the ditch including a number of cross sections;
3. Prepare a longitudinal profile and cross sections from the survey data;
4. Determine an optimum grade for the centreline of the ditch and develop a final profile and sections
5. Backfill the existing ditch to the revised grade, providing a ditch with sideslopes of at least 1.75 to 1 (H:V). Backfill should be taken from the over-steepened section of the starter dyke and compacted in lifts no less than 300mm.
6. Compaction should consist of 3 to 4 passes of a vibratory smooth drum roller.

An alternative to partially backfilling the ditch involved completely backfilling the ditch and resloping the entire starter dyke and waste rock material. It was suggested to DT that during the survey program above, the crew pick enough survey points so that

cross sections could be developed that extend into the waste rock above. The survey was completed in November, 2000. SRK is currently reviewing this data and preparing preliminary drawings for the different options.

2.3.3 Till Covers and Berms

In the upper reaches of the seepage collection channel below the till cover, DT should remove any silt that has accumulated in the channel. When the next phase of till cover is placed, this area would be recontoured and the sediment problem would be reduced. In the meantime, DT should continue to monitor the silt build-up and periodically remove the material.

DT should also place backfill up against the toe of the starter dyke adjacent to Weir 3, where material has been removed.

2.3.3 Instrumentation

Water level readings should continue to be taken from both the groundwater wells and the standpipe piezometers in the till berm around the rock pile. These readings should be taken at least semi-annually with close attention given to the water levels in P94-01A and B, and P94-02A, 02B and 02C.

Water quality samples should continue to be taken from the groundwater wells around the Vangorda Waste dump.

2.3.4 Rock pile

DT should continue to regularly monitor the cracks observed on the surface of the rock fill. Any widening of these cracks should be reported.

3. Little Creek Dam

3.1 Observations

A view of the Little Creek dam and the new emergency spillway are shown on Photo 1. Photo 10 shows a view of Little Creek Pond. Runoff from the eastern approach road continues to cause erosion and subsidence of the road embankment sideslopes as shown in Photo 11. DT constructed a drainage ditch along the inside edge of the approach road (Photo 12), which has directed much of the runoff over to the opposite bank. However, this flow passes over a loosely end dumped pile of till material before it eventually finds its way into Vangorda Creek. Consequently, the stockpile is badly eroded.

There is a significant erosion gully (Photo 13) on the upstream face of the dam, which has developed as a result of the runoff. The gully is located about 30m east of the pumphouse.

Water level in the pond during our inspection was recorded at about 1109.5m. DT periodically pumps water from the pond to Vangorda Pit. However, at the time of our inspection no water was being pumped from the pond. No cracks or major settlement of the dam were observed and there was no noticeable seepage along the toe.

The downstream face of the dam (Photo 14) shows little evidence of surficial movement, bulging or instability. The loose, uncompacted material at the toe of the dam, which was deposited during it's construction in 1991, has not moved but does shows signs of erosion.

The new spillway culvert in Little Creek dam (photos 15 and 16 and Figure 8) was also inspected during the site visit. The additional riprap that was added in September of 1999 provided the needed erosion control at the entrance to the pipe.

The riprap in the plunge pool and the upper reaches of the exit chute meets design criteria. However, more riprap is required in the lower reaches of the exit chute to provide adequate erosion protection for the 200-year flood event (Photo 17).

In 1994, six pneumatic piezometers and three thermistors were installed along the crest of the Little Creek dam. The six piezometers are located at three separate locations; two piezometers, one deep and one shallow, at each location. The location of the piezometers and thermistors are shown on Figure 9 and the most recent 2000 piezometric levels are shown in section on Figures 10 to 12. Actual readings are presented in Appendix B.

During the inspection, no seepage was observed at along the toe of the downstream dam.

3.2 Recommendations

DT should continue to regularly monitor the crest of the dam for any cracks, settlement or surficial movement of the slope.

The piezometric levels are consistent with the water levels recorded in the impoundment and are in accordance with the design safety factors associated with the stability of the dam. The thermistor readings are also consistent.

SRK recommends that the pneumatic piezometers and thermistors are monitored on a semi-annual basis and the results compiled and forwarded to SRK.

It is recommended that DT construct either a riprapped or CMP lined channel down the face of the end dumped material to minimize the erosion and the potential for sediment entering Vangorda Creek. Furthermore, the road surface should be regraded to encourage drainage off the crest and a 150mm layer of 20mm minus sand and gravel should be placed and compacted on the crest.

4. Vangorda Creek Diversion

4.1 Observations

The half-round culvert in the upper reaches (Photo 18) has performed well but the flume does not weather well along the lower reaches. The potential still remains for slide debris to enter the flume at certain locations along the channel. The crossbars are badly bent and the flume is buckled in places (Photo 19). In several areas along the flume, riprap has settled to below the lip of the culvert.

Riprap around the entrance to the culvert at the headwork's of the Vangorda diversion has dropped away exposing the underlying geotextile (Photo 20). This situation is not new and has been noted on previous inspections. Furthermore, riprap has begun to collect in the channel and around the trash rack at the inlet to the CMP narrowing the entrance. The pipe itself appears to be sound.

There are no signs of instability or settlement of the headwork's dam.

The plunge pool (Photo 21 and 22) at the outlet of the flume has lost some of the original riprap that had been placed on the sideslopes of the basin. Furthermore, where an area of the pool was excavated to allow water trucks to be filled, the water is slowly undermining the bank. SRK is currently reviewing the hydrology of the plunge pool system to determine whether there is adequate capacity to accommodate peak flows with the addition of flow from Sheep Pad Settling pond.

4.2 Recommendations

DT should place additional riprap over exposed geotextile at the headworks and continue to monitor the sideslopes above the flume for sloughing.

The riprap along flume where the material has settled below the rim of the culvert sections should be topped up and additional riprap should be placed in the excavated pool at the southeast corner of the plunge pool. Additional riprap should also be placed on the sideslopes around the perimeter of the pool. Where fresh soil is exposed non-woven geotextile filter fabric should be placed prior to laying down the rock.

5. Sludge Pond Embankment-Vangorda Water Treatment Plant

5.1 Observations

At the time of our inspection, the water level in the sludge pond was about 1m below the intake pipe at the south end of the pond (Photo 23). The tension cracks along the inside face of the pond and along the crest of the dyke have not changed since the last inspection (Photos 24). Although there is still evidence of previous settlement and minor sloughing of the downstream slope in the southwest corner of the pond, there are no signs of recent movement. Vegetation on the downstream slope is providing some stability to the face (Photo 25).

During the inspection no water treatment was in progress.

5.2 Recommendations

The following actions should be taken at the Water Treatment Plant:

- Ensure that the pond level does not exceed 2m. below crest;
- Continue to monitor on a monthly basis, the crest and sideslopes for cracking or any signs of sloughing. With the pond level at an all time low, the risk of any instability is quite small.
- Fill in or blade over tension cracks both in the crest and along the upstream face to prevent entry from runoff and precipitation.
- Weekly inspection of the upstream face and the crest for further development of the cracks is recommended.

6. Grum Settling Pond

6.1 Observations

At the time of our inspection the water level in the pond was about 3m below the crest of the dyke (Photo 26) and the downstream sideslopes showed no signs of any recent movement. No significant cracks were observed in the crest.

There was no seepage noted along the toe of the dyke.

6.2 Recommendations

The crest of the embankment should be monitored monthly for cracks and the pond level should not exceed 1.0 m below crest. Seepage into and out of the pond should also be monitored.

Monthly inspections along the toe of the embankment for seepage is recommended.

The need for the pond should be reviewed.

7. Grum Interceptor Ditch and Sheep Pad Settling Pond

7.1 Observations

In the upper reaches of the GID, the slopes have performed well and the vegetation is providing effective erosion control of the sideslopes (Photo 27). Inlets and outlets of some of the culverts are silted up and require cleaning. Below the treatment plant, however, there are sections of the ditch where the grade steepens and the sideslopes have subsided narrowing the channel (photo 28). This subsidence results in an increase in the sediment load reporting to the Sheep Pad ponds (Photo 29). It was noted that water collecting in the ponds was being siphoned into the Vangorda Pit because of the high level of suspended solids.

7.2 Recommendations

The following actions are recommended:

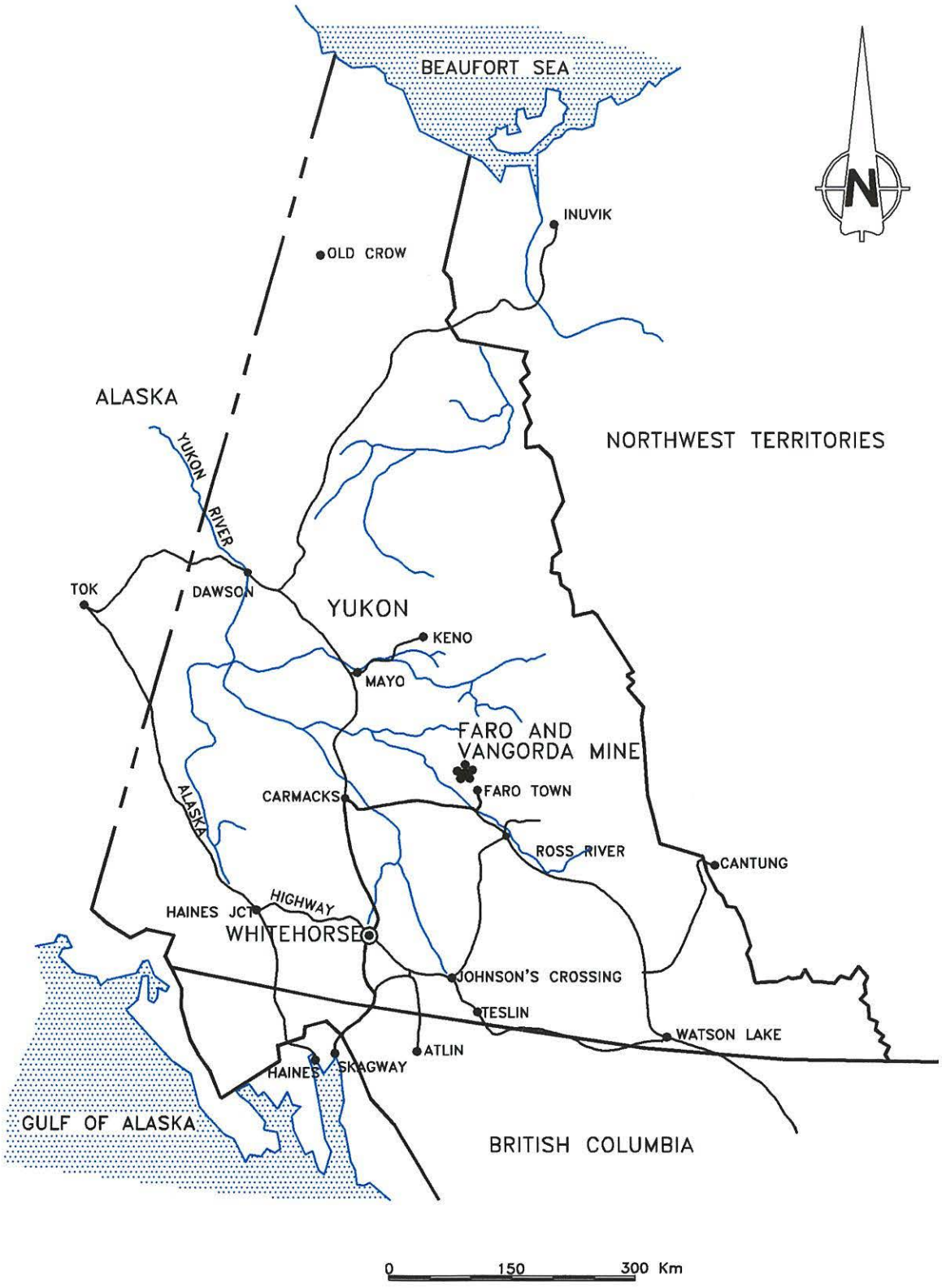
- Place additional riprap (shotrock) around inlets and outlets of all culverts where applicable to prevent erosion and sediment build-up. Geotextile should be placed against the exposed soil prior to placing the riprap;
- Monitor monthly tension cracks in the settling pond dykes, on the crest and on the upstream and downstream slopes;
- Monitor monthly the toe of the dykes for any seeps;
- Continue to provide riprap protection on the lower reaches of the GID to minimize erosion and sedimentations.

This Report, **1CD003.03 - 2000 Annual Inspection Waste and Water Management Facilities Vangorda Mine, Yukon Territories** has been prepared by:

STEFFEN ROBERTSON AND KIRSTEN (CANADA) INC.

Peter Healey, P.Eng.
Associate Principal

Figures



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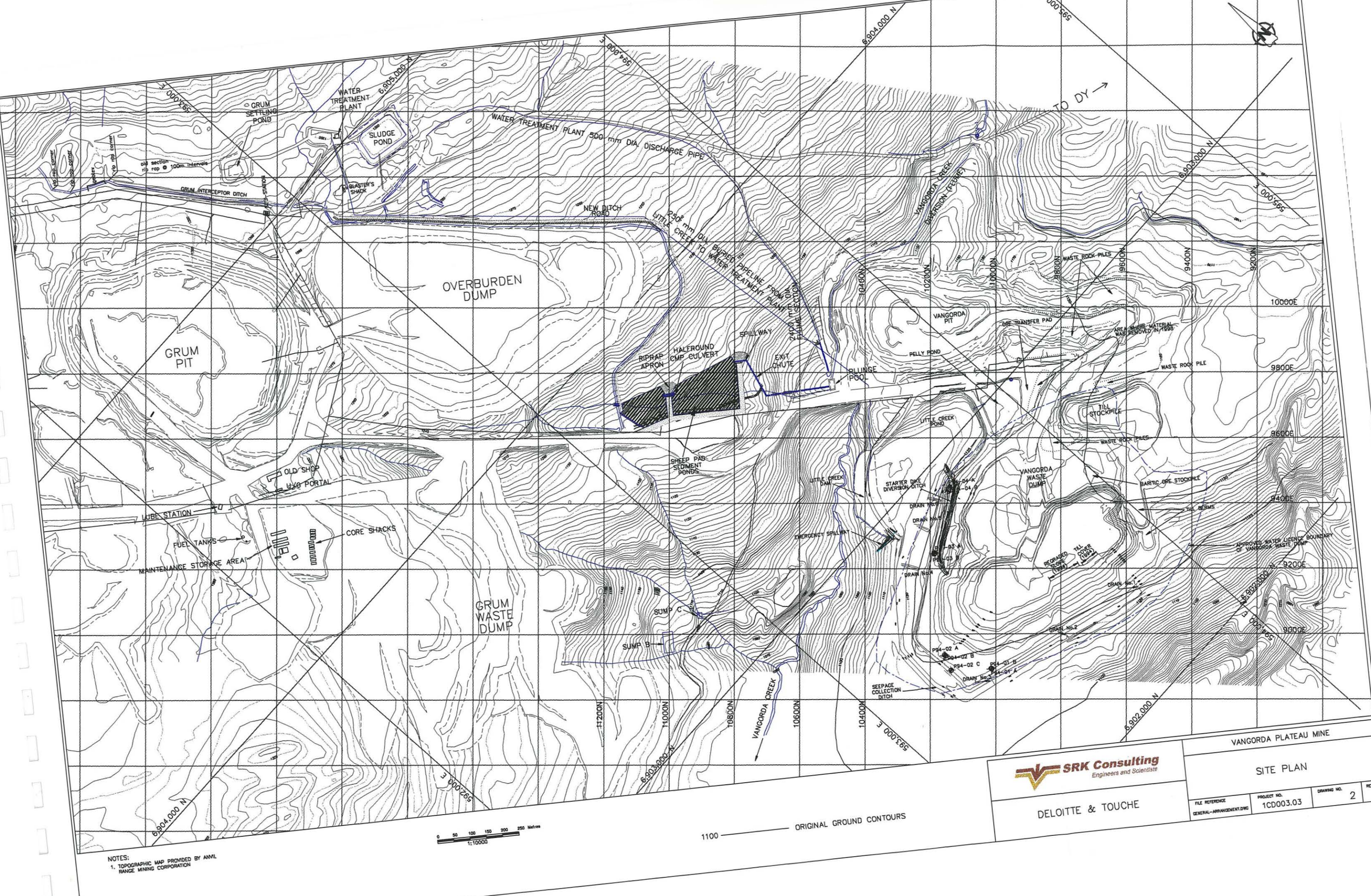
VANGORDA PLATEAU MINE

LOCATION MAP

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		1

FILE REF: YUKON



NOTES:
1. TOPOGRAPHIC MAP PROVIDED BY ANVIL RANGE MINING CORPORATION

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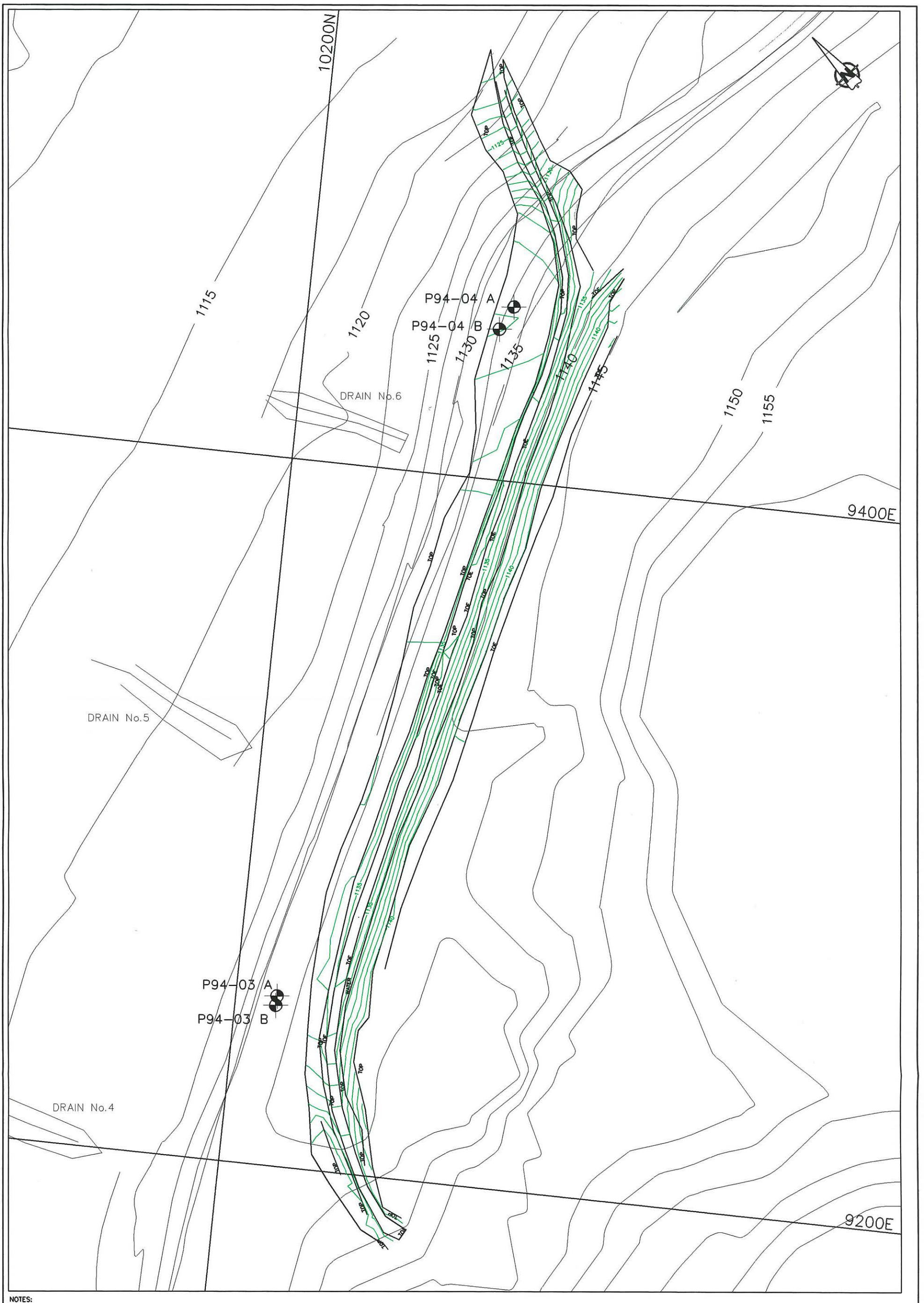
VANGORDA PLATEAU MINE

SITE PLAN

FILE REFERENCE	PROJECT NO.	DRAWING NO.	REV.
GENERAL-ARRANGEMENT.DWG	1CD003.03	2	



NOTES:

1. TOPOGRAPHIC MAP PROVIDED BY ANVIL RANGE MINING CORPORATION
2. NEW TOPO SURVEY (IN GREEN) BY YES

P94-03 A PIEZOMETER

0 5 10 15 20 25 Metres
1:1000

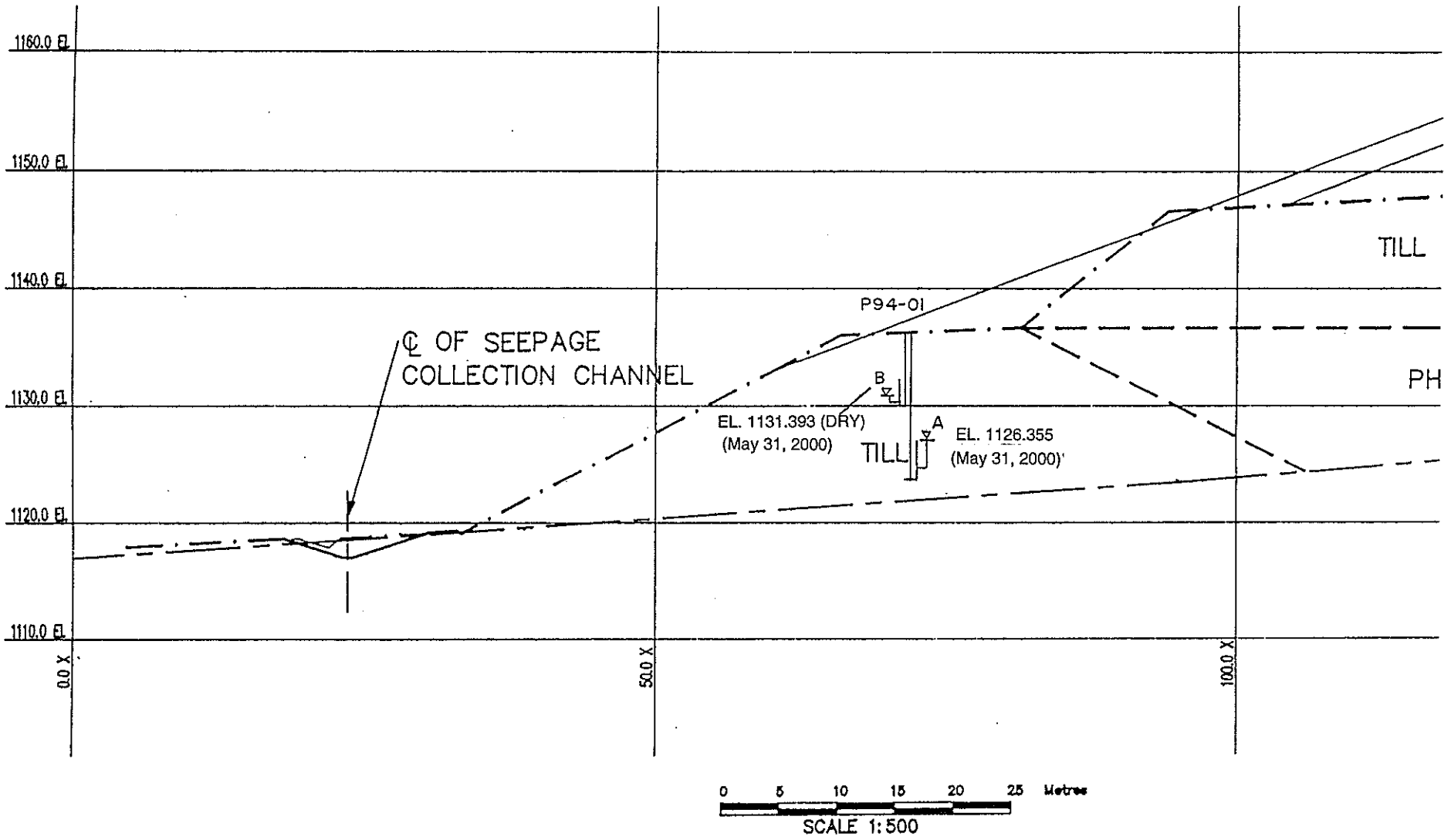
SRK Consulting
Engineers and Scientists

DELOITTE & TOUCHE

VANGORDA PLATEAU MINE

STARTER DYKE DIVERSION DITCH PLAN

FILE REFERENCE	PROJECT NO.	DRAWING NO.	REV.
DIVERSION.DWG	1CD003.03	3	



SRK Consulting
Engineers and Scientists

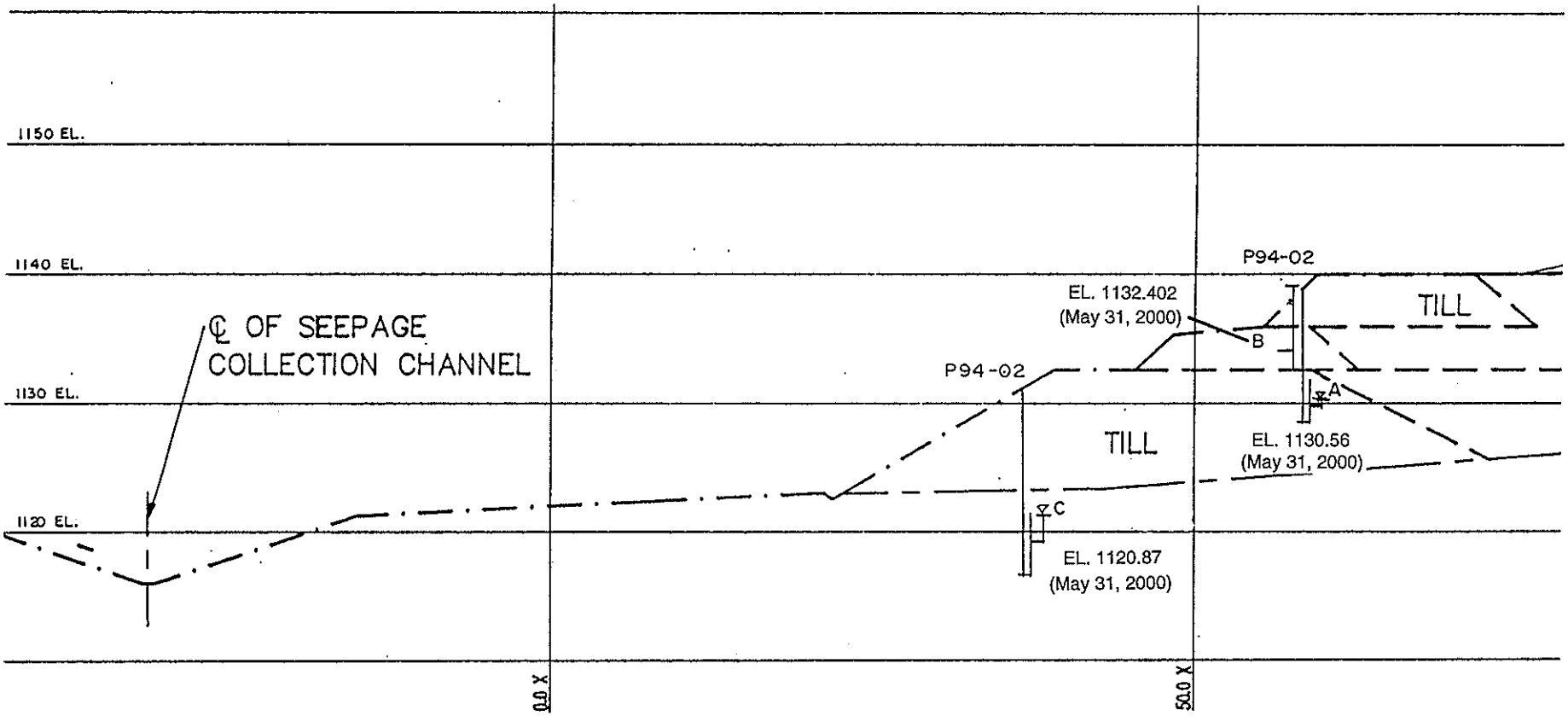
DELOITTE & TOUCHE

VANGORDA PLATEAU MINE

SECTION D–3
CHANNEL STA. 4+80

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		4

FILE REF:



0 5 10 15 20 25 Metres

SCALE 1:500

SRK Consulting
Engineers and Scientists

DELOITTE & TOUCHE

VANGORDA PLATEAU MINE

SECTION D-4
CHANNEL STA. 9+00

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		5

FILE REF:

FIGURE 6: PIEZOMETER LEVELS - VANGORDA WASTE DUMP

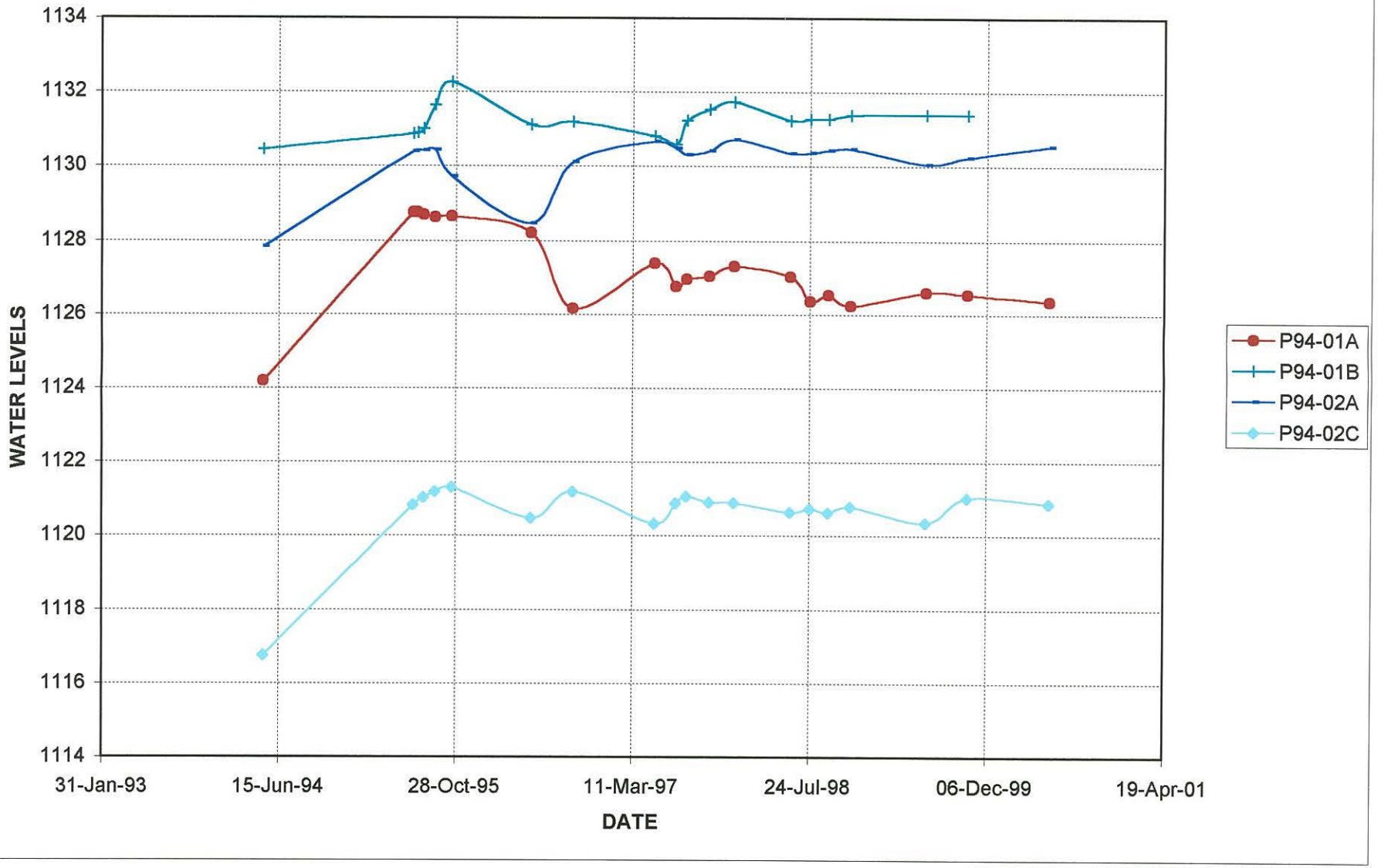
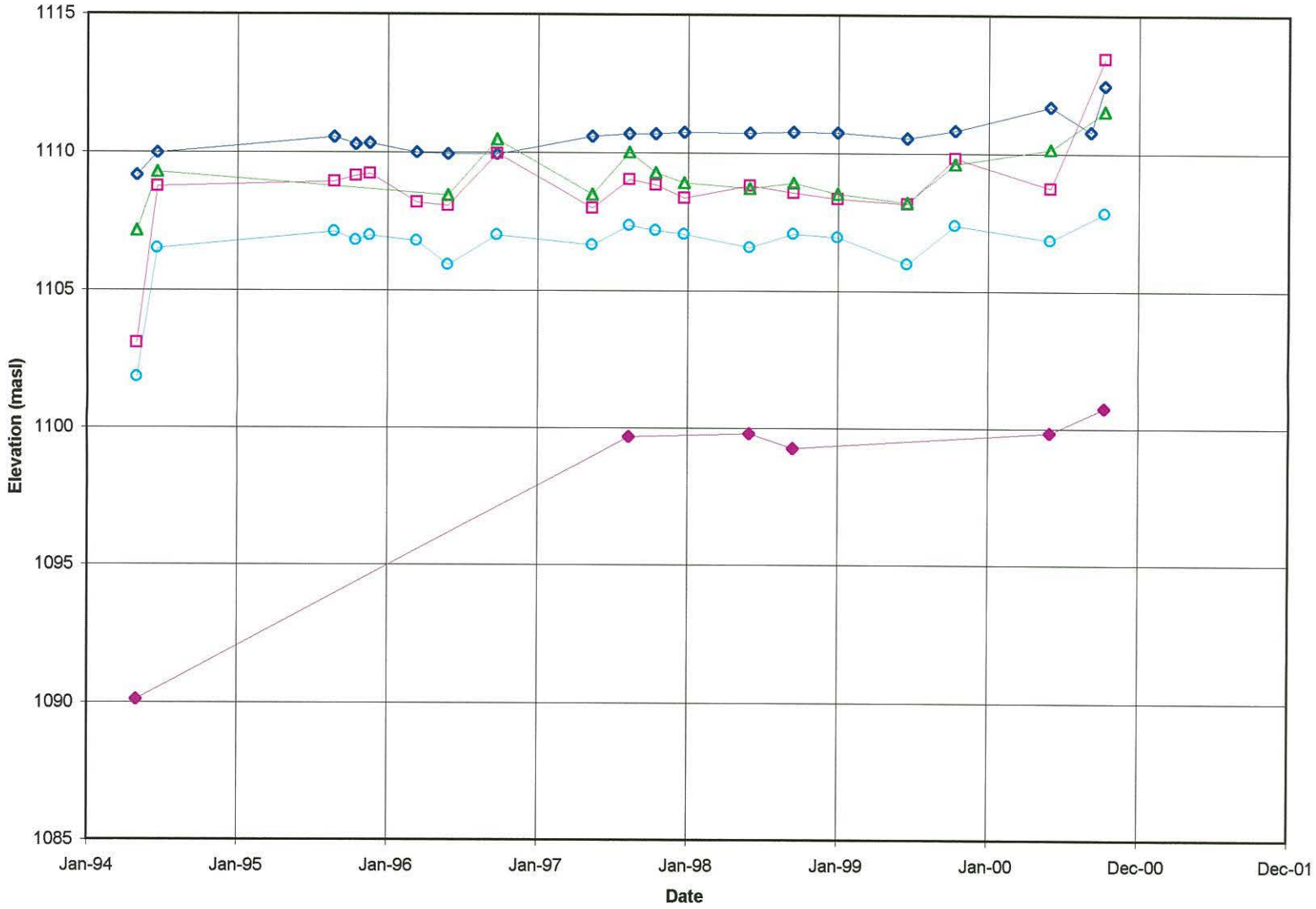
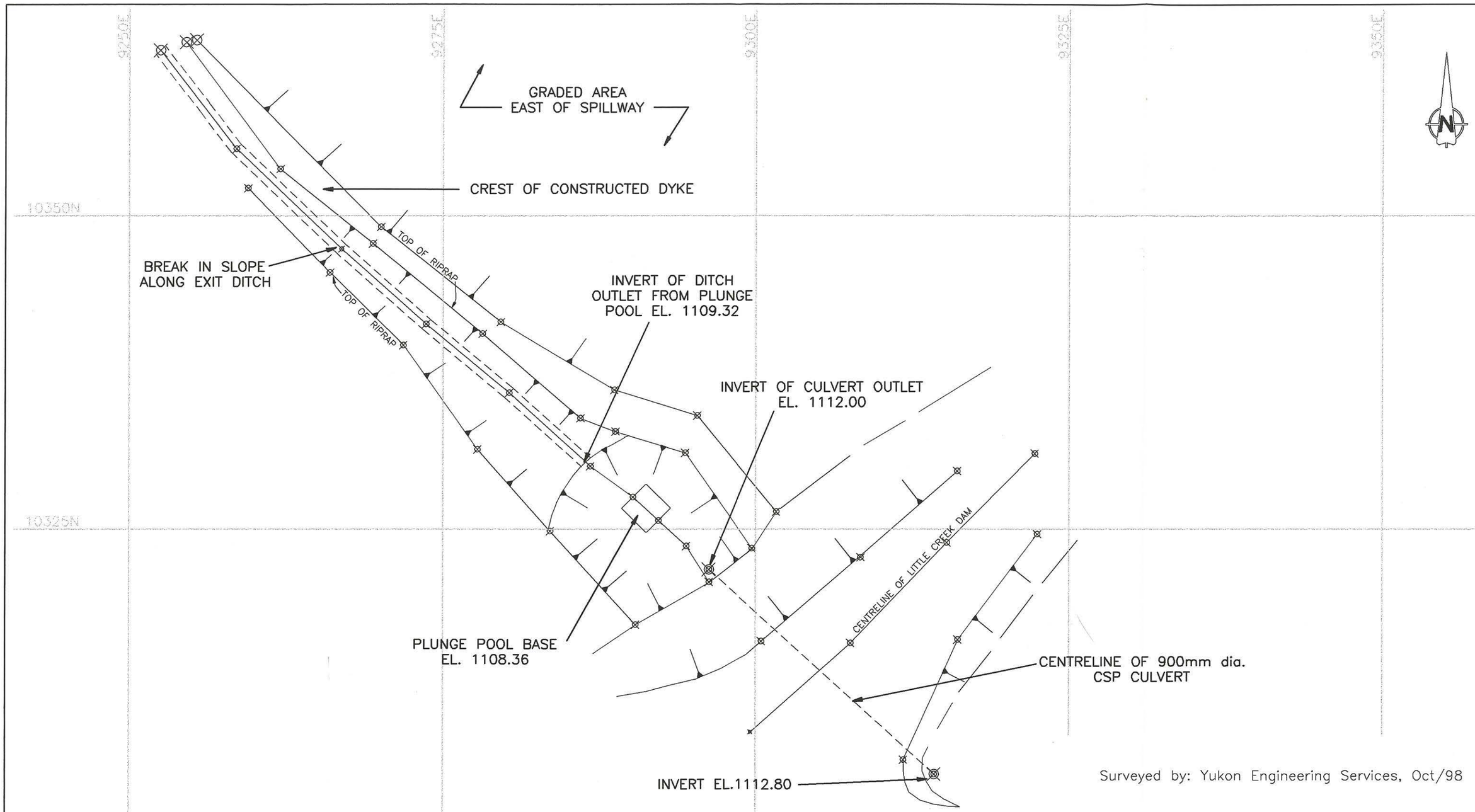


Figure 7: Vangorda Dump Toe Groundwater Elevations



graph Chart 2



Surveyed by: Yukon Engineering Services, Oct/98

0 3 6 9 12 15 metres

1:300

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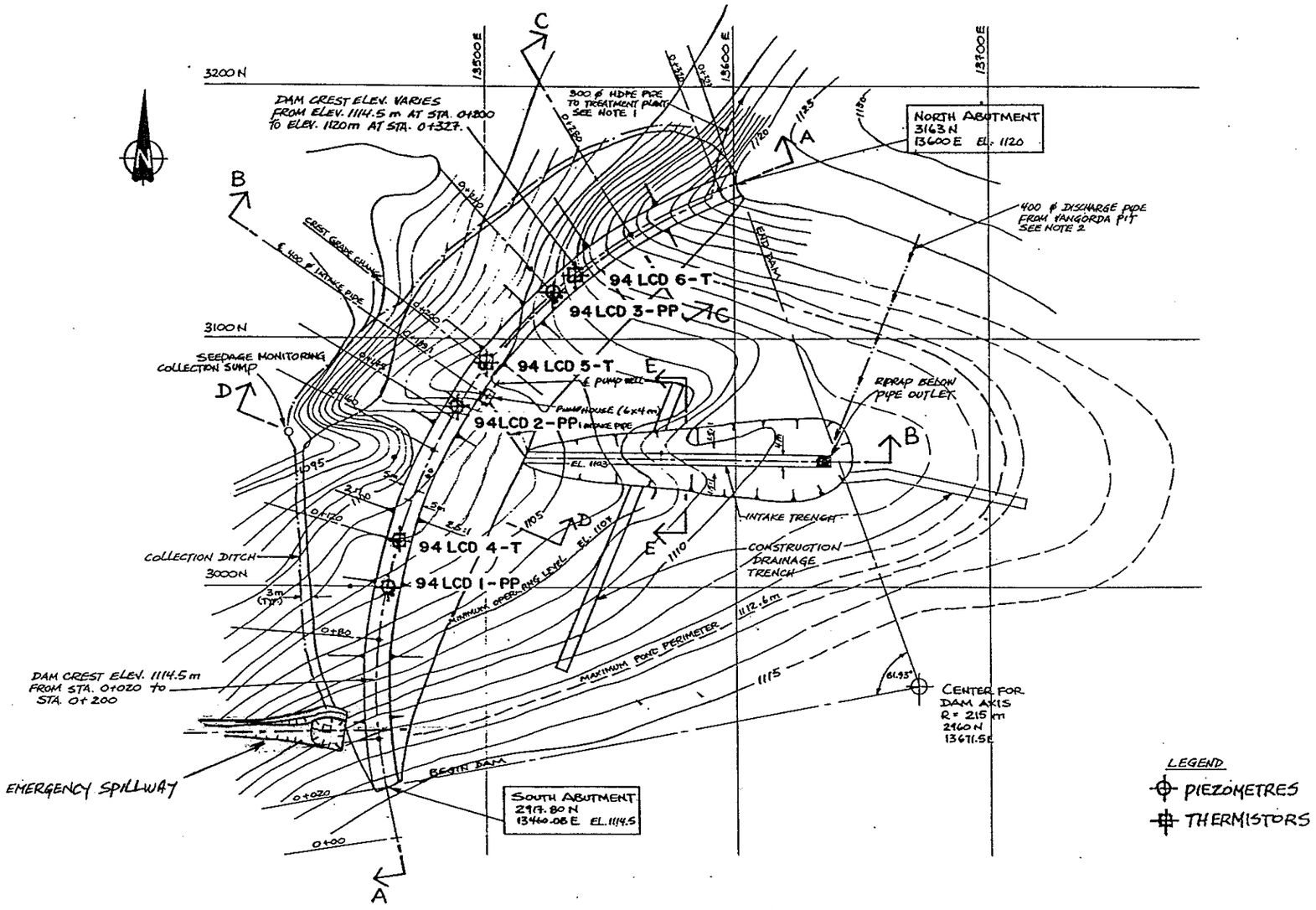
VANGORDA PLATEAU MINE

LITTLE CREEK DAM
EMERGENCY SPILLWAY

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		8

FILE REF: lcd-r12.dwg



LEGEND
- PIEZOMETRES
- THERMISTORS

GENERAL ARRANGEMENT PLAN
SCALE - 1:2000
CONTOUR INTERVAL = 1 metre
GRID SHOWN IS MINE GRID
0 10 20 30 40 50 metres

FILE REF:

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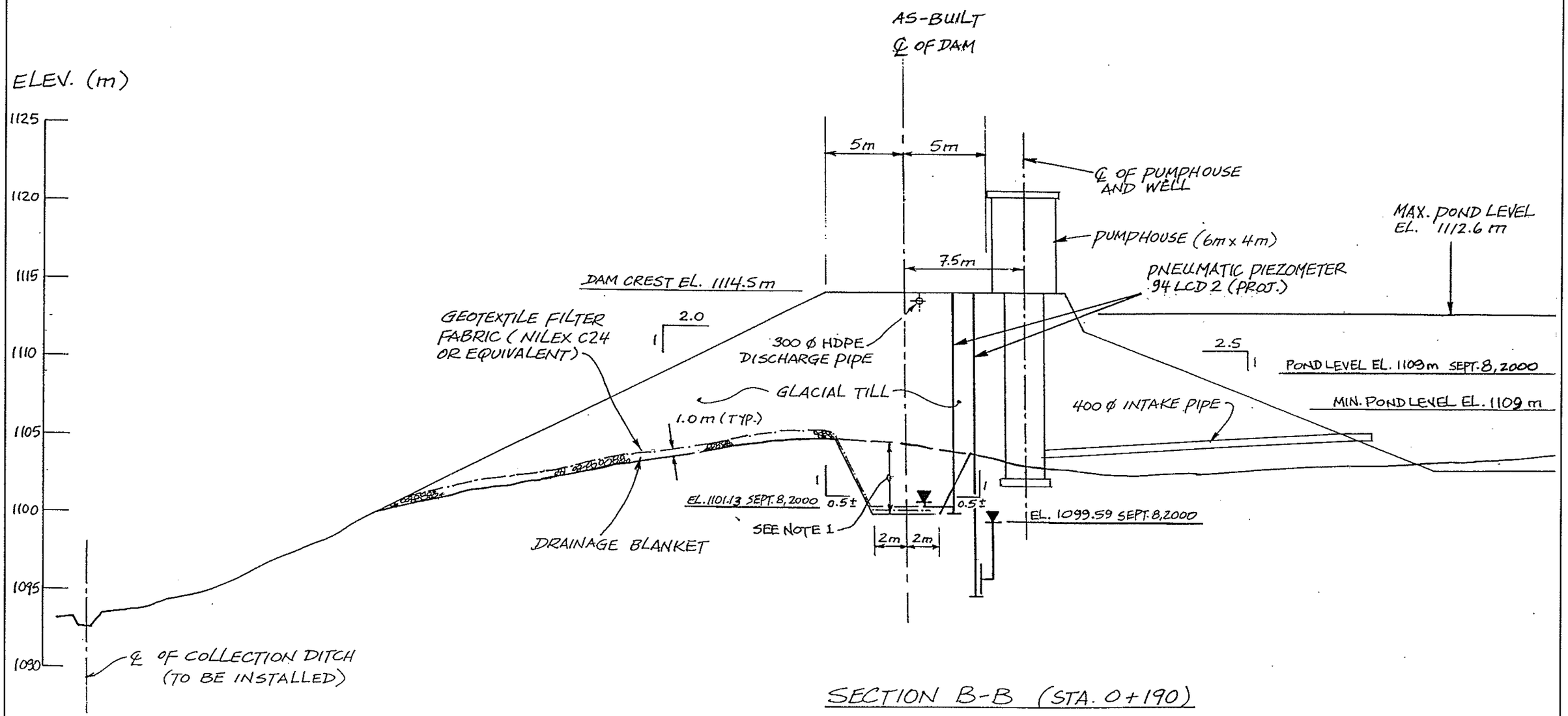
VANGORDA PLATEAU MINE

LITTLE CREEK DAM
GENERAL ARRANGEMENT PLAN

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		9



SECTION B-B (STA. 0+190)

SCALE – 1:250

FILE REF:

SRK Consulting
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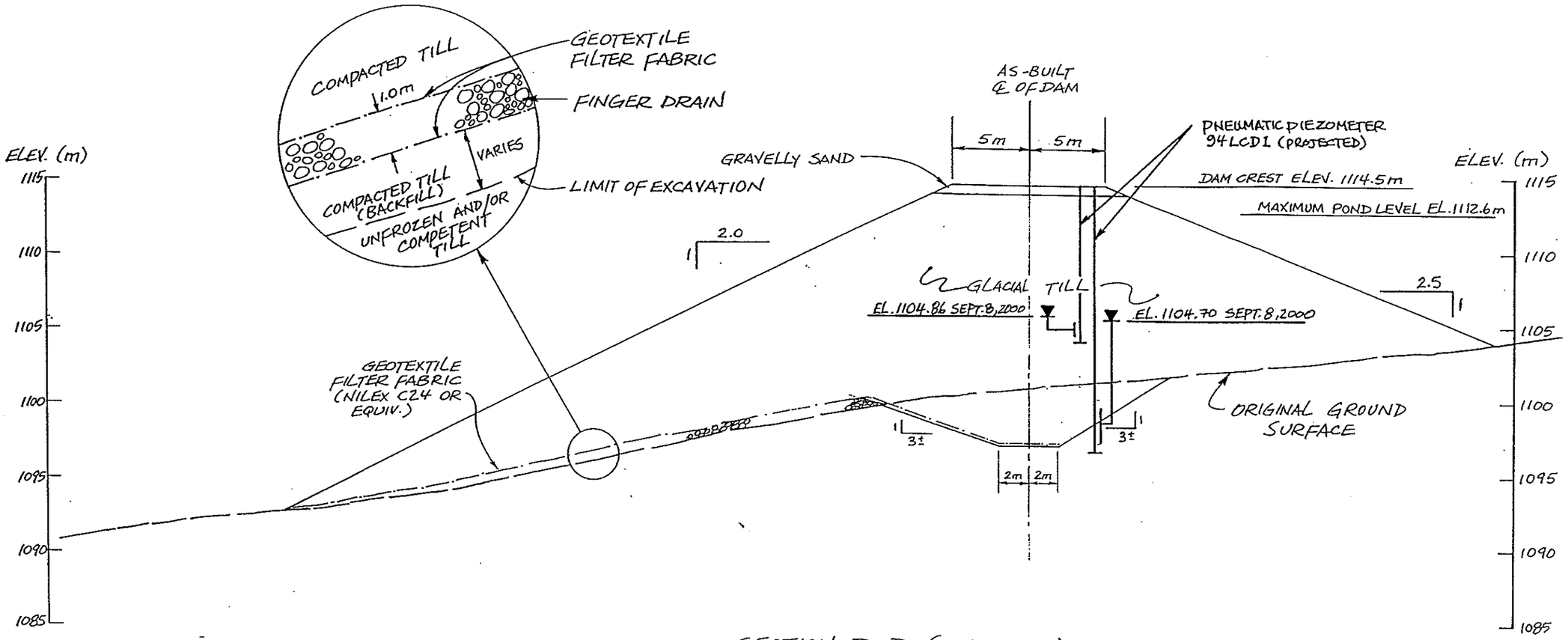
VANGORDA PLATEAU MINE

LITTLE CREEK DAM
SECTION B–B

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		10



SECTION D-D (STA. 0+144)

SCALE – 1:300

FILE REF:

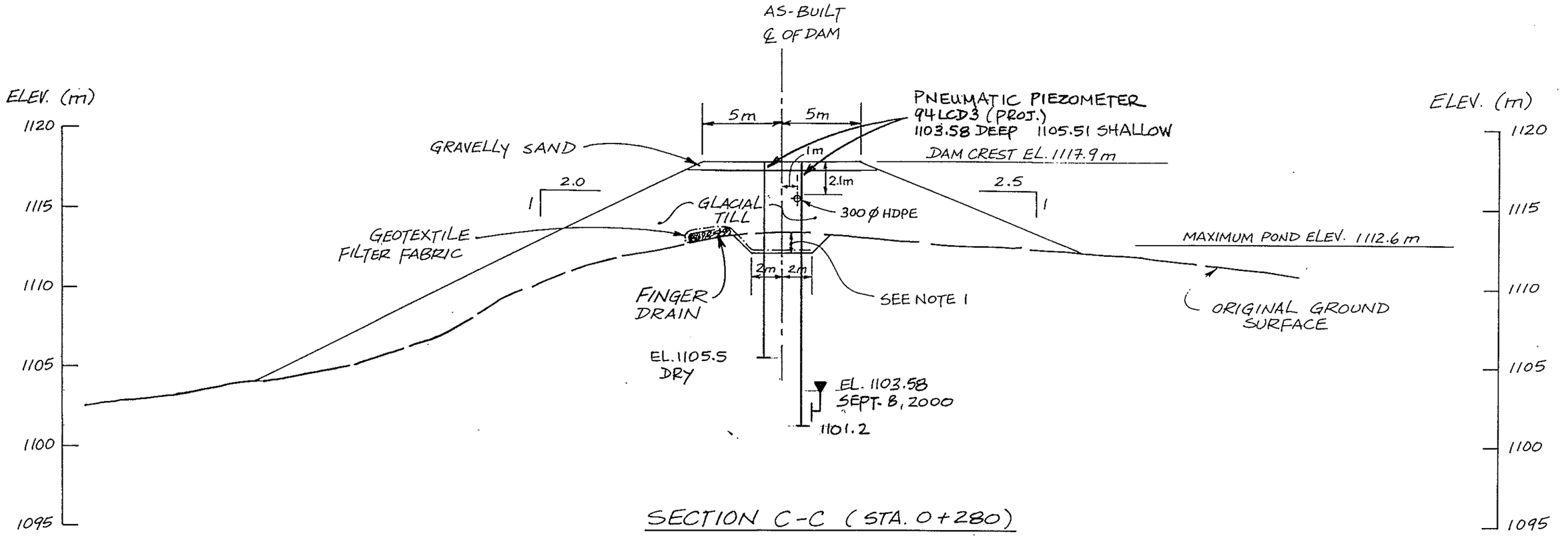
SRK Consulting
Engineers and Scientists

DELOITTE & TOUCHE

VANGORDA PLATEAU MINE

LITTLE CREEK DAM
SECTION D–D

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		11



SECTION C-C (STA. 0+280)

SCALE - 1:250

FILE REF:

SRK Consulting
Engineers and Scientists

DELOITTE & TOUCHE

VANGORDA PLATEAU MINE

LITTLE CREEK DAM
SECTION C–C

PROJECT NO.	DATE	APPROVED	FIGURE
1CD003.03	JAN. 2001		12

APPENDIX A

Photos

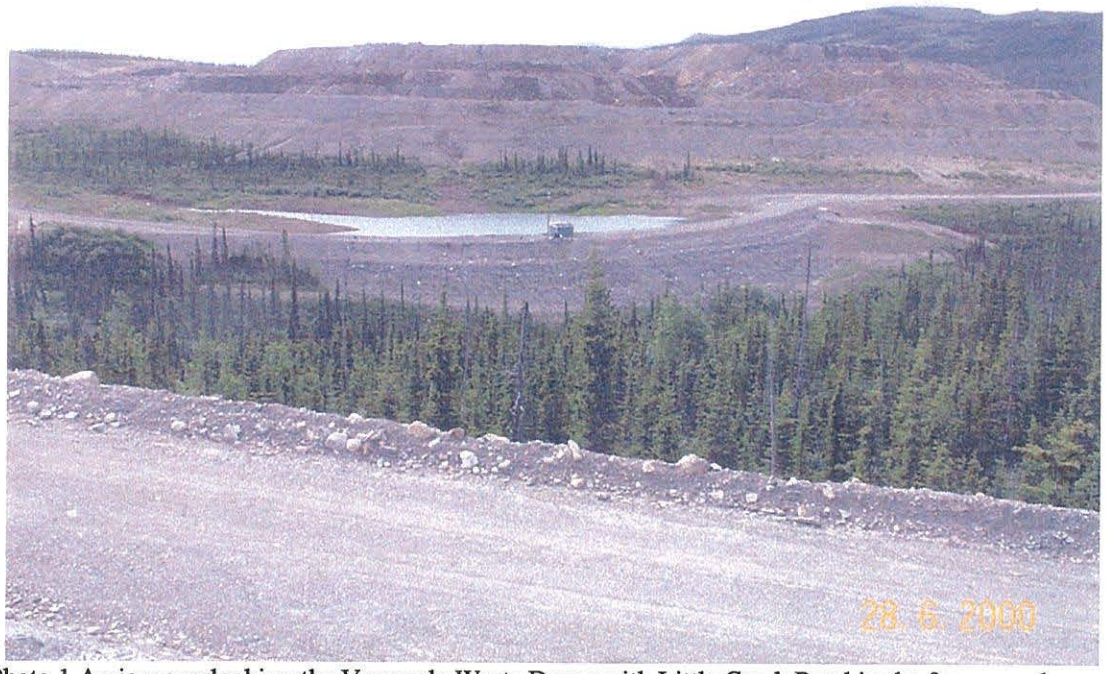


Photo 1 A view overlooking the Vangorda Waste Dump with Little Creek Pond in the foreground

Photo 2 Weir at Drain 3

Photo 3 Weir at Drain 5

Photo 4 Weir at Drain 6

Photo 5 View of the Starter Dyke Diversion Ditch

Photo 6 View looking downgradient of the upper reaches of the ditch

Photo 7 Exit reach of the diversion ditch

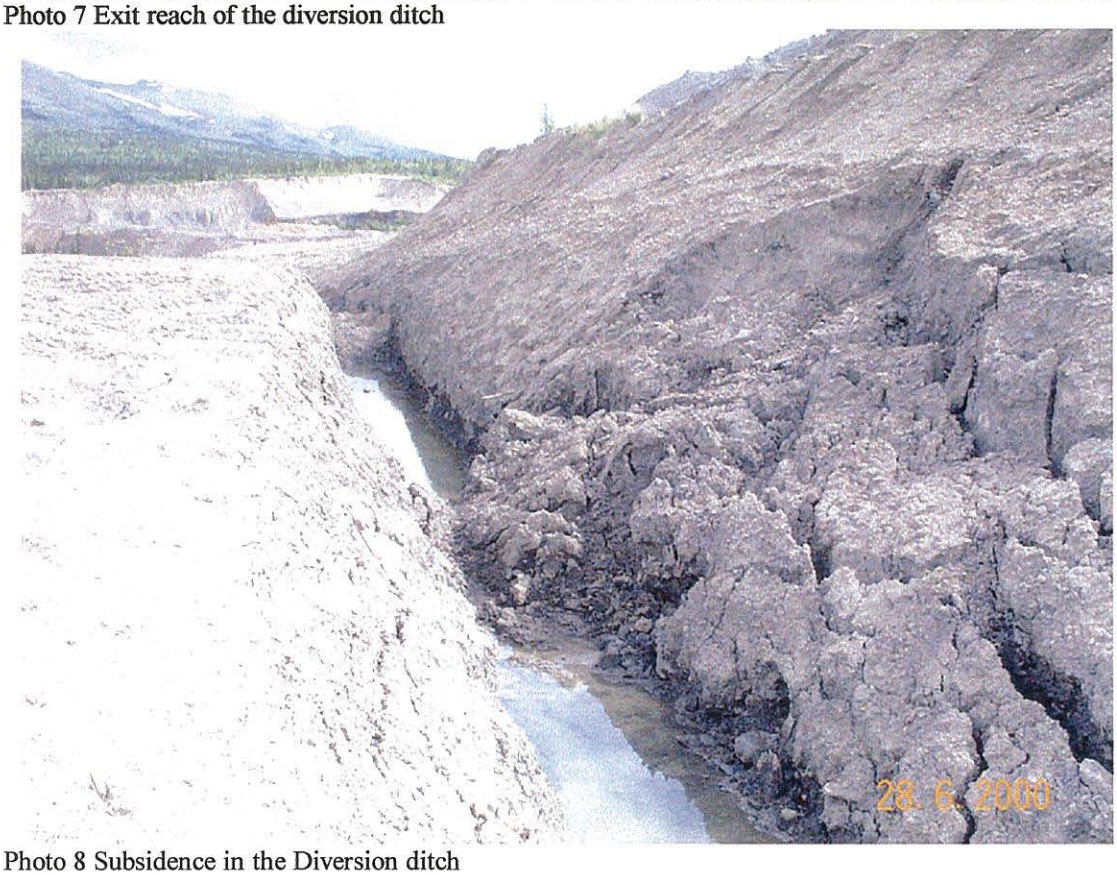


Photo 8 Subsidence in the Diversion ditch

Photo 9 Ponded Water in the diversion ditch

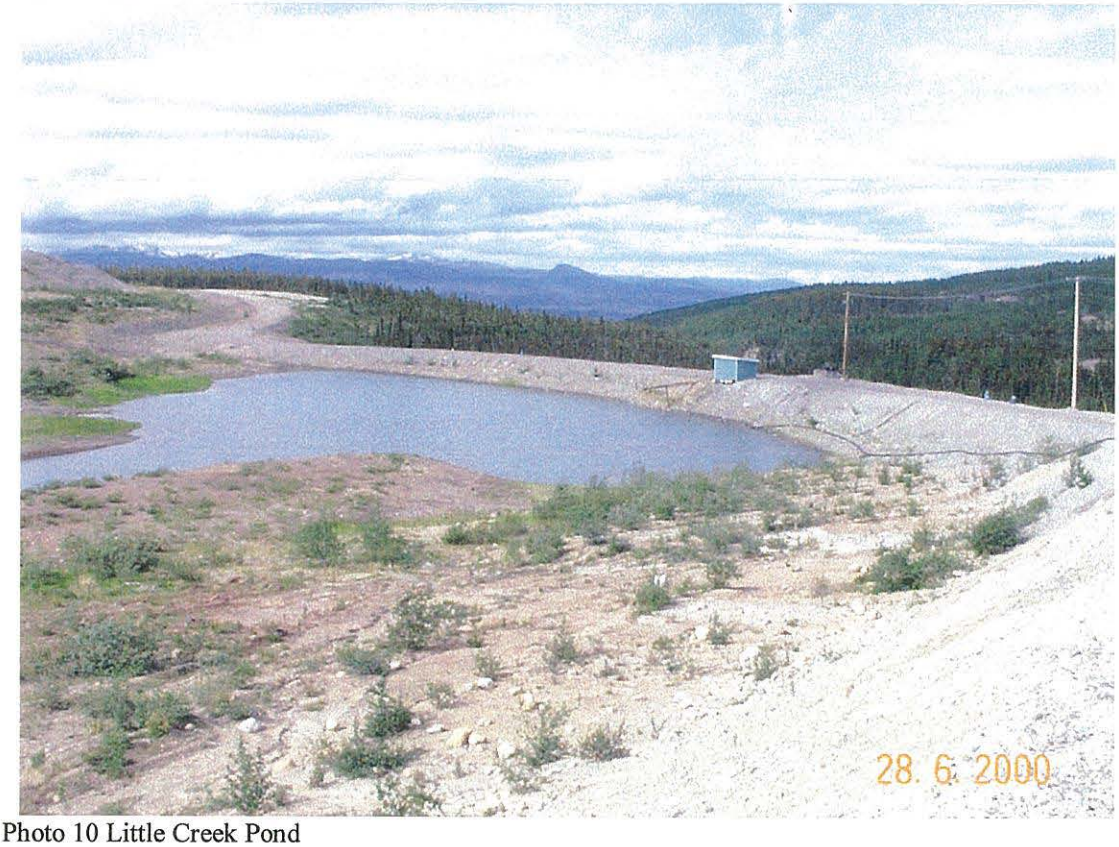


Photo 10 Little Creek Pond

Photo11 Bank Erosion on east approach road

Photo 12 Drainage ditch on the Approach road to Little Creek Dam

Photo13 Erosion Gully on the upstream face of Little Creek Dam

Photo 14 Downstream face of Little Creek Dam

Photo 15 Emergency Spillway Culvert and chute at Little Creek Dam

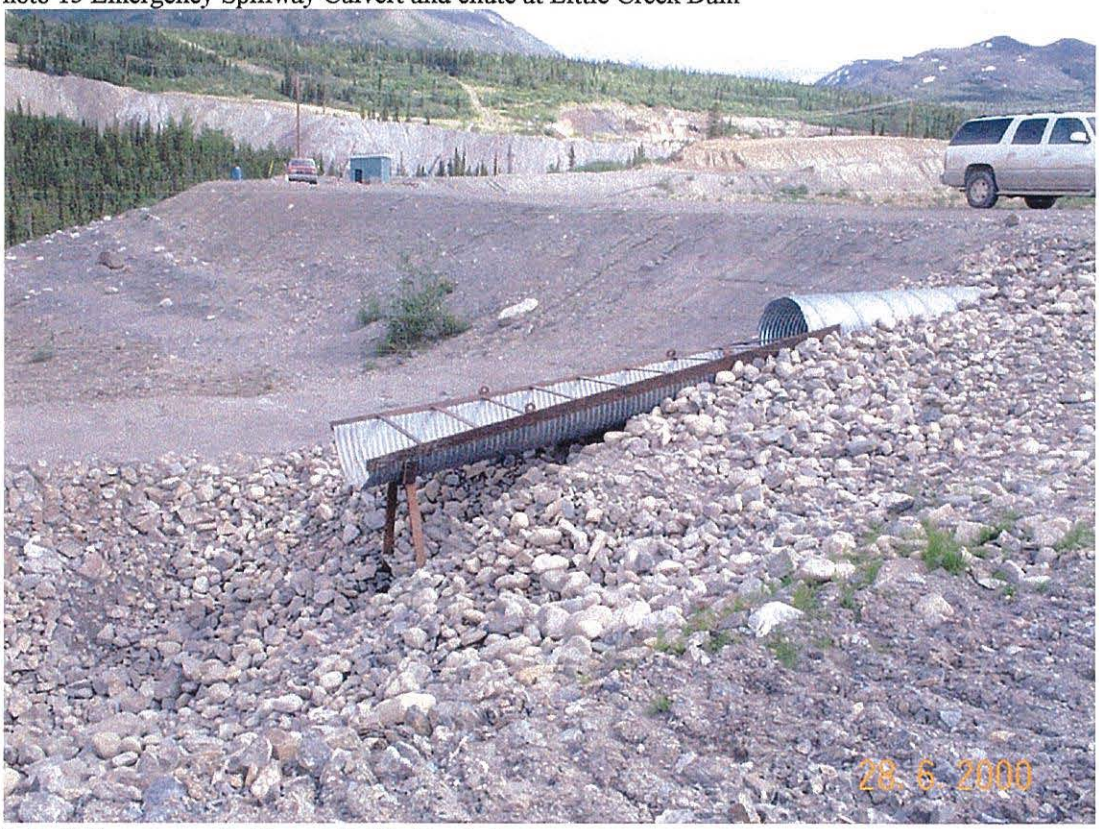


Photo 16 Emergency Spillway at Little Creek dam

Photo 17 Exit Channel below Plunge pool at Little Creek Dam Spillway

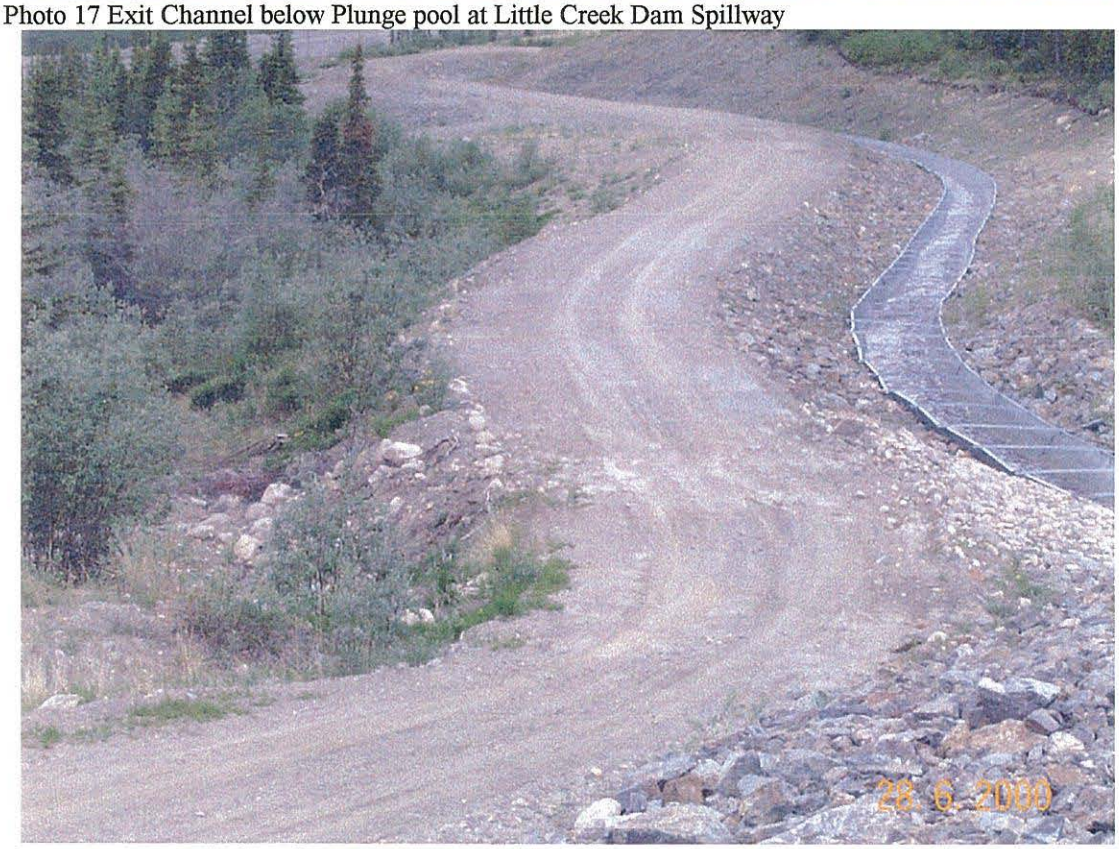


Photo 18 Upper Reaches of Vangorda Creek Diversion

Photo 19 Lower Reaches of Vangorda Creek Diversion

Photo 20 Headworks of the Vangorda Creek Diversion

Photo 21 Plunge pool at base of Vangorda Creek Diversion

Photo 22 Plunge pool at base of Vangorda Creek Diversion

Photo 23 Sludge Pond at the Treatment Plant

Photo 24 Tension Crack in crest of the Sludge Pond Dyke

Photo 25 Vegetation on downstream face of Sludge Pond Dyke.

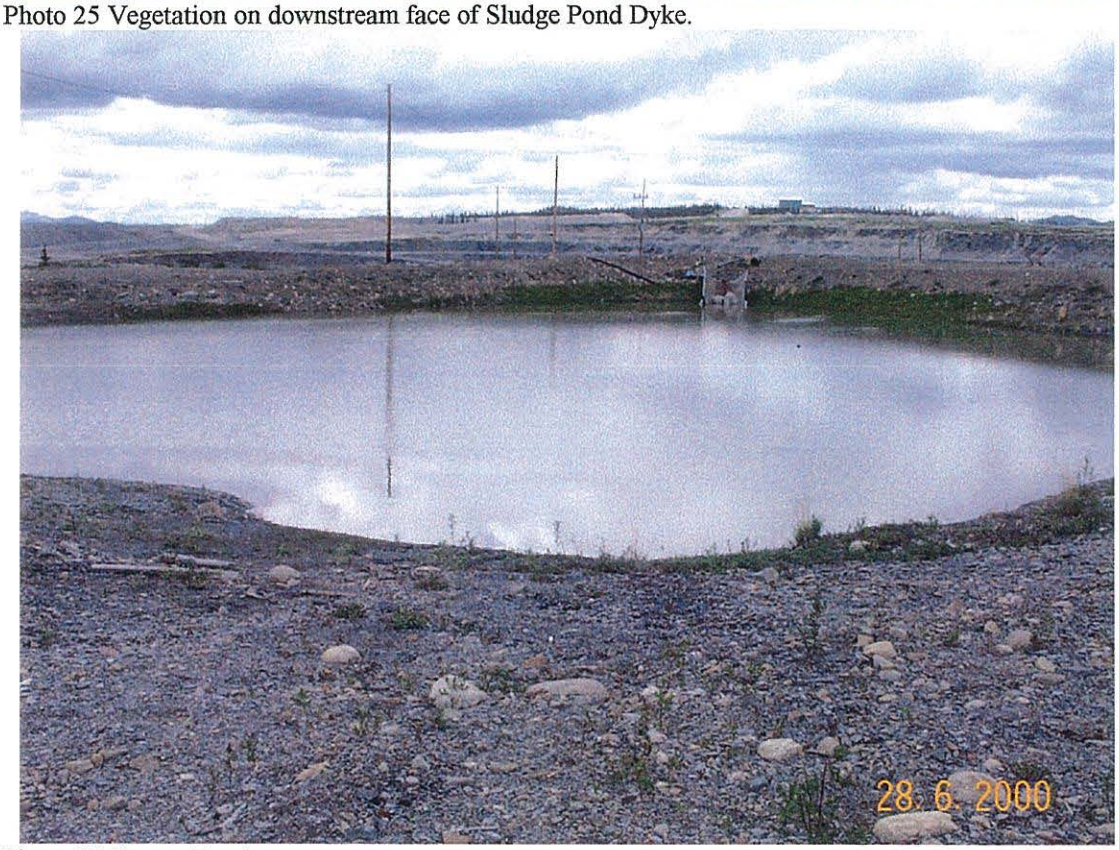


Photo 26 Grouco Pond

Photo 27 Grum Interceptor Ditch

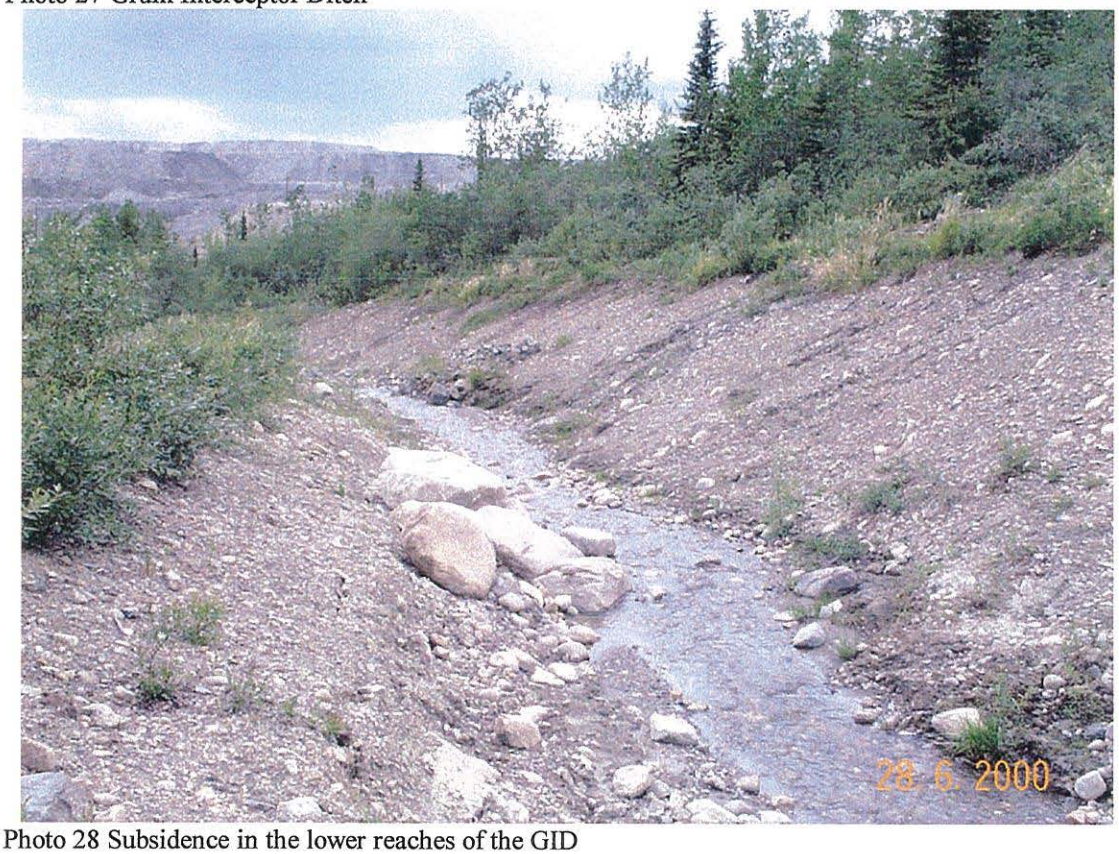


Photo 28 Subsidence in the lower reaches of the GID

APPENDIX B

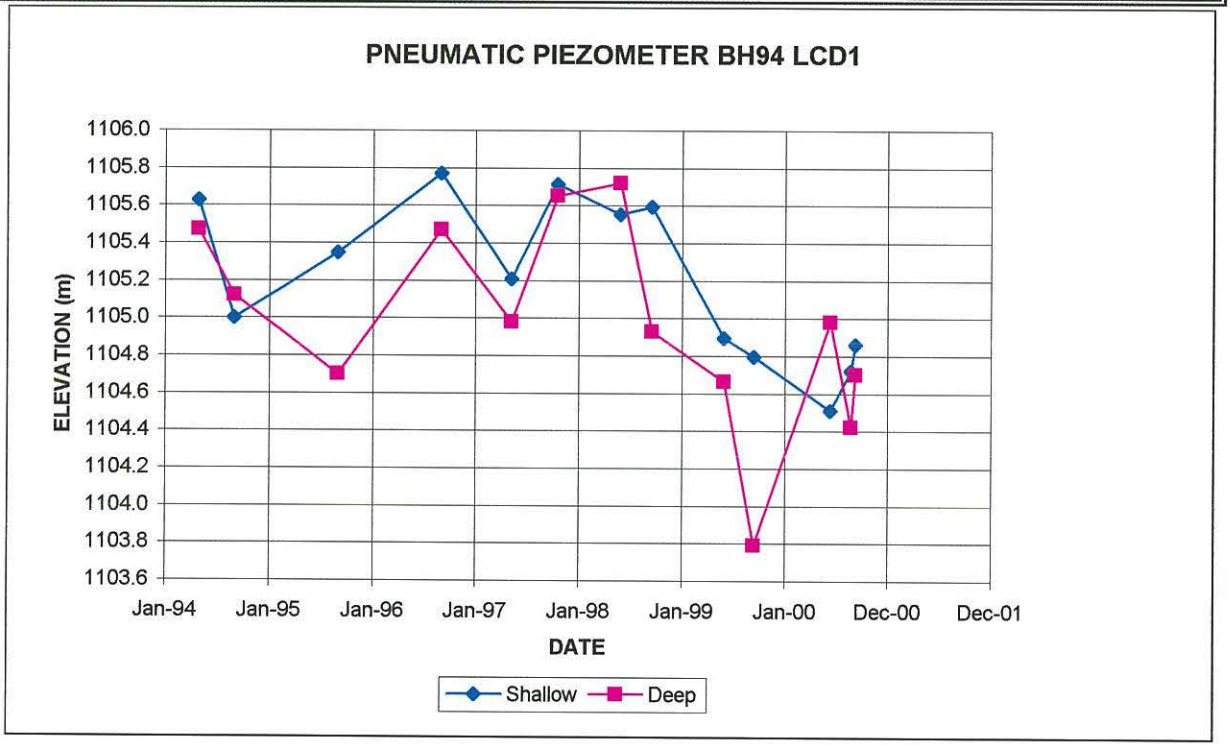
Pneumatic Piezometer and Thermistor Readings - Little Creek Dam

Little Creek Dam Pneumatic Piezometers

BH94 LCD1 **Location:** Little Creek Dam Crest **Ground Elevation:** 1114.5m **Coordinates:** 3000N, 13460E

Date Installed: June '94 **Shallow Tip Elevation:** 1103.6 **Deep Tip Elevation :** 1097.0 **Surface Protector:** yes

Date	Reading (psi)		Piezometric Elevation (m)		Pond
	Shallow	Deep	Shallow	Deep	Level
May-94	2.9	12.1	1105.63	1105.47	
Sep-94	2.0	11.6	1105.00	1105.12	
Sep-95	2.5	11.0	1105.35	1104.70	
Sep-96	3.1	12.1	1105.77	1105.47	
May-97	2.3	11.4	1105.21	1104.98	
Oct-97	3.02	12.36	1105.71	1105.65	
May-98	2.79	12.46	1105.55	1105.72	
Sep-98	2.85	11.33	1105.60	1104.93	~1109.5
May-99	1.85	10.95	1104.90	1104.67	
Sep-99	1.71	9.70	1104.80	1103.79	~1105
Jun-00	1.30	11.40	1104.51	1104.98	
Aug-00	1.60	10.60	1104.72	1104.42	
Sep-00	1.80	11.00	1104.86	1104.70	

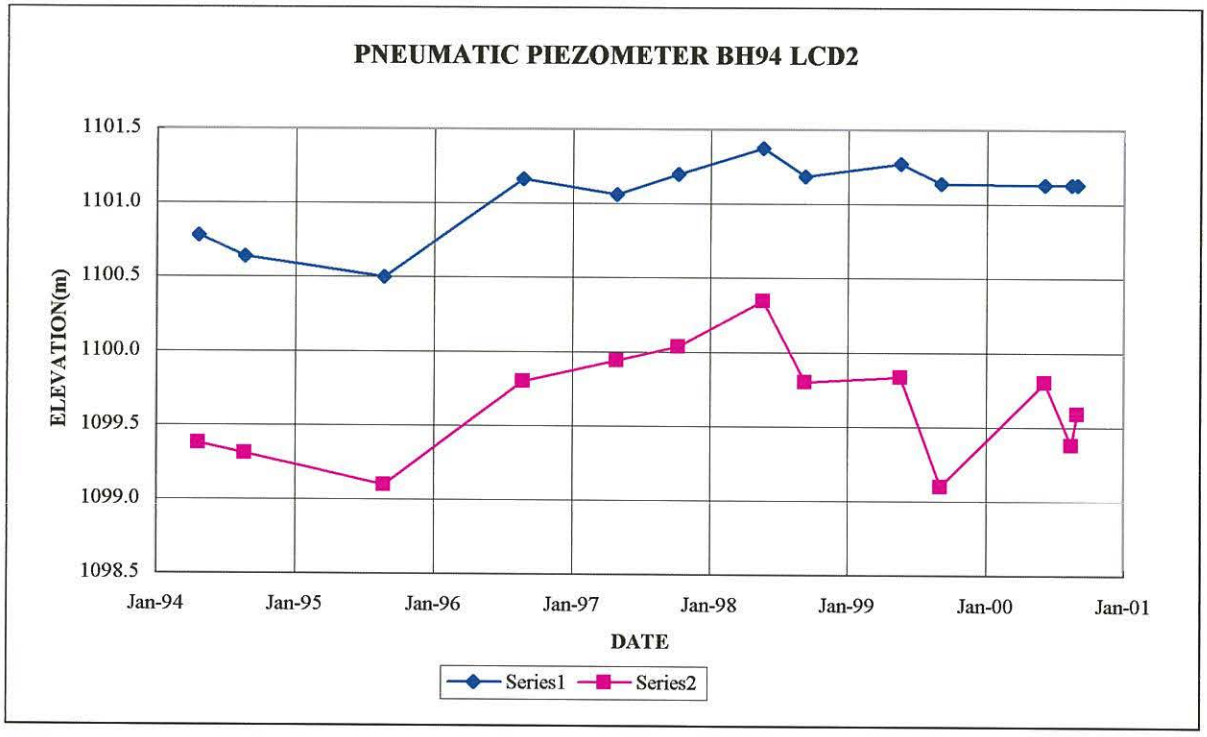


Little Creek Dam Pneumatic Piezometers

BH94 LCD2 **Location:** Little Creek Dam Crest **Ground Elevation:** 1114.5m **Coordinates:** 3065N,13485E

Date Installed: June '94 **Shallow Tip Elevation:** 1100.5 **Deep Tip Elevation :** 1094.9 **Surface Protector:** yes

Date	Reading (psi)		Piezometric Elevation (m)		Pond
	Shallow	Deep	Shallow	Deep	Level
May-94	0.4	6.4	1100.78	1099.38	
Sep-94	0.2	6.3	1100.64	1099.31	
Sep-95	0.0	6.0	1100.50	1099.10	
Sep-96	0.95	7.0	1101.17	1099.80	
May-97	0.8	7.2	1101.06	1099.94	
Oct-97	1.00	7.34	1101.20	1100.04	
May-98	1.25	7.78	1101.38	1100.35	
Sep-98	0.98	7.00	1101.19	1099.80	~1109.5
May-99	1.10	7.05	1101.27	1099.84	
Sep-99	0.91	6.00	1101.14	1099.10	~1105
Jun-00	0.90	7.00	1101.13	1099.80	
Aug-00	0.90	6.40	1101.13	1099.38	
Sep-00	0.90	6.70	1101.13	1099.59	

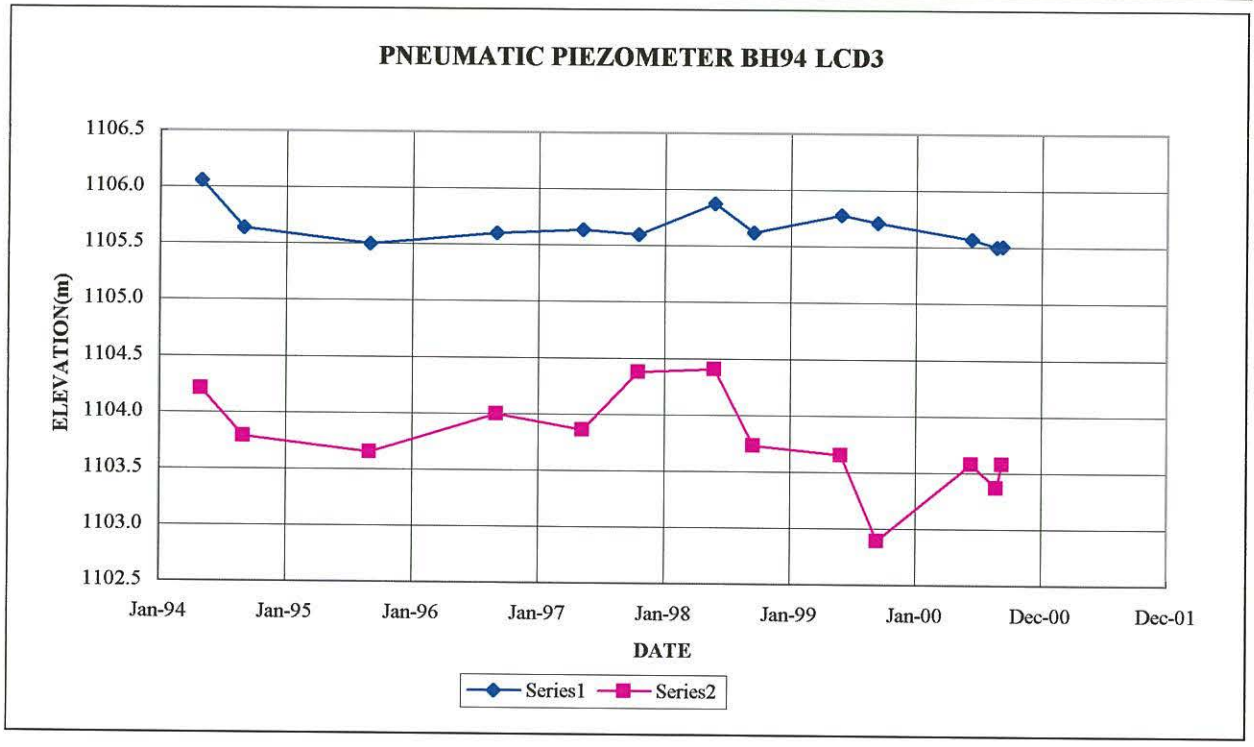


Little Creek Dam Pneumatic Piezometers

BH94 LCD3 **Location:** Little Creek Dam Crest **Ground Elevation:** 1114.5m **Coordinates:** 3115N, 13525E

Date Installed: June '94 **Shallow Tip Elevation:** 1105.5 **Deep Tip Elevation :** 1101.2 **Surface Protector:** yes

Date	Reading (psi)		Piezometric Elevation (m)	
	Shallow	Deep	Shallow	Deep
May-94	0.8	4.3	1106.06	1104.21
Sep-94	0.2	3.7	1105.64	1103.79
Sep-95	0.0	3.5	1105.50	1103.65
Sep-96	0.15	4.0	1105.61	1104.00
May-97	0.2	3.8	1105.64	1103.86
Oct-97	0.14	4.54	1105.60	1104.38
May-98	0.54	4.58	1105.88	1104.41
Sep-98	0.17	3.62	1105.62	1103.73
May-99	0.40	3.50	1105.78	1103.65
Sep-99	0.30	2.42	1105.71	1102.89
Jun-00	0.10	3.40	1105.57	1103.58
Aug-00	0.00	3.10	1105.50	1103.37
Sep-00	0.01	3.40	1105.51	1103.58



Little Creek Dam Thermistors

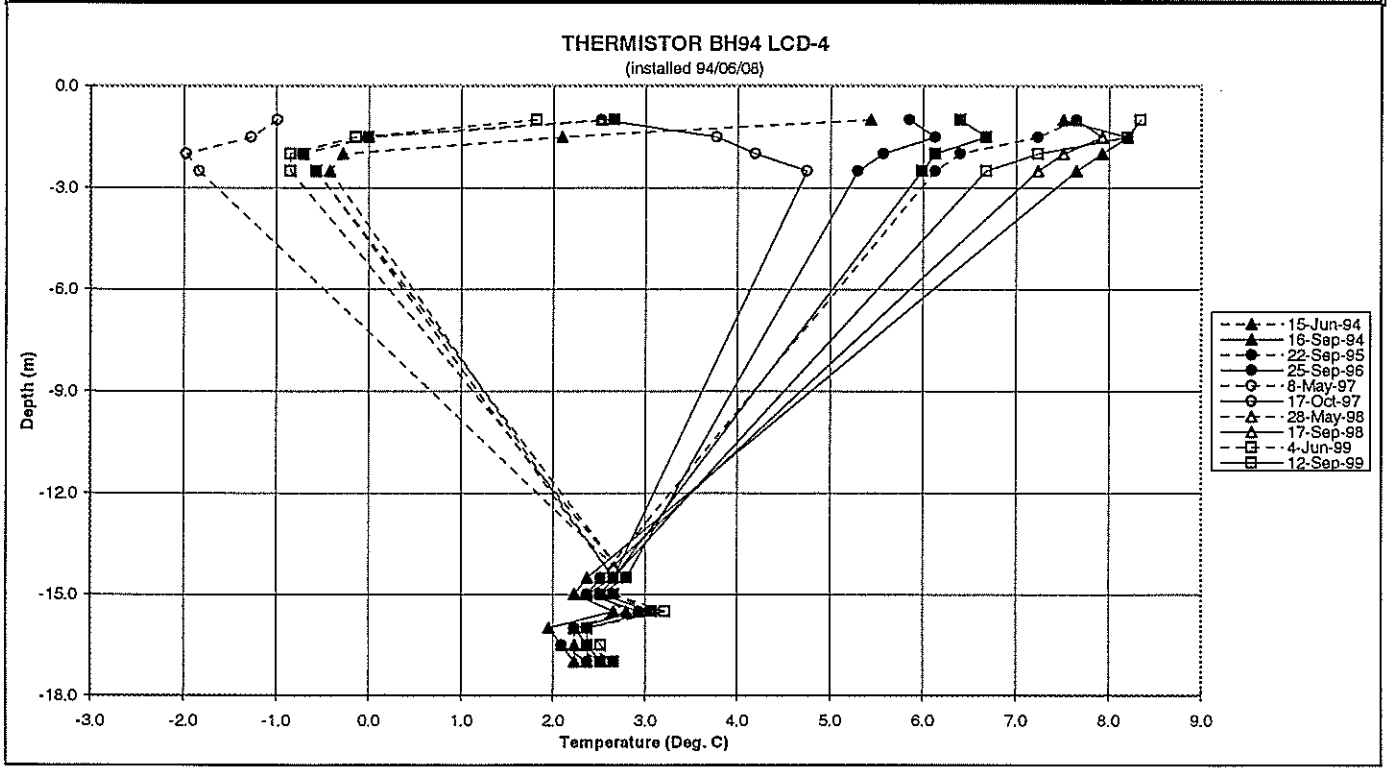
BH94 LCD-4 **Location:** Little Creek Dam Crest **Elevation:** 1114.5m **Coordinates** 3015N, 13465E

Date Installed: 8-Jun-94 **Thermistor Type:** SINCA RTD's **Ice-Bath Calibration:** not applied **Surface Protector:** yes

Depth Correction 0 Ro (Ohms)= 1854

Depth on String (m)	Actual Depth (m)	Resistivity (Ohms) 15-Jun-94	Resistivity (Ohms) 16-Sep-94	Resistivity (Ohms) 22-Sep-95	Resistivity (Ohms) 25-Sep-96	Resistivity (Ohms) 8-May-97	Resistivity (Ohms) 17-Oct-97	Resistivity (Ohms) 28-May-98	Resistivity (Ohms) 17-Sep-98	Resistivity (Ohms) 4-Jun-99	Resistivity (Ohms) 12-Sep-99	Resistivity (Ohms) 6-Jun-00	Resistivity (Ohms) 8-Sep-00
1.0	-1.0	1893	1908	1909	1896	1847	1872	1872	1909	1867	1914	1873	1900
1.5	-1.5	1869	1913	1906	1898	1845	1881	1854	1911	1853	1913	1854	1902
2.0	-2.0	1852	1911	1900	1894	1840	1884	1849	1908	1848	1906	1849	1898
2.5	-2.5	1851	1909	1898	1892	1841	1888	1850	1906	1848	1902	1850	1897
14.5	-14.5	1873	1871	1872	1874	1874	1873	1873	1872	1874	1873	1874	1873
15.0	-15.0	1872	1870	1871	1872	1872	1871	1871	1871	1873	1872	1873	1872
15.5	-15.5	1874	1873	1875	1876	1876	1875	1875	1875	1877	1876	1876	1876
16.0	-16.0	1870	1868	1870	1871	1871	1870	1870	1870	1871	1871	1871	1871
16.5	-16.5	1870	1869	1869	1871	1871	1871	1870	1871	1872	1871	1871	1871
17.0	-17.0	1870	1870	1871	1872	1872	1872	1872	1871	1873	1872	1873	1872

Depth on String (m)	Actual Depth (m)	Temperature (C) 15-Jun-94	Temperature (C) 16-Sep-94	Temperature (C) 22-Sep-95	Temperature (C) 25-Sep-96	Temperature (C) 8-May-97	Temperature (C) 17-Oct-97	Temperature (C) 28-May-98	Temperature (C) 17-Sep-98	Temperature (C) 4-Jun-99	Temperature (C) 12-Sep-99	Temperature (C) 6-Jun-00	Temperature (C) 8-Sep-00
1.0	-1.0	5.4	7.5	7.7	5.9	-1.0	2.5	2.5	7.7	1.8	8.3	2.7	6.4
1.5	-1.5	2.1	8.2	7.2	6.1	-1.3	3.8	0.0	7.9	-0.1	8.2	0.0	6.7
2.0	-2.0	-0.3	7.9	6.4	5.6	-2.0	4.2	-0.7	7.5	-0.8	7.2	-0.7	6.1
2.5	-2.5	-0.4	7.7	6.1	5.3	-1.8	4.7	-0.6	7.2	-0.8	6.7	-0.6	6.0
14.5	-14.5	2.7	2.4	2.5	2.8	2.8	2.7	2.7	2.5	2.8	2.7	2.8	2.7
15.0	-15.0	2.5	2.2	2.4	2.5	2.5	2.4	2.4	2.4	2.7	2.5	2.7	2.5
15.5	-15.5	2.8	2.7	2.9	3.1	3.1	2.9	2.9	2.9	3.2	3.1	3.1	3.1
16.0	-16.0	2.2	2.0	2.2	2.4	2.4	2.2	2.2	2.2	2.4	2.4	2.4	2.4
16.5	-16.5	2.2	2.1	2.1	2.4	2.4	2.4	2.2	2.4	2.5	2.4	2.4	2.4
17.0	-17.0	2.2	2.2	2.4	2.5	2.5	2.5	2.5	2.4	2.7	2.5	2.7	2.5



Little Creek Dam Thermistors

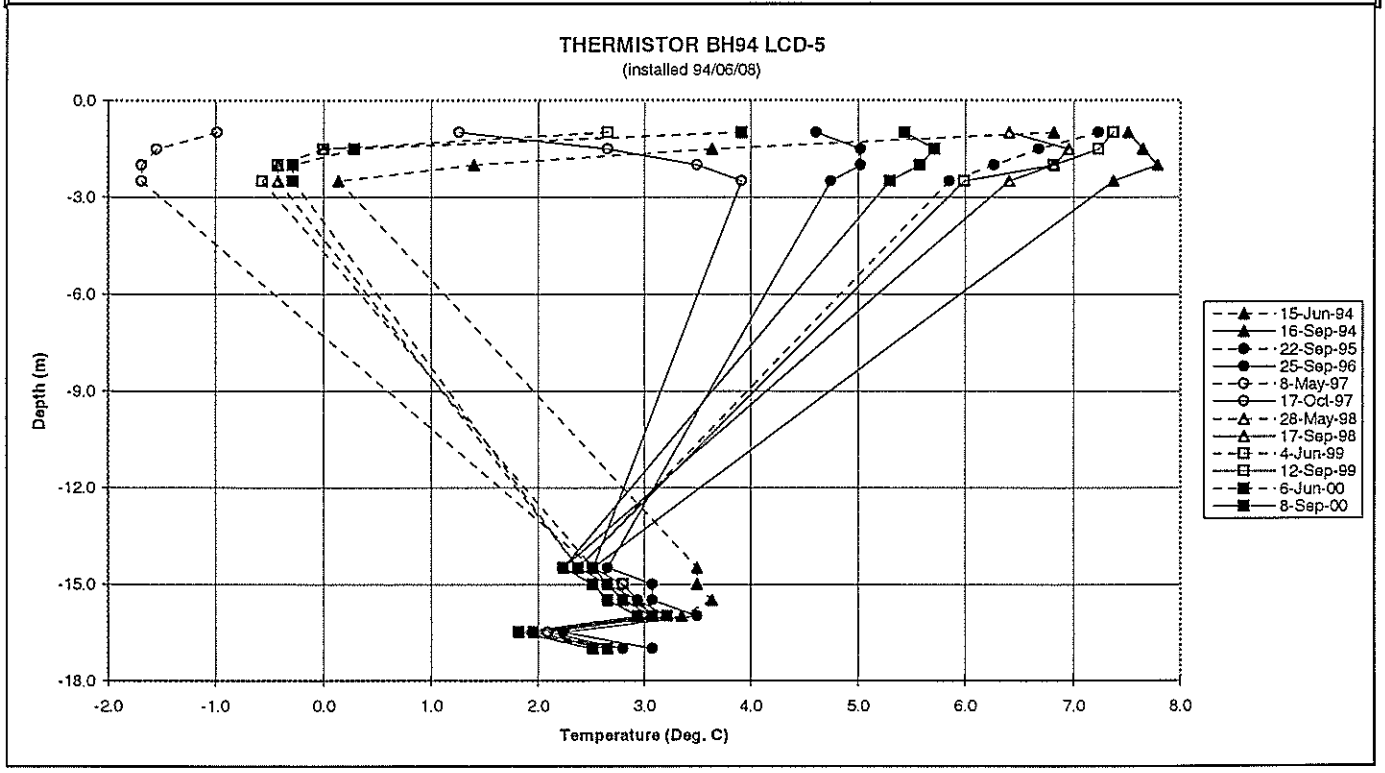
BH94 LCD-5 **Location:** Little Creek Dam Crest **Elevation:** 1114.5m **Coordinates** 3090N, 13500E

Date Installed: 8-Jun-94 **Thermistor Type:** SINCA RTD's **Ice-Bath Calibration:** not applied **Surface Protector:** yes

Depth Correction 0 Ro (Ohms)= 1854

Depth on String (m)	Actual Depth (m)	Resistivity (Ohms) 15-Jun-94	Resistivity (Ohms) 16-Sep-94	Resistivity (Ohms) 22-Sep-95	Resistivity (Ohms) 25-Sep-96	Resistivity (Ohms) 8-May-97	Resistivity (Ohms) 17-Oct-97	Resistivity (Ohms) 28-May-98	Resistivity (Ohms) 17-Sep-98	Resistivity (Ohms) 4-Jun-99	Resistivity (Ohms) 12-Sep-99	Resistivity (Ohms) 6-Jun-00	Resistivity (Ohms) 8-Sep-00
1.0	-1.0	1903	1908	1906	1887	1847	1863	1882	1900	1873	1907	1882	1893
1.5	-1.5	1880	1909	1902	1890	1843	1873	1854	1904	1854	1906	1856	1895
2.0	-2.0	1864	1910	1899	1890	1842	1879	1851	1903	1851	1903	1852	1894
2.5	-2.5	1855	1907	1896	1888	1842	1882	1851	1900	1850	1897	1852	1892
14.5	-14.5	1879	1872	1871	1873	1872	1872	1871	1870	1872	1871	1871	1870
15.0	-15.0	1879	1873	1873	1876	1874	1874	1873	1872	1874	1873	1873	1872
15.5	-15.5	1880	1875	1874	1876	1875	1875	1874	1873	1874	1874	1874	1873
16.0	-16.0	1878	1876	1877	1879	1877	1877	1876	1875	1877	1876	1876	1875
16.5	-16.5	1868	1868	1868	1870	1869	1869	1867	1867	1868	1868	1868	1867
17.0	-17.0	1873	1873	1874	1876	1874	1874	1873	1872	1873	1873	1873	1872

Depth on String (m)	Actual Depth (m)	Temperature (C) 15-Jun-94	Temperature (C) 16-Sep-94	Temperature (C) 22-Sep-95	Temperature (C) 25-Sep-96	Temperature (C) 8-May-97	Temperature (C) 17-Oct-97	Temperature (C) 28-May-98	Temperature (C) 17-Sep-98	Temperature (C) 4-Jun-99	Temperature (C) 12-Sep-99	Temperature (C) 6-Jun-00	Temperature (C) 8-Sep-00
1.0	-1.0	6.8	7.5	7.2	4.6	-1.0	1.3	3.9	6.4	2.7	7.4	3.9	5.4
1.5	-1.5	3.6	7.7	6.7	5.0	-1.5	2.7	0.0	7.0	0.0	7.2	0.3	5.7
2.0	-2.0	1.4	7.8	6.3	5.0	-1.7	3.5	-0.4	6.8	-0.4	6.8	-0.3	5.6
2.5	-2.5	0.1	7.4	5.9	4.7	-1.7	3.9	-0.4	6.4	-0.6	6.0	-0.3	5.3
14.5	-14.5	3.5	2.5	2.4	2.7	2.5	2.5	2.4	2.2	2.5	2.4	2.4	2.2
15.0	-15.0	3.5	2.7	2.7	3.1	2.8	2.8	2.7	2.5	2.8	2.7	2.7	2.5
15.5	-15.5	3.6	2.9	2.8	3.1	2.9	2.9	2.8	2.7	2.8	2.8	2.8	2.7
16.0	-16.0	3.4	3.1	3.2	3.5	3.2	3.2	3.1	2.9	3.2	3.1	3.1	2.9
16.5	-16.5	2.0	2.0	2.0	2.2	2.1	2.1	1.8	1.8	2.0	2.0	2.0	1.8
17.0	-17.0	2.7	2.7	2.8	3.1	2.8	2.8	2.7	2.5	2.7	2.7	2.7	2.5



Little Creek Dam Thermistors

BH94 LCD-6	Location:	Little Creek Dam Crest	Elevation:	1114.5m	Coordinates 3125N, 13535E		
	Date Installed:	10-Jun-94	Thermistor Type:	SINCA RTD's	Ice-Bath Calibration:	not applied	Surface Protector: yes
Depth Correction	0.4		Ro (Ohms)=	1854			

Depth on String (m)	Actual Depth (m)	Resistivity (Ohms) 15-Jun-94	Resistivity (Ohms) 16-Sep-94	Resistivity (Ohms) 22-Sep-95	Resistivity (Ohms) 25-Sep-96	Resistivity (Ohms) 8-May-97	Resistivity (Ohms) 17-Oct-97	Resistivity (Ohms) 28-May-98	Resistivity (Ohms) 17-Sep-98	Resistivity (Ohms) 4-Jun-99	Resistivity (Ohms) 12-Sep-99	Resistivity (Ohms) 6-Jun-00	Resistivity (Ohms) 8-Sep-00
1.0	-1.4	1881	1915	1913	1909	1853	1875	1866	1909	1864	1912	1868	1903
1.5	-1.9	1858	1909	1902	1903	1841	1877	1849	1901	1849	1899	1850	1894
2.0	-2.4	1857	1910	1901	1903	1843	1882	1850	1901	1850	1896	1852	1895
2.5	-2.9	1858	1907	1899	1901	1843	1883	1850	1897	1849	1891	1851	1891
10.0	-10.4	1896	1884	1884	1894	1883	1881	1882	1881	1883	1880	1883	1881
10.5	-10.9	1877	1875	1875	1887	1875	1873	1875	1873	1876	1873	1874	1873
11.0	-11.4	1880	1877	1877	1889	1878	1874	1876	1875	1878	1875	1876	1875
11.5	-11.9	1877	1875	1875	1886	1875	1872	1874	1872	1875	1872	1874	1873
12.0	-12.4	1880	1875	1875	1885	1874	1871	1873	1872	1874	1871	1874	1872
12.5	-12.9	1876	1875	1875	1886	1875	1872	1873	1872	1875	1872	1874	1872

Depth on String (m)	Actual Depth (m)	Temperature (C) 15-Jun-94	Temperature (C) 16-Sep-94	Temperature (C) 22-Sep-95	Temperature (C) 25-Sep-96	Temperature (C) 8-May-97	Temperature (C) 17-Oct-97	Temperature (C) 28-May-98	Temperature (C) 17-Sep-98	Temperature (C) 4-Jun-99	Temperature (C) 12-Sep-99	Temperatur e (C) 6-Jun-00	Temperature (C) 8-Sep-00
1.0	-1.4	3.8	8.5	8.2	7.7	-0.1	2.9	1.7	7.7	1.4	8.1	2.0	6.8
1.5	-1.9	0.6	7.7	6.7	6.8	-1.8	3.2	-0.7	6.5	-0.7	6.3	-0.6	5.6
2.0	-2.4	0.4	7.8	6.5	6.8	-1.5	3.9	-0.6	6.5	-0.6	5.9	-0.3	5.7
2.5	-2.9	0.6	7.4	6.3	6.5	-1.5	4.1	-0.6	6.0	-0.7	5.2	-0.4	5.2
10.0	-10.4	5.9	4.2	4.2	5.6	4.1	3.8	3.9	3.8	4.1	3.6	4.1	3.8
10.5	-10.9	3.2	2.9	2.9	4.6	2.9	2.7	2.9	2.7	3.1	2.7	2.8	2.7
11.0	-11.4	3.6	3.2	3.2	4.9	3.4	2.8	3.1	2.9	3.4	2.9	3.1	2.9
11.5	-11.9	3.2	2.9	2.9	4.5	2.9	2.5	2.8	2.5	2.9	2.5	2.8	2.7
12.0	-12.4	3.6	2.9	2.9	4.3	2.8	2.4	2.7	2.5	2.8	2.4	2.8	2.5
12.5	-12.9	3.1	2.9	2.9	4.5	2.9	2.5	2.7	2.5	2.9	2.5	2.8	2.5