Klohn Crippen Berger

June 15, 2012

Yukon Government
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Karen Furlong, EIT
Project Manager

Dear Ms. Furlong:

Faro Mine Complex
2011 Annual Geotechnical Review

We are pleased to submit the final report on Faro Mine Complex - 2011 Annual Geotechnical Review, including Appendix I on 2011 Site Visit Photos and Appendix II on reviewed site data. This report assesses the geotechnical performance of the water management and waste storage facilities at the Faro Mine Complex, including those at the Faro and Vangorda Plateau sites. The review is based on our site observations by Robert Lo on August 23 and 24, 2011 regarding the geotechnical aspect, and Arvind Dalpatram on September 20 and 21, 2011 regarding the hydrotechnical aspect, and ongoing review of monitoring data collected by Dennison Environmental Services (DES).

In addition, training sessions were held on site to enhance the DES field staff's appreciation of the geotechnical and hydrotechnical implications of their monitoring activities. PowerPoint presentation slides used by Robert Lo are included in Appendix III. The 2012 spring site visit was conducted by Robert Lo on May 29 and 30, 2012, and the site visit memo is included here as Appendix IV.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Robert C. Lo, P.Eng.
Project Manager

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EXECUTIVE SUMMARY

This report assesses the geotechnical and hydrotechnical performance of the water management and waste storage facilities at the Faro Mine Complex, including those at the Faro and Vangorda Plateau sites. The review is based on our site observations by Robert Lo on August 23 and 24, 2011 regarding the geotechnical aspect, and Arvind Dalpatram on September 20 and 21, 2011 regarding the hydrotechnical aspect, and ongoing review of monitoring data collected by Dennison Environmental Services (DES). In addition, training sessions were held on site to enhance the DES field staff's appreciation of the geotechnical and hydrotechnical implications of their monitoring activities.

Sections 2 and 3 of the report present our review of the Faro and Vangorda Plateau site facilities, respectively. For each facility, our site observations are first described, followed by the discussion of DES site instrumentation monitoring data, and comments and recommendations. Section 4 summarizes our review, making use of summary tables, and Section 5 outlines the main conclusions and recommendations. Representative 2011 site visit photographs are included in Appendix I, and the reviewed DES monitoring data are organized in Appendix II. Appendix III contains the PowerPoint presentation slides used by Robert Lo on August 23, 2011, and Appendix IV presents a technical memo on the 2012 spring site visit on May 29 to 30, 2012 by Robert Lo.

The key waste and water management facilities at both the Faro and Vangorda Plateau sites have functioned satisfactorily in 2011 as in the past. The care and maintenance activities, including instrument monitoring and survey measurement, are performed generally following the planned schedules.

According to the Canadian Dam Safety Guidelines (CDA 2007), both the Cross Valley Dam and Intermediate Dam will be due for their third dam safety review in 2014 because of their classification as “high” consequence dams. The latest version of the Emergency Response Plan (ERP) and Operations, Maintenance and Surveillance (OMS) Manual appear to be dated in 2008. It would be a good practice to update these documents more frequently due to inevitable changes of site personnel, operation procedures, site conditions and outside contacts.

The ongoing pit wall slope stability at the Faro and Grum Pits has been evaluated by Golder. Extension of this stability evaluation to Vangorda Pit was discussed in a site meeting on May 29, 2012. The pit-wall brim movement monitoring programs at the Faro and Grum Pits indicate that the measured distance changes are within the measurement accuracy. The distance-measurement techniques used at the Grum Pit could be applied at the Faro Pit to improve the accuracy achieved there.

The event of excess runoff in the spring of 2011, due to unsatisfactory performance of drainage structures related to the Grum Sulphide Cell cover installation, has silted up the bottom of the Moose Pond and potentially changed its exfiltration groundwater flow regime. The ramifications of this event need to be closely followed up in future years in order to remedy any potential unfavourable impacts.

Recommendations regarding both the hydrotechnical and geotechnical aspects are presented in Section 5 for specific facilities reviewed in the report. These recommendations deal with ongoing maintenance issues. They could be implemented by Yukon Government according to its priority and operational budget, as guided by its long-term closure objectives.

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1. INTRODUCTION

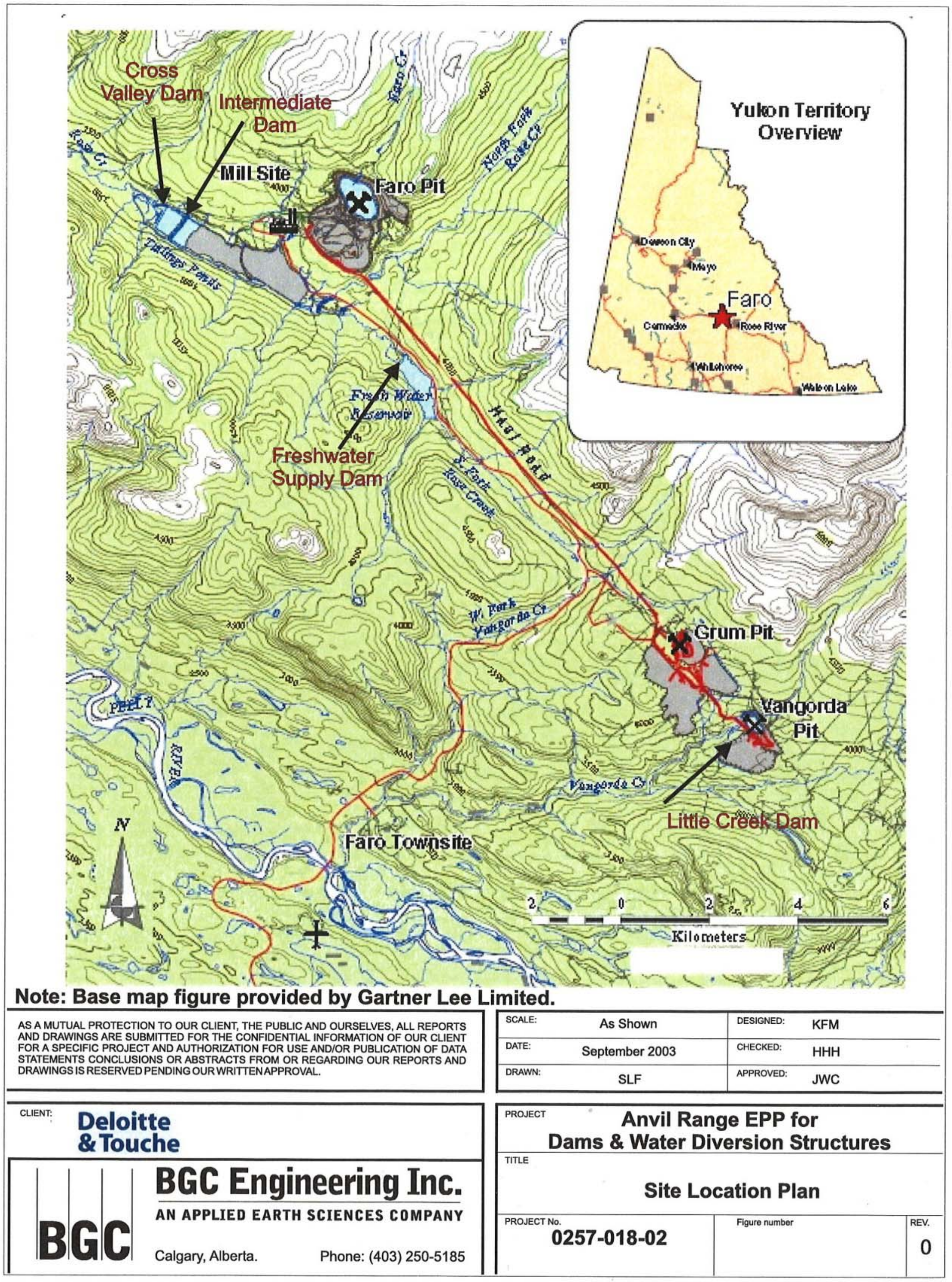
1.1 Project Background

The Faro Mine site is located approximately 200 km north-northeast of Whitehorse, Yukon, as shown on the site location plan on page 2. It consists of the Faro Mine which was in production from 1969 to 1992 (with production rates of 5,000 tonnes per day to 9,300 tonnes per day), and the Vangorda Plateau Mine which was in production from 1986 to 1998. From 1998 to 2008, the mine site has been under the management of Deloitte & Touche Inc., who was the court-appointed interim receiver. Ongoing care, maintenance, and environmental protection activities have been carried out by Denison Environmental Services since 2009, centered on a seasonal pumping and water treatment program for the Faro and Vangorda open pits, and inspection and maintenance of water retention and water diversion structures.

The annual geotechnical review reports for the mine contain a summary of the site observations, provide the instrumentation monitoring data, and note recommendations for operation and maintenance for the coming year. These reports have been prepared by Golder Associates Ltd. (1996 to 1999, 2010, 2011), Geo-Engineering (MST) Ltd. (1999), BGC Engineering Inc. (2000 to 2009), and SRK Consulting Engineers (1996 to 2011).

Two dam safety reviews were carried out by Klohn Crippen (2002) and Klohn Crippen Berger (2007). BGC prepared and updated an Emergency Response Plan (EPP) (2003, 2007 and 2008) and an Operations, Maintenance and Surveillance (OMS) Manual (2007, 2008) for the following three water retention structures, which are still relevant:

- Intermediate Dam;
- Cross Valley Dam; and,
- Little Creek Dam.



Site Location Plan of Faro Mine Complex

1.2 Project Scope

This report documents the 2011 annual review of the geotechnical performance of waste and water management facilities at the Faro Mine Complex. For ease of comparing with historical records, we will group these facilities into two sites: Faro and Vangorda Plateau sites. Although some of the following facilities are not within the scope of our 2011 task, such as Vangorda Pit, Grum Dump, we have included them for future references.

Faro Site (see Figures 1 and 2):

- Faro Pit and the Faro Creek Diversion Channel;
- North Valley Wall Interceptor Ditch;
- Rose Creek Diversion Channel;
- North Fork Rock Drain;
- K8 Creek Rock Drain;
- Secondary Tailings Impoundment;
- Intermediate Dam; and,
- Cross Valley Dam.

Vangorda Plateau Site (see Figures 3 to 5):

- Grum Pit;
- Vangorda Pit;
- Grum Dump;
- Vangorda Waste Rock Dump;
- Grum Interceptor Ditch;
- North-East Interceptor Ditch above Vangorda Pit;
- Vangorda Creek (Flume) Diversion;
- Little Creek Dam;
- Sheep Pad Sediment Ponds;
- Grum Settling Pond;

- V-15 Seepage Ditch and Moose Pond; and,
- Sludge Pond Embankment at Vangorda Water Treatment Plant.

This report is based on our site observations on August 23 and 24, 2011 by Mr. Robert C. Lo, and on September 20 and 21, 2011 by Mr. Arvind Dalpatram as well as review of site monitoring data for the period from September to December 2011 prepared by Dennison Environmental Services (DES).

1.3 Organization of Report

Sections 2 and 3 present our review of the Faro and Vangorda Plateau site facilities, respectively. For each facility, our site observations are first described, followed by the discussion of DES site instrumentation monitoring data, and comments and recommendations. Section 4 summarizes our review making use of summary tables, and Section 5 outlines the main conclusions and recommendations. Representative 2011 site visit photographs are included in Appendix I, and the reviewed DES monitoring data are organized in Appendix II. Appendix III contains the PowerPoint presentation slides used by Robert Lo on August 23, 2011, and Appendix IV presents a technical memo on the 2012 spring site visit on May 29 to 30, 2012 by Robert Lo.

1.4 Use and Limitations of Report

This report is an instrument of service of Klohn Crippen Berger Ltd. (KCB) and has been prepared for the exclusive use of the Yukon government. The content of this report reflects Klohn Crippen Berger’s best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it are the responsibility of such third parties. KCB accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

2. FARO SITE FACILITIES

2.1 **Faro Pit** (see Photos 1 and 2 and Figure 2) **and Faro Creek Diversion Channel (FCDC),** (see Photos 3 and 4 and Figures 1 and 2)

The Faro Pit is an inactive, inundated open pit structure, roughly elliptical in shape with the major axis oriented to the northwest/southeast. The east wall is, roughly, 375 m high containing two, North and South instability zones separated by a calc-silica rich rock slope.

The Faro Creek Diversion Channel (FCDC) diverts flow from the head waters, north of the Faro Pit around the east side of the mine site and discharges into the North Fork of Rose Creek. The minimum distance between the Faro Pit east wall and the diversion channel are 18.5 m and 93 m, respectively, in the North and South instability zones.

2.1.1 Observations

Faro Pit

Observations of the Faro Pit from the 2011 KCB fall site visit made by R. Lo are as follows:

- No obvious changes on the east pit wall North and South Instability Zones were observed.
- DES indicated that no significant changes were measured at points where distances between the pit east wall and Faro Creek Diversion Channel have been monitored.

Faro Creek Diversion Channel (FCDC)

Observations of the Faro Creek Diversion Channel from the 2011 KCB fall site visit by A. Dalpatram are as follows:

- Flow condition appeared to be similar to that on September 21-22, 2010.

- The channel and side slopes appeared to be stable along most of its length.
- Portions of the channel are lined with rock and geotextile or tarp. Rock armour has moved in some areas, and geotextile and tarp are exposed in some areas.

2.1.2 Instrumentation (see Figure 6)

Faro Pit (see Figure 6 for locations of reference bars and prisms)

Instrumentation at the Faro Pit includes one pond level indicator at the Faro Pit, nine reference bars to monitor pit wall regression and nine prisms to monitor pit wall movements (Golder 2010 and Golder 2011a).

Data provided by DES on Faro Pit for the year of 2011 is given in Appendix II, and discussed below:

- Pond level (Section II-A.1) – The maximum pit pond level in 2011 is at El. 1142.1 m on April 18, and the minimum level in 2011 is at El. 1140.8 m on September 19, and these levels are compared with historical values in Table 2.1. In general, the pit pond level has been operated in a lowered range varying from 1140.7 m to 1142.1 m since August 2010 as compared with the range of 1141.0 m to 1142.8 m from August 2005 to July 2010.
- Pit wall regression (Section II-A.2) –The measured relative distances between reference bars and the pit wall brim have been similar for six bars (#15351 to #15356) from 2008 to 2011, and for three newly installed bars (#15717, #15737 and #15742) from August to November 2011. Locations of the three new reference bars should be added on Figure 6 to aid interpretation. Readings for Bar #15351 in 2011 continue to be the same as those readings taken after June 24, 2010. The apparent difference in readings of about 2 m from June 24 to July 10, 2010 was attributed to potential error in the bearing of measurement distance (Golder 2011a). It appears that similar errors could also exist in readings for Pin #15352. In general, a trend of slightly decreasing distance can be discerned from these measured distances since 2008, except those readings for Bars #15351 and

#15352. The bearing issue of measurement distance should be reviewed to improve the measurement accuracy.

- Pit wall prism monitoring (Section II-A.3) – The ordinates of change in northing and easting for the prism monitoring plots should be "cm" instead of "m". The scatter of the nine data points for the change in northing and easting plots seems to increase from 2 cm in October 2006 to 3 cm in August 2009. The scatter in the northing-change plot increases further to 5 cm in September 2010 and 2011, and the scatter in the easting-change plot remains at about 3 cm in September 2010 and 2011. It is uncertain whether these changes in scatter are related to prism position/ survey accuracy issue or pit wall movement. Moreover, two prisms located uphill of the Faro Creek Diversion Channel (Points #13875 and 13877) were considered by Golder (2011a) not likely to move. However, they experienced "apparent change" of 2 cm to 3 cm in northing and 3 cm to 7 cm in easting from 2006 to 2011. The above observations may indicate that these "measured changes" could reflect the accuracy of these surveys rather than real pit wall movements.

Faro Creek Diversion Channel

Instrumentation at the Faro Creek Diversion Channel includes four staff gauges (FCD-1 to FCD-4) used to calibrate flow in the diversion channel. Data provided by DES on the diversion channel is discussed below:

- Staff gauge flow measurements (Section II-B.1) - Historical water level and calibrated flow for the Faro Creek Diversion Channel are shown in Table 2.1. There is no current discharge data for the diversion channel; however, the recorded readings in m at staff gauge FCD-1 to FCD-4 are shown on Section II-B.1. These readings should be converted to discharge flows to be useful.

Table 2.1 Water level and Flow for Faro Pit and Faro Creek Diversion Channel

Structure	Monitor Location	Historical[1]		Current (2011)	
		Max	Min	Max	Min
Faro Pit - Pond Level	FP	1143.1 m	1140.7 m	1142.1 m	1140.8 m
Faro Creek Diversion Channel - Flow	FCD-1	2213 L/s	69 L/s	-	-
	FCD-2[2]	6178 L/s	7 L/s	-	-
	FCD-3	1366 L/s	47 L/s	-	-
	FCD-4	6018L/s	47 L/s	-	-

Notes: 1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c).
2. Staff gauge FCD-2 was broken during spring freshet, and was replaced on July 4.

2.1.3 Comments and Recommendations

Comments and Recommendations regarding the Faro Pit and Faro Creek Diversion Channel are as follows:

- Continue visual monitoring of pit wall conditions with photos taken at same vantage points.
- Continue monitoring distances between the pit brim and reference bars installed in the North and South Instability Zone as a means to monitor the safety of the Faro Creek Diversion Channel at these strategic locations.
- Continue surveying the prisms installed at the pit wall as a means to monitor the pit wall movements in the North and South Instability Zone.
- Improve accuracy of reference-bar measurements in order to improve the ability to discern “real movement” of the monitored areas.
- Continue visual monitoring of diversion channel and any seepage from the channel to the Faro Pit wall with photos taken at strategic locations.
- Cover exposed geotextile and tarp in the diversion channel with rock armour. Replace damaged geotextile and tarp prior to rock armour placement.
- Faro Pit pond level has been operated in a lower range since August 2010.
- No discharge flow data are available for the diversion channel. Staff gauge flow monitoring data should be converted to discharge flow to be useful.

2.2 North Valley Wall Interceptor Ditch (NVWID) (see Photos 5 to 10 and Figures 1 and 2)

The North Valley Wall Interceptor Ditch diverts creek flow from the north valley wall around the tailings impoundment area, see Figures 1 and 2. It is approximately 3 km long and made up of constructed and natural stream channel reaches. The ditch has, relatively flat channel gradients along the constructed reaches and steep gradients along the natural stream reaches. The constructed channel reaches include:

- 920 m long upper reach;
- 430 m long middle reach; and,
- 500 m long lower reach.

2.2.1 Observations

Observations of the North Valley Wall Interceptor Ditch during the 2011 site visit by A. Dalpatram are as follows:

- The flow in the channel appeared to be slightly higher than that on September 21-22, 2010.
- The channel and side slopes appeared to be stable.
- Sedimentation deposition was observed both up and down gradient from the well-access-road crossing.
- There was moderate to heavy vegetation growth in upper and middle constructed channel reaches.

2.2.2 Instrumentation

There is currently no instrumentation in place in the interceptor ditch. There was an in-stream flow monitoring location (NWID) for the ditch, and the historical data indicated the maximum and minimum flow of 32 L/sec and 1 L/sec, respectively (Golder, 2011c).

2.2.3 Comments and Recommendations

- Monitor channel sedimentation condition at the well-access-road crossing, and remove sediments if the accumulation becomes excessive.
- Clear vegetation along the upper and middle constructed channel reaches. Clearing should also include the access road and berm along the channel to facilitate future inspection.

2.3 Rose Creek Diversion Channel (RCDC) and Canal Dyke (CD) (see Photos 11 to 16 and Figures 1 and 2)

The Rose Creek Diversion Channel diverts Rose Creek flow around the south side of the tailings impoundment. It is approximately 3.8 km long with, typically flat to moderate channel gradients along the upper reaches and steep gradients along the lower reaches. The upper reach of the diversion channel has three areas that are of geotechnical significance:

- Canal Dyke (CD): The dyke flanks the north side of the channel along the upper reach of the diversion channel and separates the channel from the tailings deposit, the Intermediate Dam Pond and the Polishing Pond, see Figures 1 and 2.
- Spoil Piles: The spoil piles are wastes generated by the construction of the Canal Dyke. They are downslope of the Canal Dyke and located at various spots along the southern periphery of the tailings impoundment.
- Backslope: The backslope is the upper portion of the south excavation slope for the diversion channel above the flowing water.

2.3.1 Observations

Observations of the Rose Creek Diversion Channel during the 2011 site visits by A. Dalpatram and R. Lo are as follows:

- Flow condition appeared to be similar to that on September 21-22, 2010.
- The channel and side slopes appeared to be stable with satisfactory rock armour conditions.
- Channel vegetation removal operation commenced last year but was not completed due to time/weather constraints.
- Minor seepage from the diversion channel at base of spoil piles into the Cross Valley Dam Polishing Pond was reported previously, but could not be located during Mr. Dalpatram's inspection.

2.3.2 Instrumentation (see Figures 7 and 8)

Rose Creek Diversion Channel

Instrumentation in the diversion channel consists of one in-stream flow monitoring location (RCSG4). There are three other monitoring locations along the North Fork Rose Creek (NFRC-23, NF2 and X2). Historical data of maximum and minimum flows at these locations are shown on Table 2.2 (Golder 2011c).

Table 2.2 Historical Range of Flow for North Fork Rose Creek and Rose Creek Diversion Channel

Location	Name	Historical[1]	
		Max (L/s)	Min (L/s)
North Fork Rose Creek	NFRC-23	8×10^3	0
	NF2	2713	613
	X2	1538	207
Rose Creek Diversion Channel	RCSG4	38×10^3	1858

Notes: 1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c).

Recorded data in "m" and their plots at above locations, except (NF2), as provided by DES, are included in Appendix II, Section II-C.1. However, these data are not converted to flow data in 2011.

Canal Dyke

A summary of existing instrumentation on the Canal Dyke, Spoil Piles and Backslope of the diversion channel is shown in Table 2.3. Plots and recorded data, provided by DES, for these instruments are given in Appendix II: Section II-D (Piezometers in Section II-D.1, Thermistors in Section II-D.2 and Inclinometers in Section II-D.3). Only electronic files of unprocessed historical inclinometer readings are included in Section II-D.3.

Table 2.3 Instrumentation for Canal Dyke, Spoil Piles and Backslope of Diversion Channel

Structure	Instrumentation (See Figures 6 and 7)
Canal Dyke	Pneumatic Piezometers - 3 singe piezometers[1] (CD-7, CD-9, CD-10); and 9 paired piezometers with tips at deep and shallow depths (BH88-7[2], BH88-11[2], BGC05-02/BGC05-03, BGC05-06, CD-13, CD-15, CD-19[2], CD-21[2], CD-26)
	Thermistors - 5 (BGC05-04 and CD-10, CD-15, CD-21 and CD-26)
	Inclinometers - 9 (Borehole_1, BGC05-05, BGC05-08, CD-10, CD-15, CD-19, CD-21, BH91-CD-1 and BH94-CD-1)
Spoil Piles	Thermistors - 3 (SP-2[3], SP-3 and SP-5)
	Inclinometers - 2 (SP-2 and SP-5)
Backslope of Diversion Channel	Pneumatic Piezometers - 2 (BS-5 and BS-9)
	Thermistors - 4 (BS-5, BS-9, BS-10 and BS-12)
	Inclinometers - 3 (BS-5, BS-9 and BS-10)

Notes:
1. CD-7, CD-9 and CD-10 not monitored since 2009.
2. BH88-7, BH88-11 and CD-19 destroyed in 2004, and CD-21 deep piez. destroyed in 2005.
3. SP2 not monitored since 2008.

2.3.3 Comments and Recommendations

Comments and recommendations about the Rose Creek Diversion Channel and Canal Dyke are as follows:

- Continue to check and remove vegetation in the diversion channel periodically.
- Continue to monitor instrumentation on a regular basis.
- Conduct geotechnical inspection of the diversion channel during spring peak flow condition.
- Staff gauge monitoring data at RCSG4, NFRC-23 and X2 should be converted to discharge flows to be useful.
- Document seepage locations from the diversion channel into tailings impoundment area after fresh snow-fall condition.
- The piezometric levels either show a downward trend or are in a range consistent with historical variations.

- Seasonal variation of ground-temperature profiles as monitored by the thermistors at monitored locations shows similar historical range.

- No initial readings of inclinometers are available to compute changes relative to the reference readings, so no movement profiles can be reviewed. These initial readings of inclinometers should be obtained for future processing and interpretation (BGC 2010).

- The reasons for the initial installation of inclinometers and thermistors are to be determined from historical design and construction documents in order to review the relevance of these instrumentation readings to the current performance of the Canal Dyke and Rose Creek Diversion Channel as well as the requirements for ongoing monitoring of these instrumentations.

- There is an indication that the above instrumentations were installed to track the geothermal and deformational development of the discontinuous permafrost present in the original foundation of these structures (Golder 1981). Current geothermal profiles seem to indicate that the foundation at depth at many locations of these structures remains frozen. Thus the current frequency of thermistor-readings at two to three times yearly appears to be reasonable. However, Golder's evaluation of the performance of these instrumentations in the period of 1982 to 1999 should be reviewed.

2.4 North Fork Rock Drain (NFRD) (see Photos 17 to 18 and Figure 1)

The North Fork Rock Drain is a mine haul road stream crossing constructed of coarse waste rock fill, and drain rock. It functions as a conduit for water travelling along the North Fork Rose Creek to continue on across the haul road along its southern reach, see Figures 1 and 2. The haul road that the stream crosses is approximately 55 m high with a 25 m crest width.

2.4.1 Observations

Observations of this structure during the 2011 site visit by A. Dalpatram are as follows:

- Flow condition was lower than peak runoff during the 2011 spring freshet. Head pond water level was well below the wood debris deposited on the road embankment slope.
- Stable crest and side slopes of mine haul road. Minor slumping of downstream face has occurred but is not a cause for concern at this time.
- Downstream drainage condition is acceptable with three braided channels combined to form one channel at the location of water-level monitoring and water sampling.

2.4.2 Instrumentation

Instrumentation at the North Fork Rock Drain consists of water level readings taken periodically throughout the year to record the pond elevation at both upstream and downstream of the mine haul road. A summary of the historical maximum and minimum values including the most current data (2011) is shown in Table 2.4. Recorded water level plots provided by DES, are given in Appendix II, Section II-E.1.

Table 2.4 Water Level at North Fork Rock Drain

Name	Historical[1] (m)		Current (2011) (m)		Comments
	Max	Min	Max	Min	
NF-1	1094.35[2]	1088.97	1094.35	1089.84	Upstream of haul road
NF-2	1089.11[2]	1085.02	1089.11 on May 12	1084.85 on September 5	Downstream of haul road

Notes: 1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c).
2. Maximum levels increased by 1.47 m from 1092.88 to 1094.35 for NF-1, and by 2.17 m from 1086.94 to 1089.11 for NF-2 based on 2011 data (Golder 2011c).

2.4.3 Comments and Recommendations

- The crest and side slopes of the mine haul road appeared to be stable.
- Continue to monitor head pond level and downstream creek level and flow condition, especially during spring freshet season.
- Water elevations at both NF-1 and NF-2 have exceeded historical maximum values as indicated in Table 2.4, resulting in the modification of maximum historical values.

- Estimate the available freeboard of the North Fork Rose Creek at the Main Access Road crossing (see Photo 11 and Figure 1) on May 12, 2011. We understand that there is another culvert in the vicinity across the Main Access Road. The flow capacity of the North Fork Rose Creek across the Main Access Road should be assessed in light of relatively high water level measured at NF-2, downstream of the North Fork Rock Drain during the freshet of 2011.

2.5 K8 Creek Rock Drain (K8CRD) (see Photos 19 to 20)

The K8CRD is a mine haul road stream crossing constructed of coarse waste rock fill, and drain rock. It functions as a conduit for water flowing along the northern reach of the K8 Creek to cross the main mine haul road. The haul road that the creek crosses is approximately 55 m high with a 25 m crest width. There is currently no instrumentation or monitoring program at this creek crossing.

During the 2011 site visit, A. Dalpatram observed the following:

- Flow condition was lower than peak runoff during the 2011 spring freshet. Head pond water level was well below the wood debris deposited on the road embankment slope.
- The crest and side slopes of the mine haul road appeared to be stable.
- Downstream drainage condition is acceptable.

Future monitoring should continue to check the head pond level and downstream flow condition, especially during the spring freshet season. Location of the K8 Creek Rock Drain should be shown on site figures.

2.6 Secondary Tailings Impoundment (STI) (see Photos 21 to 26 and Figures 1 and 2)

The Secondary Tailings Impoundment is located on the east side of the Down Valley project area. The Secondary Tailings Dam is a perimeter tailings dam that retains tailings, supernatant, and run-off water, and encloses the original tailings impoundment. The dam crest is approximately 1120 m long, 6 m wide, with the crest elevation varying from El. 1060.2 m to El. 1063.3 m along its length. The overall dam height is about 28 m.

2.6.1 Observations

Observations of the geotechnical aspect of this structure during the 2011 site visit by R. Lo are as follows:

- The crest, upstream and downstream slopes appeared to be stable.
- No evidence of seepage along the downstream slope.
- Lower road conditions were satisfactory.
- A row of tailings piles was located on the upstream shoulder of the crest along the southwest portion of the dam. Tailings deposits covering the dam crest in the area were eroded by runoff from this row of tailings piles (see Photo 25).
- Cracks that were observed previously along the downstream road in the vicinity of the upstream end of the Rose Creek Diversion Channel were not seen, possibly due to road grading work.

2.6.2 **Instrumentation** (see Figure 8)

Instrumentation at the Secondary Tailings Impoundment consists of 3 standpipe piezometers installed in 1981 on the dam crest and 4 standpipe piezometers installed in 2003 in the tailings pond (Piezometer P03-4 has not been monitored since September 2008). A summary of the current readings taken from these instruments along with historical maximum and minimum readings are shown in Table 2.5. Individual plots of piezometric levels at these piezometers as provided by DES, are included in Appendix II, Section II-F.1. Piezometers P81-6 to P81-8 have been dry, while P03-1 to P03-3 show variation less than 1 m except when blockage occurred. The piezometric levels monitored at these piezometers have been quite steady, about 5 m to 6 m below the ground surface when not dry.

Table 2.5 Historical and Current Water Level at Piezometers Located at Secondary Tailings Impoundment

Location	Piezo-meter[3]	Historical[1] (m)		Current (2011) (m)		Comments
		Max	Min	Max	Min	
Dam Crest	P81-06	Dry	Dry	Dry	Dry	-
	P81-07	Dry	Dry	Dry	Dry	-
	P81-08	Dry	Dry	Dry	Dry	-
Tailings Pond	P03-01	-[2]	1054.54	1055.60	1055.20	-
	P03-02	-[2]	1053.72	1054.53	1054.48	-
	P03-03	-[2]	1054.48	-[2]	1054.41	-

Notes:
1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c).
2. Max. reading near ground level due to blockage.
3. P03-04 piezometer has not been monitored since September 2008, but no reason was recorded.

2.6.3 Comments and Recommendations

- Continue to monitor dam performance.
- Continue to monitor piezometer instrumentation.
- Continue to monitor any cracks on the downstream road adjacent to the upstream end of the Rose Creek Diversion Channel, where cracks were observed in the spring of 2011.
- Check vegetation growth on the downstream dam slope periodically and clear vegetation, as required.

2.7 Intermediate Dam (ID) (see Photos 27 to 38 and Figures 1 and 2)

The Intermediate Dam is located at the west end of the Intermediate Pond, just east of the Polishing Pond. It retains tailings, supernatant, and run-off water on the upstream side and polishing pond water on the downstream side. The dam is approximately 650 m long, 7 m wide at the crest and 32 m high. The dam crest elevation is at 1049.2 m, and the spillway invert elevation is at 1047.7 m.

2.7.1 Observations

Observations of the dam during the 2011 site visits by R. Lo and A. Dalpatram are as follows:

- Pond level was drawn down, and pump barge was being removed in preparation for the winter.
- Stable crest, upstream and downstream slopes and spillway channel, in general.
- Near south abutment, minor upstream slope fill adjustment was noted (see Photo 33).
- Wave erosions of upstream slope were closely inspected at different elevations (see Photos 29 to 31).
- Downstream slope is experiencing extensive rill erosion (see Photos 34 and 38), with longitudinal cracks and minor slope slumps developing (see Photo 35), and eroded materials are depositing on the downstream berm, which had been graded for berm maintenance, thus was not very apparent.
- DES placed wooden stakes on the downstream slope in the southwest portion to assist ongoing monitoring (see Photos 34 and 35).
- Significant shoulder erosion of the downstream berm was also observed at numerous locations, which require repair (see Photo 36).
- Eroded debris from the downstream slope could potentially cover the exit face of the drainage zone above the downstream berm surface.

2.7.2 **Instrumentation** (see Figures 7 and 9)

Instrumentation at the Intermediate Dam consists of a pond level measurement of the intermediate pond; 14 standpipe piezometers at 9 locations; one single pneumatic piezometer and three paired pneumatic piezometers with tips at shallow and deep depths. The pizometers are installed in the embankment zones downstream of the core above, in and below the horizontal drain at the downstream berm elevation as well as in the dam foundation. They are distributed from the northeast dam segment to the southwest abutment (see Figure 9).

A summary of current maximum and minimum pond and piezometric levels as well as corresponding historical maximum and minimum levels are shown in Table 2.6. Plots of piezometric levels for these piezometers are included in Appendix II, Section II-G.1.

Table 2.6 Historical and Current Intermediate Pond and Water Level at Piezometers Located at Intermediate Dam

Location	Name	Historical[1] (m)		Current (2011) (m)		Comments
		Max	Min	Max	Min	
Water Level Readings						
Int. Pond	IP	1047.58	1043.47[2]	1045.59	1043.47	Target El. 1043 m
Standpipe Piezometers (Nested piezometers at P01-4, BH96-3 and BH96-4)						
Dam Crest	BH96-1	1031.65	1027.37[3]	1028.67	1027.37	-
	BH96-2	1031.94	1028.44	1029.13	1028.89	-
	BH94-IDC-1	dry	dry	dry	dry	-
	BKS04-06	dry	dry	dry	dry	-
	BKS04-07	dry	dry	dry	dry	-
Dam Toe	P01-3	1030.63	1027.48[3]	1029.64	1027.48	-
	P01-4A	1032.24	1029.27	1031.42	1029.68	Shallow
	P01-4B	1032.17	1029.06	1030.68	1029.07	Deep
	BH96-3A	1031.38	1026.62	1028.67	1027.78	Shallow
	BH96-3B	1031.45	1027.48	1028.7	1027.86	Deep
	BH96-4A[4]	1032.04	1027.61	-	-	No readings for 2011
	BH96-4B[4]	1032.28	1028.39	-	-	No readings for 2011
	BH96-4C[4]	1031.64	1027.74	-	-	No readings for 2011
	BH96-4D[4]	1031.75	1027.62[3]	1028.87	1027.62	-
Pneumatic Piezometers (BH91-ID3 to ID6 are nested piezometers with one tip deep and one shallow)						
South Abutment	BH91-ID3	1039.23	1036.82	1037.31	1036.82	Shallow
		1038.04	1030.32[3]	1033.87	1029.32	Deep
Dam Toe	BH91-ID4	1035.91	1028.28	1029.68	1028.49	Shallow
		1031.85	1026.74	1028.35	1027.02	Deep
	BH91-ID6	1040.9	1026.62[3]	1028.09	1026.62	Shallow
		1034.96	1020.82	1029.15	1027.82	Deep
	BH91-ID7	1035.2	1028.82[3]	1029.94	1028.82	-

Notes:
1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c).
2. Minimum level decreased by 0.08 m from 1043.55 to 1043.47 m for Intermediate Pond based on 2011 data (Golder 2011c).
3. BH96-1 Minimum level decreased by 0.26 m from 1027.63 m to 1027.37 m.
   P01-3 Minimum level decreased by 0.26 m from 1027.74 m to 1027.48 m.
   BH96-4D Minimum level decreased by 0.11 m from 1027.73 m to 1027.62 m.
   BH91-ID3 Deep Minimum level decreased by 0.47 m from 1030.79 m to 1030.32 m.
   BH91-ID6 Shallow Minimum level decreased by 0.21 m from 1026.83 m to 1026.62 m.
   BH91-ID7 Minimum level decreased by 0.14 m from 1028.96 to 1028.82 m.
4. BH96-4: 4 nested piezometers with -4A being the shallowest, and -4D being the deepest.

2.7.3 Comments and Recommendations

- Continue to monitor pond and piezometric levels on a regular basis.

- Continue to monitor upstream slope wave erosion zone because the Intermediate Pond level has been drawn down to below the riprap protection zone since 2010. Remedial measures, such as replacement of riprap, may be required if excessive erosion is observed. However, remedial measures must take into consideration the works required for permanent closure of the pond, which is expected to occur within the next 5 years.

- Continue to monitor minor damfill adjustment of the upstream slope near the south abutment.

- Repair shoulder erosions of the downstream berm.

- Monitor ongoing development of rill erosions on the downstream slope and related longitudinal cracks and slope slumps.

- Consider experimenting with potential remedial measures to mitigate rill erosion development on the downstream slope, such as grass planting or placement of riprap, or gabions.

- Monitor sediment deposition over the discharge face of the drainage zone above the downstream berm surface.

- Check piezometric data to ascertain potential blockage of drains.

- Review and update, if required, geotechnical stability analyses based on the current planned pond operation range.

- The piezometric levels either show a downward trend or are in a range consistent with historical variations.

- The pond should be pumped down to the targeted drawdown level as described in the 2011 Geotechnical Data Review (Golder, 2011c).

2.8 Cross Valley Dam (CVD) (see Photos 39 to 42 and Figures 1 and 2)

The Cross Valley Dam is located immediately west of the Polishing Pond at the downstream limit of the Rose Creek Tailings Facility. The Polishing Pond is designed for the 60-day retention capacity for seepage from the tailings storage facility and discharge from the Faro Water Treatment Plant. The Cross Valley Dam is 500 m long, 7 m wide at the crest and 17 m high. The dam crest elevation is at 1033.1 m, while the spillway channel invert is at 1031.7 m.

2.8.1 Observations

Observations of the dam during the 2011 site visits by R. Lo and A. Dalpatram are as follows:

- The crest, upstream and downstream slopes and spillway channel appeared to be stable.
- Tension cracks previously observed on the dam crest in the spring of 2011 were not observed.

2.8.2 Instrumentation (see Figures 7 and 10)

Instrumentation at the Cross Valley Dam consists of a pond level measurement, 12 standpipe piezometers, four pneumatic piezometers and two thermistors. Except one piezometer installed in the embankment zone downstream of the core, all other piezometers are installed in the dam foundation at and beyond the downstream toe and beneath the dam crest. One functional shallow thermistor string (BH88-4) is installed in the dam fill zone upstream of the dam core, and one deep thermistor string is installed in the dam foundation underneath the upstream dam crest shoulder (CVDC-6). In addition, four weirs are installed downstream of the dam, Weir X11, X12, X13, and Weir 3.

A summary of historical and current pond and piezometer levels are shown in Table 2.7. Thermistor BH88-4 data indicates that the dam fill undergoes seasonal temperature variation from below to above 0^{o} C down to a depth of 4.2 m, while the deep Thermistor CVDC-6 data indicates that the dam foundation is essentially thawed. A summary of historical and current maximum and minimum flow weir readings are shown in Table 2.8.

Detailed readings and plots, as provided by DES, are included in Appendix II, Section II-H.

Table 2.7 Historical and Current Polishing Pond and Water Level at Piezometers Located at Cross Valley Dam

Structure	Name	Historical[1] (m)		Current (2011) (m)		Comments
		Max	Min	Max	Min	
Water Level Readings						
Polish Pond	PP	1030.33	1026.31	1029.35	1026.94	Target El. 1027 m
Standpipe Piezometers						
Dam Toe	CVDT-1	1018.57	1017.13	1017.83	1017.78	-
	CVDT-2	1019.5	1015.43	1015.66	1015.49	-
	P01-02[2]	1018.3	1017.42	1017.21	1017.01	Shallow
		1019.73	1017.86	1019.73	1018.86	Deep
	P01-11[2]	1017.83	1016.65	1016.77	1016.61	-
Dam Crest	CVDC-4	1019.05	1016.72	1018.68	1018.57	Deep
	CVDC-7	1017.74	1015.14	1015.36	1015.34	Shallow
		1019.21	1015.27	1017.47	1017.33	Deep
	94CVDC-1[2]	1024.58	1022.73	1023.18	1022.71	-
	CVDC-9	1024.74	1019.91	1020.52	1020.34	Shallow
		1025.61	1021.18	1023.25	1023.02	Deep
Pneumatic Piezometers						
Dam Toe	CVDP-1	1019.83	1017.38	1018.22	1018.01	-
	CVDP-3	1017.65	1016.11	1016.39	1016.11	-
	CVDP-5	1022.05	1018.13	1020.30	1020.09	-
	CVDP-6	1019.55	1016.99	1017.73	1017.59	-

Notes:
1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c).
2. Historical minimum has been reduced by 0.41 m from 1017.42 m to 1017.01 m for P01-02. Historical minimum has been reduced by 0.04 m from 1016.65 m to 1016.61 m for P01-11. Historical minimum has been reduced by 0.02 m from 1022.73 m to 1022.71 m for 94CVDC1.

Table 2.8 Historical and Current Maximum and Minimum Weir Flow Downstream of Cross Valley Dam

Weir Number	Historical (L/s)		Current (2011) (L/s)	
	Maximum	Minimum	Maximum	Minimum
X11 (North)	20.9	2.56[2]	8.15	2.56[1]
W3 (Central)	7.1	0.13[2]	3.69	0.13[1]
X12 (South)	2.03[3]	0.03[2]	2.03	0.03[1]
X13 (Combined)	43.9	10.1	34.5	11.0

Notes:
1. Minimum flow in 2011 was below historical minimum value for Weirs X11, W3 and X12.
2. Historical minimum has been reduced from 3.8 to 2.56 L/s for Weir X11, from 1.7 to 0.13 L/s for Weir W3 and from 0.1 to 0.03 L/s for Weir X12.
3. Historical maximum has been increased from 1.0 to 2.03 L/s for X12.

2.8.3 Comments and Recommendations

- Continue to monitor pond and piezometric levels, ground temperatures and weir flows on a regular basis.
- Monitor potential recurrence of tension cracks on the dam crest.
- The piezometric levels either show a downward trend or are in a range consistent with historical variations.
- Thermistor BH88-4 data indicates that the dam fill undergoes seasonal temperature variation from below to above 0^{o} C down to a depth of 4.2 m, while the deep Thermistor CVDC-6 data indicates that the dam foundation is essentially thawed. Thus, the frequency of thermistor-readings for the Cross Valley Dam could be reduced to once a year sometime in June. Weirs X11, X12 and Weir 3 show lower flow readings than past minimum values, while Weir X12 shows higher reading than past maximum value.
- The pond should be pumped down to the targeted drawdown level as described in the 2011 Geotechnical Data Review (Golder, 2011c).

3. VANGORDA PLATEAU SITE FACILITIES

3.1 **Grum Pit (GP)** (see Photos 43 to 46 and Figures 3 to 5)

The Grum Pit is the northern most major structure at the Vangorda Plateau Site, approximately 12 km southeast of the Faro Pit. It is currently an inundated, inactive open pit with an approximate elliptical shape, extending 850 m in the north/south direction and 600 m in the east/west direction. The dominating wall of the pit is the east pit wall which is 160 m high. Instability of the east wall appears to be still evolving (Golder 2009a), and ongoing monitoring of potential pit-wall brim movement started in the summer of 2010.

3.1.1 Observations

Observations of the Grum Pit during the 2011 site visits by R. Lo and A. Dalpatram are as follows:

- There appears to be a new slump on the southeast wall of the pit (see Photo 46).

3.1.2 **Instrumentation** (see Figure 11)

Instrumentation at the Grum pit involves two sets of monitoring pins: 6 pins (GP-N1 to GP-N6) and 4 pins (GP-S1 to GP-S4) along two alignments about 150 m apart (see Figure 11) for monitoring movement on the pit wall brim. Two pins furthest away from the pit wall (GP-N6 and GP-S4) are assumed stationary. Distances from other pins relative to the stationary pin along the same alignment are measured periodically and calculated to detect any relative movements. In addition, there is a pit pond-level measurement point, and two piezometers installed in the Grum Pit cut slot.

A summary of the maximum extension of these points as compared to readings taken in July 2010, is shown in Table 3.1. Plots showing changes of the distance from a given monitoring pin to the corresponding reference pin as provided by DES, are given in Appendix II, Section II-I.

Table 3.1 Relative Distance from Monitoring Pin to Stationary Pin on Grum Pit Wall Brim

Location	Pin Name	Distance Measured Relative to Pin GP-S4 or GP-N6, (m)		
		July 29, 2010	**Dec.6, 2011**	**Relative to GP-S4**
South Alignment	GP-S1	29.006	28.983	GP-S1
	GP-S2	23.444	23.423	GP-S2
	GP-S3	15.630	15.620	GP-S3
	GP-S4	0	0	GP-S4
				Relative to GP-N6
North Alignment	GP-N1	28.738	28.725	GP-N1
	GP-N2	23.356	23.349	GP-N2
	GP-N3	18.130	18.114	GP-N3
	GP-N4	12.004	11.997	GP-N4
	GP-N5	5.740	5.726	GP-N5
	GP-N6	0	0	GP-N6

Notes: 1. **GP-S4 and GP-N6 Pins assumed stationary.**

Detailed data of pond water level, monitoring-pin survey and cut slot piezometers, as provided by DES, are included in Appendix II, Section II-I. As shown on the chart in Section II-I.1, the pond level at Grum Pit rose 2.81 m from 1208.64 m on January 3, 2011 to 1211.45 m on January 3, 2012. It is currently above the AMP trigger level at about 1211 m. If the pond level continues to rise at the same rate in 2012, it would most likely rise above the maximum recommended elevation at about 1213.5 m.

3.1.3 Comments and Recommendations

- An error on the record for Pin GP-N5 on January 5, 2012 is suspected. This error is suspected to propagate to calculated distances for other pins as shown on pages 3 to 5 of Appendix II-I.2. This should be checked by TEES. Essentially, records show that there is little change in the relative distances measured between the monitored pins for both the GP-N1 to GP-N6 array and GP-S1 to GP-S4 array located, respectively, north and south of the transformer station.

- The calculation and plotting of "velocity of pins movement" do not enhance the interpretation of monitored data and, therefore, should be discontinued.
- Continue visual monitoring of pit wall conditions with photos taken from the same vantage points.
- Continue survey of monitoring pins installed on the pit brim.
- Survey of pit-brim monitoring pins since 2010 seems to indicate nominal variation of distances between pins, which could be attributed to random measurement errors.
- Movement-monitoring survey techniques used for the Grum Pit brim seem to provide more accurate result than those used for the Faro Pit brim. Improvement of survey techniques used at the Faro Pit brim could be considered.
- Piezometric level at both piezometers shows a variation range of about 1 m in the summer months. Significant drop of piezometric level in winter months could be due to the influence of freezing.
- Currently, the Grum Pit pond level is above the AMP trigger level at about 1211 m, and would most likely rise above the maximum recommended elevation at about 1213.5 m by the end of 2112. We understand that to date there is no pump installation at Grum Pit to drawdown the pond level. Thus, control of pond level at the Grum Pit by installing a pump barge should be a high priority in 2012.

3.2 **Vangorda Pit (VP)** (see Photos 47 to 48)

The Vangorda pit is approximately 1.8 km southeast of the Grum Pit, just to the north of the Vangorda Waste Dump, see Figures 3 to 5. It is an inactive, inundated open pit with an approximate elliptical shape, long axis oriented in the northwest to southeast direction.

3.2.1 Observations

We understand that, currently, there is a pump barge that pumps water to the water treatment plant (see Photo 48).

3.2.2 Instrumentation

There is currently only a pit pond-level measurement point at the Vangorda Pit. Pond-level data and plots provided by DES are included in Appendix II, Section II-J.

3.2.3 Comments and recommendations

Continue visual monitoring of pit wall conditions with photos taken at same vantage points at least at yearly interval.

- Pond water level has been decreasing since 2009 and is well below the maximum recommended elevation. Continue to monitor the pond water level on a regular basis.

3.3 Grum Dump (GD) (see Figures 3 to 5)

The Grum Dump is an old waste dump located just south of the Grum Pit. The dump is currently undergoing reclamation. It was not visited during the site visit due to ongoing work with heavy equipment. We understand that the recent reclamation work at the Grum Dump caused an excess runoff event in the spring of 2011, resulting in siltation of Moose Pond, and temporary rise of Moose Pond water level and excess seepage from the pond as discussed in Section 3.11.

We recommend that regular visual monitoring be carried out for the Grum Dump, including taking photos.

3.4 Vangorda Waste Rock Dump (VWRD) (see Photos 49 to 64)

The Vangorda Waste Rock Dump, located to the south of the Vangorda Pit and Little Creek Dam, has six transverse base drains installed beneath the glacial till starter dyke to collect dump seepage into a seepage collection ditch. The collected seepage, in turn, drains into a pond retained by the Little Creek Dam, see Figures 3 to 5 (SRK-Robinson 1994).

3.4.1 Observations

Observations of the waste dump and its transverse base drains during the 2011 site visits by R. Lo and A. Dalpatram and are as follows:

- Drain No. 1 – The drain was dry (see Photos 54 and 56), and does not have a weir. DES reported that the drain is usually dry.
- Drain No. 2 – The drain was dry. DES reported that the drain is usually dry.
- Drain No. 3 – The staff gauge was tilted, and the weir plate was found to be delaminated (see Photos 57 and 58). DES reported that the flow is usually measured with a bottle and a watch.
- Drain No. 4 – The drain does not have a weir (see Photo 62). DES reported that usually only a small trickle flows through the drain, and the flow is estimated by eye.
- Drain No. 5 – The weir plate was found to be split into two pieces (see Photo 63). There are boulders in the pool upstream of the weir and the channel invert downstream of the weir appeared to be too high to provide the flow condition required for proper flow measurement.
- Drain No. 6 – The weir plate and channel appeared to be in satisfactory condition for flow measurement. There was evidence of subsidence of waste dump slope above the drain in the past (see Photos 52, 53 and 64).

3.4.2 **Instrumentation** (see Figures 4, 5 and 12)

Instrumentation at the Vangorda Waste Dump consists of four v-notch weirs at transverse base drains 2, 3, 5 and 6 for flow measurement, 16 piezometers and 4 groundwater monitoring wells in the dump area. The maximum piezometric level in 2011, and the corresponding date as well as trigger level as provided by SRK (2011), are shown in

Table 3.2. Detailed data on base drain flows and piezometric levels provided by DES are included in Appendix II, Section II-K.

Table 3.2 Monitored and Trigger Piezometer Level at Vangorda Waste Dump

Groundwater Monitoring Well/ Piezometer		Date of Max. Piez. Level in 2011	Max. Piez. Level, m	Trigger Level[1] m (amsl)	Above Trigger Level
V34	GW-94-01	Sept. 4	1111.58	1115	No
V35	GW-94-02	Sept. 4	1110.37	1115	No
V36	GW-94-03	Jul. 2	1110	1113	No
V37	GW-94-04	Sept. 4	1107.72	1109	No
V39	P-94-01A	Jan. 24	1125.26	1131	No
V40	P-94-01B	Nov. 3	1130.7	1133	No
V41	P-94-02A	Oct. 11	1130.47	1133	No
V42	P-94-02B	Sept. 26	1132.24	1134	No
V43	P-94-02C	Sept. 20	1121.6	1125	No
V44	P-94-03A	Oct. 11	1120.96	1126	No
V45	P-94-03B	Sept. 26	1124.71	1126	No
V47	P-94-04B	Sept. 20	1125.48	1126	No
-	P-2001-02A	May 23	1119.02	1123	No
-	P-2001-02B	May 30	1118.95	1123	No
-	P-2001-03	Oct. 31	1082.31	1120	No
DH1	PW-10-01	Oct. 11	1126.05	1135	No
DH2	PW-10-02	May 30	1128.18	1131	No
DH3	PW-10-03	Jan. 24	1123.47	1130	No
DH4	PW-10-04	Mar. 28	1132.57	1133[2]	No
DH5	PW-10-05	May 23	1137.95	1139	No

Notes: 1. Trigger levels were taken from SRK (2011).
2. Trigger level at Piezometer PW-10-04 in Hole DH4 was increased from 1132 to 1133 m by SRK (2011).

3.4.3 Comments and Recommendations

Comments and recommendations regarding future geotechnical performance of the Vangorda Pit are as follows:

- Drain No. 3 – Staff gauge and delaminated weir plate should be repaired, if flow is not measured with a bottle and watch.

- Drain No. 4 – A weir should be installed, if flow increases to measurable levels.
- Drain No. 5 – Weir plate should be repaired. Boulders in the upstream pool should be removed and the channel invert immediately downstream of the weir should be lowered slightly to provide good free flow conditions required for weir flow measurement.
- Drain No. 6 – Continue to monitor subsidence of waste dump slope above the drain observed in the past.
- Flows at all base drains are consistent with historical data.
- Piezometric level at all piezometers and groundwater monitoring wells in 2011 varies within the historical range, and is below the trigger level provided by SRK (2011).

3.5 **Grum Interceptor Ditch** (see Photos 65 to 70 and Figures 3 to 5)

The Grum Interceptor ditch diverts water around the Grum Pit and Grum Overburden Dump. It consists of the following three reaches:

- 900 m long ditch upslope of the Grum Pit to divert clean water away from the pit;
- 900 m long ditch along the northeast toe of the Grum Overburden Dump; and,
- 650 m long ditch to convey flow downhill to Tributary B of the Vangorda Creek.

A. Dalpatram observed the following during the 2011 site visit:

- Stable channel and side slopes; and,
- Light vegetation growth along some portions of the ditch.

There is currently no instrumentation for the Grum Interceptor Ditch. Future monitoring of the ditch should include looking for ditch blockage, slope slump, or increased vegetation growth.

3.6 **North East Interceptor Ditch (NEID)** (see Photos 71 to 74, Figures 4 to 5)

The North East Interceptor Ditch diverts surface runoff away from the Vangorda Pit. A. Dalpatram observed the following during the 2011 site visit:

- Flow condition similar to that on May 24-25, 2011.
- Evidence of ditch cleaning (i.e., re-excavation of ditch channel) was noted along the upstream reach, where the ditch appeared to be shallow (see Photo 71).
- Minor ditch side-slope slumps along most of the ditch (see Photo 73).

There is currently no instrumentation in place to monitor the ditch flow. Future monitoring of the ditch should include:

- Monitor ditch side slopes, especially along reaches with slope slumps; and,
- Check existing ditch dimensions against design dimensions for upstream reach to confirm that the ditch has adequate capacity.

3.7 **Vangorda Creek Diversion (Flume)** (see Photos 75 to 86 and Figures 3 to 5)

The Vangorda Creek Diversion (Flume) diverts flow from Vangorda Creek around the Vangorda Pit via a Corrugated Steel Pipe (CSP) half-pipe, or flume. The headworks for the flume include: a main culvert under the road at the upstream end of the flume and a trashrack at the culvert inlet (see Photo 77), and two emergency spillway culverts with a trash rack at a higher level under the road (see Photo 76). At the end of the diversion, the flume discharges to a plunge pool (see Photos 83 and 84), west of the Vangorda Pit, and the flow is carried across the haul road via a CSP culvert and drop box to the Vangorda Creek (see Photo 86). There is no instrumentation related to the diversion flume.

3.7.1 Observations

Observations by A. Dalpatram during the 2011 site visit are as follows:

- Trashracks for the main culvert and emergency spillway culverts at the headworks were clear (see Photos 76 and 77). There was some build-up of sediment against the main culvert trashrack (see Photo 77).
- Pipe plates at the first and last joints in the main culvert appear to be separated (see Photos 78, 80).
- When viewed from upstream end, the crown of the main culvert appeared to have slightly deformed downwards. When viewed from downstream end, the main culvert appeared to have a vertical bend near the upstream end.
- The flume is damaged, mainly from ice removal activities during the winter (The half section of CSP was dented with holes, and the pipe bracings were bent or broken, see Photos 81 and 82). We understand that no ice removal has taken place in recent years.
- There was a small amount of debris against trashrack at the inlet of the culvert to the drop box (see Photo 84).
- Pipe plates at the first joint in the culvert to the drop box appear to be separated (see Photo 85).

3.7.2 Comments and Recommendations

- Check as-built drawings to determine if the main culvert has a vertical bend.
- Monitor trashracks and remove debris and sediment, as required, to maintain discharge capacity.
- Monitor corrosion and abrasion along the culvert inverts.
- Monitor culverts for deformation and separation of plates at joints.

- Monitor condition of the flume and try to avoid further damage to the flume during ice removal activities.

3.8 Little Creek Dam (LCD) (see Photos 87 to 94 and Figures 3 to 5)

The Little Creek Dam was completed in 1991. It is located just northwest of the Vangorda Waste Dump, and currently collects contact water from the Vangorda Waste Dump in the form of seepage and surface runoff. Water collected here is pumped to the Vangorda Pit for treatment at the Vangorda water treatment plant, see Figures 3 to 5.

The Little Creek Dam is a homogeneous embankment dam constructed of local glacial till. It has a cutoff trench and a granular base drains downstream under the downstream slope (see Figure 14 for the dam section). The crest is about 10 m above natural ground, ranging in elevation from 1114.5 m to 1120 m. Side slopes are 2H:1V on the downstream side and 2.5H:1V on the upstream side. A zone of permafrost encountered at the south abutment was excavated prior to till placement. A 900 mm diameter, Corrugated Steel Pipe (CSP) emergency spillway is located at the south abutment (see Photos 88 and 89).

3.8.1 Observations

Observations of the Little Creek Dam by R. Lo during the 2011 site visit are as follows:

- Stable dam crest and slopes (see Photos 87, 89 to 91 and 94) with rill erosions developed on both the downstream and upstream crest shoulders and slopes (see Photos 92 and 93).
- Culvert spillway was in good condition (see Photos 88 and 89).
- Pond level was drawn down prior to the removal of submersible pump in preparation for the winter (see Photo 93).

3.8.2 Instrumentation (see Figures 13 and 14)

Instrumentation at the Little Creek Dam consists of a pond level measuring point; three pared pneumatic piezometers (P94-LCD-1 to P94-LCD-3) with tips at both shallow and deep depths; three thermistor strings installed in 1994 on the dam crest (94LCD-4T to 94LCD-6T) to a depth ranging from 13 m to 17 m; and seven piezometers (P09-LCD-1 to P09-LCD-7) installed in 2010 along the downstream toe (SRK 2011).

Since mid-2010, the pond level has been lowered by about 2 m from the range of 1109 to 1111 m to the range of 1107 to 1109 m. The pond level and maximum piezometric level and corresponding date in 2011 for these piezometers are summarized in Table 3.3. The ground temperature profiles beneath the dam crest monitored in 2011 indicate that the dam fill and foundation is essentially thawed with the exception of the surficial zone down to a depth of 5 m to 7 m undergoing seasonal freezing. Detailed data of the pond and piezometric levels and ground temperatures, as provided by DES, are included in Appendix II, Section II-L.

Table 3.3 Monitored Piezometer Level at Little Creek Dam

Pond/Piezometer		Date of Max. Piez. Level in 2011 (m)	Max. Piez. Level, m
Pond Level		About 1106.5 to 1109 m since mid-2010	
BH94-LCD-1	Shallow	May 27[1]	1104.16
	Deep		1104.42
BH94-LCD-2	Shallow	May 27[1]	1101.13
	Deep		1099.24
BH94-LCD-3	Shallow	May 27[1]	1105.57
	Deep		1103.37
P09-LCD-1		Jul. 2	1093.74
P09-LCD-2		Jul. 2	1093.46
P09-LCD-3		Jul. 2	1092.04
P09-LCD-4		Jun. 13	1091.62
P09-LCD-6		Jul. 2	1090.57
P09-LCD-7		Sept. 20	1097.41

Notes: 1. Only one reading was taken on May 27, 2011 for piezometers BH94-LCD-1 to BH94-LCD-3.
2. No information about the reason and details for the installation of P09 series of piezometers is available, and P09-LCD-5 may not be functional, as no data for this piezometer is given.

3.8.3 Comments and Recommendations

- Consider repair of rill erosions on both dam slopes.
- Seasonal variation of pond level to be shown on all piezometric-level plots to assist the interpretation of piezometric response to pond level variation.
- For the BH94 series of pneumatic piezometers (LCD-1 to LCD-3 shallow and deep piezometers), the piezometric levels either show a downward trend (LCD-1 shallow and deep) or are in a range consistent with historical variations (LCD-2 and LCD-3 shallow and deep).
- In general, BH94- series piezometers located along the dam crest show piezometric levels fluctuating with the pond level, while P09- series piezometers located along the downstream dam toe only show minor variation of piezometric level, with the exception of P09-LCD-4.
- The details for the installation for P09- series of piezometers are requested for better understanding of the reason for their installation, and interpretation of monitored data obtained from these piezometers.
- Since geothermal profiles at the Little Creek Dam indicate that the temperature at depth is essentially thawed, the frequency of thermistor-readings for the dam could be reduced to once a year sometime in June.

3.9 Sheep Pad Sediment Ponds (see Photos 95 to 97 and Figures 3 to 5)

The Sheep Pad Sediment Ponds are located between the Grum and Vangorda Pits along the main haul road. The facility consists of two ponds which collect surface runoff from upslope areas, including the Grum Overburden Dump. The upstream pond discharges to the downstream pond via a CSP half-round pipe. The lower pond discharges towards the plunge pool for the Vangorda Creek Flume via a riprap lined spillway channel. There is a weir to monitor flow at the sediment ponds (see Photo 95).

During the 2011 site visit, A. Dalpatram observed the following:

- Stable pond retaining dyke embankment; and,
- The upstream section of the spillway channel had no riprap in the bottom, and the underlying geotextile was exposed.

The missing riprap in the spillway channel should be replaced.

3.10 **Grum Settling Pond** (see Photos 98 to 100 and Figures 4 to 5)

The Grum Settling Pond, located just north of the Grum Pit, functions as part of the water treatment facility at the Vangorda Plateau site. Water from the pond discharges to the Grum Interceptor ditch via a riprap lined spillway channel. There is no instrumentation related to the settling pond.

- During the 2011 site visit, A. Dalpatram observed that the spillway channel appeared to be in good condition, with minor vegetation growth. Future monitoring for the settling pond should include periodic check for erosion and vegetation growth along the spillway channel and dyke embankment integrity.

3.11 **V-15 Seep Ditch** (see Photos 101 to 109 and Figures 4 to 5) **and Moose Pond** (see Photos 110 to 115 and Figures 3 to 5)

The V-15 Seep Ditch is a bentomat lined ditch that diverts Grum Dump seepage water from the V-15 pond to Moose Pond. Both structures are located between the Grum Dump and the Vangorda Waste Dump (see Figures 3 to 5). There is currently no instrumentation installed at either the V-15 Seep Ditch or Moose Pond.

Y G (2011a and 2011b) documented the event of excess runoff in the spring of 2011 due to the fact that some of the engineered drainage structures related to the installation of the Grum Sulphide Cell (GSC) cover did not function properly.

3.11.1 Observations

Observations by R. Lo during the 2011 site visit are as follows:

- Excess water from runoff over newly constructed Grum Dump cover was allowed to enter into the Moose Pond in the spring of 2011.
- Significant erosion and slumping of the sides of the V-15 seep ditch was observed at the location where the ditch entered into a steep reach before entering the Moose Pond (see Photos 108).
- Sedimentation caused by excess inflow sealed off the Moose Pond bottom (see Photo 110), and raised the pond level and caused excess seepage through a retaining esker (see Photos 112), and slumping of esker downstream slope (see Photos 113 to 115).
- Cessation of inflow to Moose Pond resulted in drop of pond level to the current level, which is probably higher than previous pond levels.
- Exfiltration from Moose Pond has probably changed from the pond bottom to the bank slope at higher elevations.

3.11.2 Comments and Recommendations

- Repair the damaged section of the V-15 ditch upslope of the Moose Pond.
- Prevent future inflow of extraneous water from sources not in existence prior to 2011 into the Moose Pond.
- Evaluate the exfiltration capacity of the current Moose Pond, and the changes in the groundwater flow regime related to the 2011 spring excess runoff event, by carrying out the following:
  - Determine the bathymetry of the Moose Pond.
  - Monitor the exfiltration performance of the Moose Pond starting from 2012 to determine whether it has an adequate exfiltration capacity, and whether the downstream seepage condition under the new groundwater regime is acceptable?

- Monitor the slope stability and integrity of the esker ridge along the discharge face of its downstream slope (see Photos 112 to 115).
- Review potential remedial works that may be required to restore the stability and integrity of the esker ridge.
- Evaluate the long-term impact of the 2011 excess runoff incident on the normal exfiltration operation of the Moose Pond before the incident. In other words, can the Moose Pond serve its filtration function under the changed condition in the future without detrimental effects, or more costly measure needs to be implemented to restore its original condition.

3.12 Sludge Pond Embankment at Vangorda Water Treatment (see Photos 116 to 118 and Figures 3 to 5)

The Sludge Pond Embankment, located just east of the Grum Pit, is a rectangular shaped pond retained by an embankment dyke. During the 2011 site visit, A. Dalpatram observed that the pond had been emptied resulting in a low water level. There is no instrumentation at this pond and its periphery dyke. Regular monitoring and maintenance are required to ensure satisfactory performance of the structure.

4. SUMMARY

Section 4 summarizes our 2011 review in three sub-sections by means of two tables:

- General review in Section 4.1; and,
- Review of 2011 DES Monitoring Plan in Section 4.2.

4.1 General Review

Table 4.1 Faro Mine Site Complex – 2011 Summer/Fall Site Visit Summary

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Faro Pit	• An inactive open pit, roughly elliptical shaped, with major axis along northwest-southeast direction. • The east wall is about 375 m high, containing two, North and South, Instability Zones, separated by a calc-silicate rock slope. • Minimum distances between the pit wall and the Faro Creek Diversion Channel are 18.5 m and 93 m, respectively in the North and South Instability Zone.	• No obvious changes on the east pit wall North and South Instability Zones were observed. • DES data indicated that no significant changes were measured at reference bars where distances between the pit wall and Faro Creek Diversion Channel have been monitored. Similarly DES pit-wall prisms survey data indicated no significant changes.	• Continue visual monitoring of pit wall conditions with photos taken at same vantage points. • Continue monitoring distances between the pit wall and Faro Creek Diversion Channel at installed reference bars, and improving survey techniques. • Continue monitoring prisms installed on the pit wall. • Continue to have pit slope stability reviewed periodically, especially in case of development of new sizable slumps.
Faro Creek Diversion Channel (FCDC)	• Diverts creek flow from head waters north of the Faro Pit around the east side of the mine site, and discharges into North Fork Rose Creek.	• Flow condition was similar to that on Sept. 21-22, 2010. • Portions of the channel are lined with rock and geotextile or tarp. Rock armour has moved in some areas, and geotextile and tarp are exposed in some areas. • Stable channel and side slopes, satisfactory rock armour and lined channel.	• Continual monitor the staff gauges along the diversion channel. • Continue visual monitoring of diversion channel and any seepage from the channel to the Faro Pit wall with photos taken at strategic points. • Cover exposed geotextile and tarp with rock armour. Replace damaged geotextile and tarp, if any.
North Valley Wall Interceptor Ditch (NVWID)	• Diverts creek flow from north valley wall around tailings impoundment area. • Approximately 3,000 m long, consisting of constructed and natural stream channel sections. Constructed channel sections include: • 920 m long upper reach; • 430 m long middle reach; and • 500 m long lower reach. • Relatively flat channel gradients along constructed sections and steep stream gradients along natural channel sections.	• Slightly higher flow condition than that on Sept. 21-22, 2010. • Stable channel and side slopes. • Sedimentation developing both up and down gradient from the well-access road crossing. • Moderate to heavy vegetation growth in upper and middle constructed channel reaches.	• Monitor channel sedimentation condition at the well-access road crossing, and remove sediments if excessive sediment is deposited in the channel. • Clear vegetation along upper and middle constructed channel reaches. Clearing should also include the access road and berm along the channel to facilitate future inspection.
Rose Creek Diversion Channel (RCDC)	• Diverts creek channel flow around south side of tailings impoundment area. • Approximately 3,800 m long with relatively flat to moderate stream channel gradients along upper reaches and steep gradients along lower reaches.	• Flow condition was similar to that on Sept. 21-22, 2010. • Stable channel and side slopes, satisfactory rock armour conditions. • Channel vegetation removal operation commenced last year but was not completed due to time/weather constraints. • Minor seepage from RCDC at base of spoil piles into CVD Polishing Pond was reported previously, but could not be located during this inspection.	• Continue to monitor instrumentation. • Conduct geotechnical inspection of RCDC next spring during peak flow condition. • Document seepage locations from RCDC into tailings impoundment area after fresh snow fall condition.

Table 4.1 Faro Mine Site Complex – 2011 Summer/Fall Site Visit Summary (cont'd)

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
North Fork Rock Drain (NFRD)	• Mine haul road stream crossing constructed from coarse waste rock fill and drain rock. • Road embankment approximately 55 m high, with 25 m crest width.	• Flow condition was lower than peak runoff during 2011 spring freshet. Head pond water level was well below beached wood debris level on road embankment slope. • Stable crest and side slope of mine haul road. Minor slumping of downstream face has occurred but is not a cause for concern at this time. • Downstream drainage condition is acceptable with three braided channels combined to one channel at water-level monitor and sample location.	• Continue to monitor head pond level and downstream flow conditions. • Currently there is an auxiliary culvert beside the main culvert across the main access road. • Estimate available freeboard of North Fork Rose Creek at the main access road crossings on May 12, 2011, when highest creek level was recorded at NF-2 location. • Consider contingency measures for the potential flood impact on the main access road.
K8 Creek Rock Drain (K8CRD)	• Mine haul road stream crossing constructed from coarse waste rock fill and rock drain. • Road embankment approximately 55 m high, with 25 m crest width.	• Flow condition was lower than peak runoff during 2011 spring freshet. Head pond water level was well below beached wood debris level on road embankment slope. • Stable crest and side slopes of mine haul road. • Downstream drainage condition acceptable.	• Continue to monitor head pond level and downstream flow conditions. • Show the location of the rock drain on site figures.
Secondary Tailings Impoundment (STI)	• Perimeter tailings dam, retains tailings, supernatant and run-off water. • Encloses original tailings impoundment. • Dam Crest approximately 1120 m long, 6 m wide and, varies from El. 1060.2 m to El. 1063.3 m. • Dam height: 28 m.	• Stable crest, upstream and downstream slopes • No evidence of seepage along the downstream toe. • Lower road conditions are satisfactory. • A row of tailings is located on the upstream shoulder of the crest along the southwest portion of the dam, forming the source of tailings deposited on the dam crest due to runoff erosion. • Cracks that were observed previously along the downstream road adjacent to the upstream end of the Rose Creek Diversion Channel were not seen, possibly due to road grading work.	• Continue to monitor dam performance. • Continue to monitor instrumentation. • Continue to monitor any cracks on the downstream road adjacent to the upstream end of the Rose Creek Diversion Channel, where cracks were observed previously. • Check vegetation growth on the downstream slope and clear, if required.
Intermediate Dam (ID)	• Intermediate tailings/water dam, retains tailings, supernatant and run-off water on upstream side, and polishing pond water on downstream side. • Dam height: 32m. • Crest approximately 650 m long, 7 m wide at El. 1049.2 m and spillway channel invert at El. 1047.7 m	• Pond level was drawn down, and pump barge was being removed in preparation for the winter. • Stable crest, upstream slope and spillway channel, in general. • Near south abutment, upstream slope fill adjustment was noted. • Wave erosions of upstream slope were closely inspected at different elevations. • Downstream slope was experiencing extensive rill erosion, with longitudinal cracks and minor slope slumps developing, and eroded materials were depositing on the downstream berm, which had been graded for berm maintenance, thus not very apparent. • DES placed wooden stakes on the downstream slope in the southwest portion of the dam to assist ongoing monitoring. • Significant shoulder erosion of the downstream berm was also observed at numerous locations, which require repair. • Eroded debris from the downstream slope could potentially cover discharge face of the drainage zone originally day lighting above the downstream berm.	• Continue to monitor instrumentation. • Continue to monitor upstream face wave erosion. Remedial measures, such as replacement of riprap, may be required if excessive erosion is observed. However, remedial measures must take into consideration the works required for permanent closure of the pond, which is expected to occur within the next 5 years. • Continue to monitor damfill adjustment of upstream slope near the south abutment. • Repair shoulder erosion of the downstream berm. • Monitor ongoing downstream slope rill erosion, and resulting slope slumps and longitudinal cracks. • Consider experimenting with potential remedial measures to reduce rill erosion of the downstream slope, such as grass planting or placement of riprap or gabions. • Monitor sediment deposition over the discharge face of the drainage zone. • Piezometric data at P96-2 appeared to show low piezometric level, and not indicating blockage of drainage zone. • Review and update, if required, geotechnical stability analysis based on current dam conditions, including lowered operating water levels implemented since mid-2010.

Table 4.1 Faro Mine Site Complex – 2011 Summer/Fall Site Visit Summary (cont'd)

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Cross Valley Dam (CVD)	• Polishing Pond dam is designed for 60-day retention capacity of seepage and discharge water from tailings storage facility and water treatment plant. • Dam height: 17 m. • Crest approximately 500 m long, 7 m wide at El. 1033.1 m and spillway channel at El. 1031.7 m.	• Stable crest, upstream and downstream slopes and spillway channel. • Tension cracks previously observed on the dam crest, were not seen.	• Continue to monitor instrumentation. • Monitor tension cracks on dam crest, if they reappear.
Vangorda Plateau Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Grum Pit	• An inactive pit, elliptical in shape, extending 850 m in north/south direction and 600 m in east/west direction. • The east pit wall is about 160 m high. • East wall instability appears to be continually evolving.	• There appears to be a new slump on the southeast wall of the pit. • Pit-brim monitoring points survey since 2010 indicates nominal changes, which could be attributed to random measuring errors.	• Continue visual monitoring of pit wall conditions with photos taken from same vantage points. • Continue monitoring distances between survey pins located on the pit brim, perhaps with reduced frequency, if no significant movements are measured. • Continue to have pit slope stability reviewed periodically, especially incase of development of new sizable slumps. • Install pump barge at Grum Pit pond to control pond level.
Vangorda Pit	• An elongated, inactive pit, with the long axis oriented in the northwest-southeast direction. • A pump barge pumps water to the treatment plant.	• Initiate taking photos to document pit wall conditions.	• Continue visual monitoring of pit wall conditions with photos taken at same vantage points at least at yearly interval.
Grum Dump	• Waste dump undergoing reclamation	• The dump was not visited due to ongoing work with heavy equipment. • The re-vegetated slopes of the dump looked good from afar.	• Continue regular monitoring • Excessive runoff developed in the spring of 2011 due to unsatisfactory performance of drainage structures related to the installation of the Grum Sulphide Cell cover. Similar incidents are to be prevented in order to preserve the exfiltration function of Moose Pond.
Vangorda Waste Rock Dump	• Six transverse drains installed beneath the till starter dyke to collect dump seepage into a seepage collection ditch. • Collected seepage drains into a pond retained by the Little Creek Dam	• Drain No. 1 – was dry. Does not have a weir. DES data indicates drain is usually dry. • Drain No. 2 - was dry. DES data indicates drain is usually dry. • Drain No. 3 – Staff gauge was tilted and weir plate was delaminated. DES reports flow usually is measured with a bottle and a watch. • Drain No. 4 – Does not have a weir. Usually only a small trickle flows through drain, and flow is estimated by eye. • Drain No. 5 – Weir plate was split into 2 pieces. There are boulders in the pool upstream of the weir and the channel invert downstream of the weir is too high. • Drain No. 6 – Weir plate and channel in satisfactory condition for flow measurement. There was evidence of subsidence of waste dump slope at the drain in the past.	• Drain No. 3 – Staff gauge and delaminated weir plate should be repaired, if flow is not measured with a bottle and a watch. • Drain No. 4 – A weir should be installed, if flow increases to measurable levels. • Drain No. 5 – Weir plate should be repaired. Boulders in the upstream pool should be removed and the channel invert immediately downstream of the weir should be lowered slightly to provide good free flow conditions required for flow measurement. • Drain No. 6 – Continue to monitor subsidence of waste dump slope above the drain observed in the past.

Table 4.1 Faro Mine Site Complex – 2011 Summer/Fall Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities			
STRUCTURE	**DESCRIPTIONS**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Grum Interceptor Ditch	The Interceptor ditch consists of 3 reaches: • 900 m long ditch upslope of Grum Pit to divert clean water away from the pit; • 900 m long ditch along the northeast toe of Grum Overburden Dump; and • 650 m long ditch to convey flow downhill to Vangorda Creek.	• Stable channel and side slopes. • Light vegetation growth along some portions of the ditch.	• Continue routine monitoring of ditch
North East Interceptor Ditch above Vangorda Pit	• Located uphill of the Vangorda Pit. • Diverts surface runoff away from the pit.	• Flow condition similar to that in May 24-25, 2011. • Minor ditch side-slope slumps observed along most of the ditch. • Evidence of ditch cleaning (i.e., re-excavation) was noted along the upstream portion of the ditch. The ditch appeared to be shallow along this reach.	• Continue to monitor ditch side slopes, especially along reaches with slope slumps. • Check existing ditch dimensions for upstream portion of the ditch against design dimensions to confirm that the ditch has adequate flow capacity as designed.
Vangorda Creek (Flume) Diversion	• Diverts Vangorda Creek around Vangorda Pit via a CSP half-pipe (flume). • Headworks for flume include a main culvert and trashrack. • Headworks also include 2 emergency culverts at a higher level, c/w trashrack. • Flume discharges to a plunge pool, and flow is carried across the haul road via a CSP culvert and drop box to Vangorda Creek channel.	• Trashracks for the main culvert and emergency culverts at the headworks were clear. There was some build-up of sediment against the main culvert trashrack. • Pipe plates at the first and last joints in the main culvert appeared to be separated. • When viewed from upstream end, the crown of the main culvert appeared to have slightly deformed downwards. When viewed from downstream end, the main culvert appeared to have a vertical bend near the upstream end. • Flume is damaged, likely from ice removal activities during the winter (CSP is dented, has holes and pipe bracings are bent or broken). We understand that no ice removal has taken place in recent years. • Small amount of debris against trashrack for the culvert to the drop box. • Pipe plates at the first joint in the culvert to the drop box appeared to be separated.	• Check as-built drawings to determine if main culvert has a vertical bend. • Monitor trashracks and remove debris and sediment, as required, to maintain discharge capacity. • Monitor corrosion and abrasion along the culvert inverts. • Monitor culverts for deformation and separation of plates at joints. • Monitor condition of the flume. Try to avoid further damage to the flume due to ice removal activities, if possible.
Little Creek Dam	• Water dam to collect Vangorda Waste Rock Dump contact water to be pumped to the Vangorda Pit lake.	• Stable dam slopes with rill erosion developed on the downstream and upstream crest shoulders and slopes. • Culvert spillway in good condition. • Pond level drawn down prior to removal of submersible pump in preparation for the winter	• Consider repair of rill erosion on both dam slopes.
Sheep Pad Sediment Ponds	• Facility consists of 2 ponds which collect surface runoff from upslope areas, including the Grum Overburden Dump. • The upstream pond discharges into the downstream pond via a CSP half-round pipe. • The lower pond discharges towards the plunge pool for the Vangorda Flume via a riprap lined spillway channel.	• Stable pond retaining dyke embankment. • The upstream section of the spillway channel has no riprap in the bottom, and the underlying geotextile is exposed.	• Replace missing riprap in spillway channel, and replace damaged geotextile, if any.

Table 4.1 Faro Mine Site Complex – 2011 Summer/Fall Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities			
STRUCTURE	**DESCRIPTIONS**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Grum Settling Pond	• Pond discharges to Grum Interceptor ditch via a riprap lined spillway channel	• Spillway channel appeared to be in good condition, with minor vegetation growth.	• Continue to monitor spillway channel for erosion and vegetation growth. • Continue to monitor retaining dyke embankment.
V-15 Seep Ditch and Moose Pond	• Seepage water from Grum Dump daylights at V-15 Pond. • Bentomat lined V-15 ditch diverts water from V-15 Pond to Moose Pond.	• Significant erosion and slumping of the sides of the V-15 diversion channel was observed at the location where the ditch entered into a steep reach upstream of Moose Pond. • Excess water from runoff over newly constructed Grum Dump cover was allowed to enter into Moose Pond in the spring of 2011. • Sedimentation caused by excess inflow sealed off the Moose Pond bottom, raised pond level and caused excess seepage through a retaining esker, and slumping of esker downstream slope. • Cessation of inflow to Moose Pond resulted drop of pond level to the current level, which is probably higher than previous pond levels. • Exfiltration from Moose Pond has probably changed from the pond bottom to the bank slope at higher elevations.	• Repair the erosion-damaged section of the V-15 ditch upslope of Moose Pond. • Prevent future inflow into Moose Pond from extraneous sources not in existence prior to 2011. • Determine Moose Pond bathymetry. • Continue to monitor Moose Pond performance starting from 2012 to determine new groundwater flow regime related to exfiltration from the Moose Pond, and the exfiltration capacity. • Continue to monitor seepage flow along the downstream slope of the retaining esker. • Continue to monitor the downstream slope of the retaining esker to review potential remedial works required to restore the stability and integrity of the esker ridge. • Evaluate the long-term impact of the 2011 excess-inflow incident on the normal exfiltration operation of the Moose Pond, and consider the optional option.
Sludge Pond Embankment at Vangorda Water Treatment Plant	• Rectangular-shaped sludge pond retained by embankment dyke.	• Low pond level.	• Continue existing monitoring.

4.2 Review of 2011 Monitoring Plan

The Faro Mine Complex is currently in care and maintenance. Table 4.2 summarizes our review of the Dennison Environmental Services (DES) geotechnical - hydrotechnical monitoring frequency in 2011. Our comments are based on our site visit discussions and the data we received since our visits. These preliminary comments are proposed for the review by Yukon Government and DES. Further discussion and ongoing adjustment of the monitoring program based on the review of obtained monitoring data, actual site conditions and operational and maintenance requirements could make the program more flexible and responsive to both the routine and special needs of 2012.

Table 4.2 Review of Dennison Environmental Services 2011 Monitoring Plan

Structure	Type of Record	Monitoring Frequency	
		Current (2011)[1]	Comments
Faro Pit (FP)	Pit Lake Level	Twice monthly	Twice monthly
	Pit Wall Surface Movement Monitoring	Twice yearly	Monitored 3 to 4 times in 2011
	Pit Wall Prisms Survey	Once yearly	Once yearly
Faro Creek Diversion (FCD)	Staff Gauge Reading	Twice monthly from April to October	No reading in 2011
North Valley Wall Interceptor Ditch (NWID)	In-Stream Flow Monitoring	No monitoring program	No monitoring program
Rose Creek Diversion Channel (RCDC)	Staff Gauge Reading	Daily from April to September	Follow schedule closely
North Fork Rock Drain (NFRD)	Water Level Measure	Weekly from May to July Twice Monthly from August to September	NF1 - Twice monthly from mid-May to September in 2011 NF2 - Follow schedule closely
Secondary Dam (SD)	Piezometers	3 times yearly	2 times yearly
Intermediate Dam (ID) and Pond	Pond Water Level	Weekly	Weekly
	Piezometers	3 times yearly	3 times yearly in 2012
Cross Valley Dam (CVD) and Pond	Pond Water Level	Weekly	Weekly
	Piezometers	3 times yearly	3 times yearly in 2012
	Thermistors	3 times yearly	Propose to reduce to once a year in 2012
	Weir Readings	Weekly to monthly	Weekly
Canal Dyke (CD)	Piezometers	2 to 3 times yearly	2 to 3 times yearly
	Inclinometers	2 times yearly	2 times yearly
	Themistors	2 to 3 times yearly	2 to 3 times yearly
Grum Pit (GP)	Pit Wall Surface Movement Monitoring	Monthly	Propose to reduce to 4 times yearly in 2012
	Piezometers	Monthly	Monitored close to planned schedule
Vangorda Waste Rock Dump (VWRD)	Piezometers Within Dump	Twice yearly	Monitored more frequently in 2011 as requested by Yukon Government
	Weir Readings	Twice monthly from May to October	Monitored more frequently in 2011 as requested by Yukon Government
	Monitoring Wells Downstream of Dump	Twice yearly	Monitored more frequently in 2011 as requested by Yukon Government
Little Creek Dam (LCD)	Piezometers	Twice yearly	Monitored as planned
	Thermistors	Twice yearly	Propose to reduce to once a year in 2012

Note: 1. DES monitored specific instruments at special frequency besides those indicated here as requested by Yukon Government in 2011.

5. CONCLUSIONS AND RECOMMENDATIONS

Based on our summer/fall site visits and ongoing data review, the main conclusions and recommendations are outlined in Sections 5.1 and 5.2.

5.1 Conclusions

Our major conclusions are outlined as follows:

- The key waste and water management facilities at both the Faro and Vangorda Plateau sites have functioned satisfactorily in 2011 as in the past. The care and maintenance activities, including instrument monitoring and survey measurement, are performed generally following the planned schedules.
- The pit-wall brim movement monitoring programs at the Faro and Grum Pits indicate that the measured distance changes are within the measurement accuracy. The distance-measurement techniques used at the Grum Pit could be applied at the Faro Pit to improve the accuracy achieved there.
- The latest dam-safety related documents, as we understand, are as follows:
    - Emergency response plan (ERP) for Intermediate Dam, Cross Valley Dam, Little Creek Dam, Faro Creek Diversion Channel, Rose Creek Diversion Channel and Vangorda Creek Diversion Flume (BGC 2008);
    - Operations, Maintenance and Surveillance (OMS) Manual for Selected Dams (BGC 2008); and
    - 2007 Dam Safety Review - Cross Valley Dam, Intermediate Dam and Little Creek Dam (KCB 2008).
- In the 2007 Dam Safety Review, both the Cross Valley Dam and Intermediate Dam were classified as “high” consequence dam, while the Little Creek Dam was classified as “low” consequence dam. According to the Canadian Dam Safety Guidelines (CDA 2007), a dam safety review is required every 7 years for a “high” consequence dam, while no review is required for a “low” consequence dam. Thus, both the Cross Valley Dam

and Intermediate Dam will be due for their third dam safety review in 2014.

- The latest version of the Emergency Response Plan (ERP) and Operations, Maintenance and Surveillance (OMS) Manual appear to be dated in 2008. It would be a good practice to update these documents more frequently due to inevitable changes of site personnel, operation procedures, site conditions and outside contacts.

- The event of excess runoff in the spring of 2011, due to unsatisfactory performance of drainage structures related to the Grum Sulphide Cell cover installation, has silted up the bottom of the Moose Pond and potentially changed its exfiltration groundwater flow regime. The ramifications of this event need to be closely followed up in future years in order to remedy any potential unfavourable impacts.

- In conducting the review of site instrumentation monitoring, we were assisted by Yukon Government to obtain past project reports. It appears that the original reasons for installing some of the instrumentation, such as inclinometers and thermistors along the Canal Dyke were related to foundation permafrost. We would like to request the design and construction documents for the Canal Dyke and the last comprehensive review of instrumentation data in the 1990s.

We have reduced the frequency for thermistor monitoring at the Cross Valley Dam and Little Creek Dam to once a year in June, as the monitored subsoil temperatures now show absence of permafrost.

5.2 Recommendations

Our main recommendations regarding the hydrotechnical and geotechnical aspects of the site facilities as well as the presentation of site monitoring data are discussed below:

<u>Hydrotechnical Aspects</u>

- Faro Creek Diversion Channel:

    - Continual monitor the staff gauges along the diversion channel.

- Cover exposed geotextile and tarp with rock armour. Replace damaged geotextile and tarp, if any.

- North Valley Wall Interceptor Ditch:

  - Monitor channel sedimentation at the well-access road crossing, and remove excessive sediments to maintain flow capacity.

  - Clear dense vegetation growth along the upper and middle constructed channel reaches, including the access road and berm to facilitate ongoing inspection.

- Intermediate Dam:

  - Continue to monitor upstream face wave erosion. Remedial measures, such as replacement of riprap, may be required if excessive erosion is observed. However, remedial measures must take into consideration the works required for permanent closure of the pond, which is expected to occur within the next 5 years.

  - Monitor ongoing downstream slope rill erosion, and resulting slope slumps and longitudinal cracks. Consider experimenting with potential remedial measures, such as grass planting or placement of riprap or gabions.

  - Repair shoulder erosion of the downstream berm.

- Grum Pit:

  - Install a pump barge at the Grum Pit pond to prevent further rise of the pond level above the maximum recommended elevation at 1213.5 m.

- Vangorda Waste Rock Dump:

  - At Drain No. 5 – Weir plate should be repaired. Boulders in the upstream pool should be removed and the channel invert immediately downstream of the weir should be lowered slightly to provide good free flow conditions required for flow measurement.

- North-East Interceptor Ditch above Vangorda Pit:

  - Continue to monitor ditch side slopes, especially along reaches with slope slumps, and repair slumped ditch sections to maintain flow capacity.

- Vangorda Creek (Flume) Diversion:
  - Check as-built drawings to determine if main culvert has a vertical bend.
- Little Creek Dam:
  - Monitor ongoing rill erosion along the downstream and upstream slopes. Consider experimenting with potential remedial measures, such as grass planting or placement of riprap.
- Sheep Pad Sediment Ponds:
  - Replace missing riprap in spillway channel, and replace damaged geotextile, if any.

Geotechnical Aspects

- Faro and Grum Pit Brim:
  - Continue the current pit-brim potential movement monitoring programs and improve the survey techniques at Faro Pit Brim to enhance measurement accuracy.
  - Continue to check pit slope stability periodically, especially in case of development of new sizable slope slumps.
- Intermediate Dam:
  - Both the upstream and downstream slope improvements for the Intermediate Dam should be guided by the long-term closure provision for the dam. Thus, the closure planning for the dam should be considered as a high priority item.
  - Monitor the dam performance, and carry out additional analyses, if necessary, to address the issue of lowered operation range and increased rate of drawdown of the Intermediate Pond level.
- Moose Pond:
  - Monitor quality of seepage water downstream of the esker ridge to confirm that the Moose Pond retains its exfiltration function.

- Follow up the changed exfiltration groundwater flow regime from the Moose Pond starting from 2012.

- Monitor the downstream slope of the esker ridge where seepage flow daylights, and implement remedial measures to maintain the stability and integrity of the esker ridge.

Site Monitoring Data Presentation

The following suggestions are made with the intention to improve the review of massive site monitoring data. Further discussion with site staff may be needed to achieve the objective without causing unnecessary extra work.

- Graphical presentation:

  - Long-term data plot – The selection of time scale tick mark and label should assist readers to readily appreciate the year, and season. Thus, January 1 and July 1 of each year would be good candidates.

  - Yearly data plot – When the long-term plot gets too crowded, such as the temperature profiles, yearly plot for the data in the current year should be provided.

  - Piezometeric data plot – For dam piezometers, the upstream pond level should always be included with sufficient data to show the seasonal variation of the pond level as most of the current plots do.

- Status of Instrument - For each site facility, all historical instrumentation should be tabulated, and their current status indicated (such as functional, or only preserved or status unknown) and the year when the instrument was no longer monitored, and why? In the piezometer summary table, information on ground surface, elevation of piezometer tip or monitored interval should be included. Consideration should be given to update the location plan of all instrumentation for each structure, as required.

- Separation of Summary Charts and Back-up Tabulated Data - Consideration be given to prepare a set of summary plots similar to those included in Appendix II of this report, separating from those supporting data.

- Presentation of Flow Discharge Data - We noticed only staff gauge data were given in metre rather than converted discharge flow for Faro Creek and Rose Creek Diversion Channels in 2011, with no explanation. If difficulty is encountered in flow conversion such as calibration issue, it should be stated. Staff gauge data has to be converted to flow discharge to be useful.

We appreciate the opportunity to work on this interesting and environmentally important project, and to discuss with you and site personnel in our site meetings. We believe that ongoing communication among Yukon Government and its site monitoring representative, closure and annual review consultants is critically important in the current care and maintenance phase.

KLOHN CRIPPEN BERGER LTD.

Arvind Dalpatram. P.Eng. of British Columbia
Senior Project Hydrotechnical Engineer

June 15, 2012

PROFESSIONAL ENGINEER
YUKON
ROBERT C. LO
TERRITORY

Robert C. Lo, P.Eng.
Project Manager

REFERENCES

BGC 2008. Operations, Maintenance and Surveillance Manual for Selected Dams.

BGC 2008. Emergency Response Plan for Intermediate Dam, Cross Valley Dam, Little Creek Dam, Faro Creek Diversion Channel, Rose Creek Diversion Channel and Vangorda Creek Diversion Flume, Nov. 20.

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CDA 2007. Dam Safety Guidelines, Canadian Dam Association, Dec.

Golder 1981. Recommendations for Performance Instrumentation of the Cyprus Anvil Down Valley Project near Faro, Oct. 5.

Golder 2009a. Geotechnical Slope Stability Assessment of the East Wall of the Grum Pit, Nov. 23.

Golder 2009b. 2009 Faro Pit Slope Movement Monitoring, Nov. 24.

Golder 2011a. 2010 Faro Pit Slope Stability - Monitoring Data Review, Feb. 23.

Golder 2011b. 2010 Annual Geotechnical Dam Inspection - Faro Mine Complex, Feb. 28.

Golder 2011c. Geotechnical 2011 Data Review - Faro Mine Complex, Sept. 12.

KCB 2008. 2007 Dam Safety Review - Cross Valley Dam, Intermediate Dam and Little Creek Dam, April 9.

SRK-Robinson 1994. Construction Report - Vangorda Rehabilitation, Nov.

SRK 2011a. 2010 Annual Inspection - Waste and Water Management Facilities - Vangorda/Grum, Feb.

SRK 2011b. 2011 Geotechnical Inspection - Waste and Water Management Facilities - Vangorda/Grum, Aug.

Y G 2011a. Moose Pond and Associated Water Management Structures - Elevated TSS in Discharge to Vangorda Creek, Yukon Energy, Mines and Resources, May 18.

Y G 2011b. Grum Sulphide Cell Surface Water Management: Elevated TSS and Zinc in Discharge to Vangorda Creek, Yukon Energy, Mines and Resources, May 27.

FIGURES

FIGURES

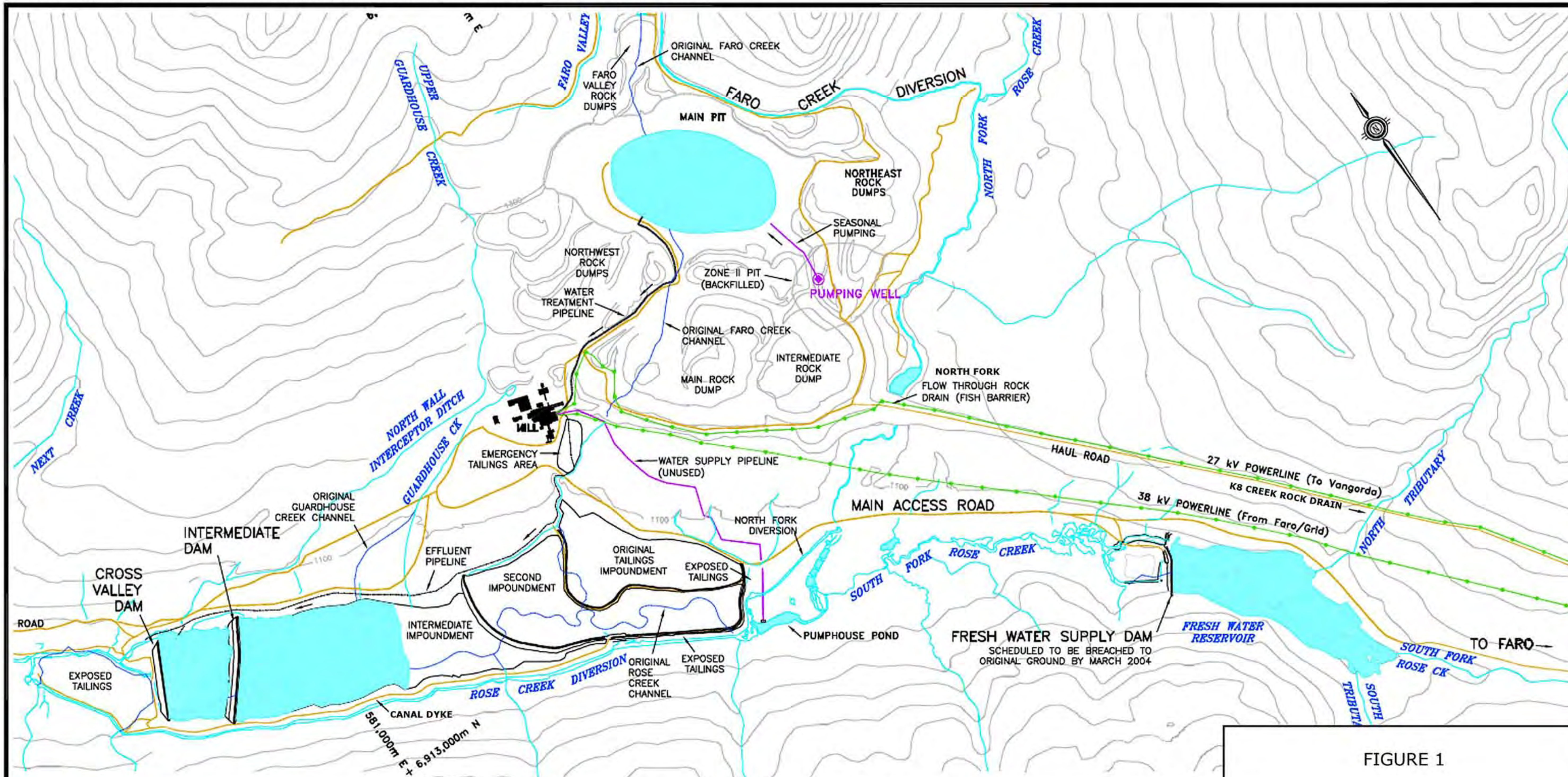


Fig. 1 Original Source: Figure 2 Faro Mine Site – Overview BGC 2003. Report on Emergency Preparedness Plan for Selected Dams and Water Diversion Structures

CLIENT: **Deloitte & Touche**

NOTE: BASE MAP FIGURE PROVIDED BY GARTNER LEE LTD.

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

LEGEND:

- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- EFFLUENT PIPELINE
- PIPELINE
- WATER TREATMENT PIPELINE
- POWERLINE
- SURFACE WATER

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED

SCALE:	AS SHOWN
DATE:	OCTOBER 2003
DRAWN:	GEJ
DESIGNED:	KM
CHECKED:	HHH/JWC
APPROVED:	JWC

FIGURE 1

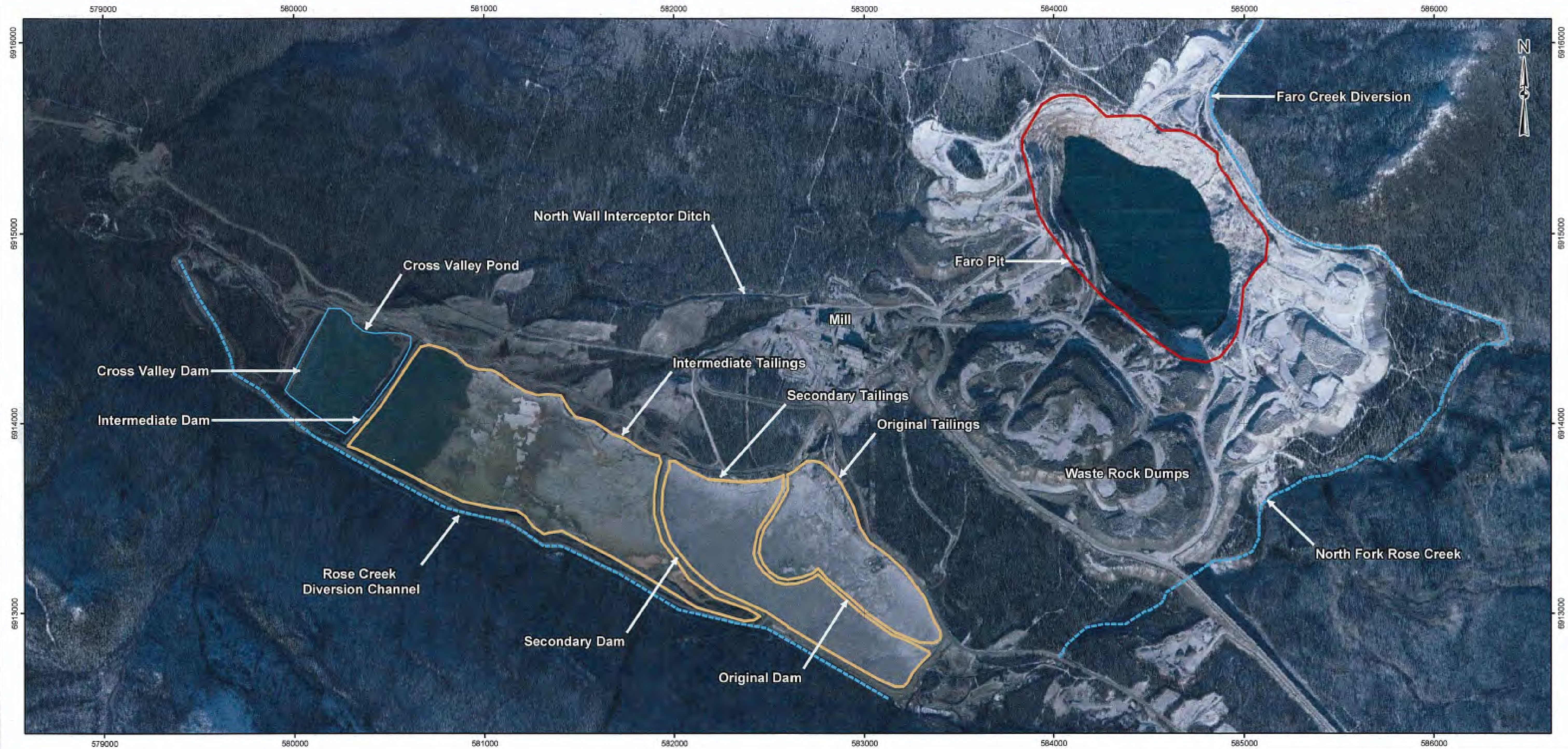
PROJECT: ANVIL RANGE EPP FOR DAMS & WATER DIVERSION STRUCTURES

TITLE: FARO SITE GENERAL LAYOUT

PROJECT No.	FIGURE No.	REV.
0257-018-02	2	0

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone: (403) 250 5185

Z:\MWCR\M09770A01 - Gov't Yukon-FaroSiteGeotech\300 Design\Figures\GIMP_edited_files\Figure2_Faro_Site_Air_Photo.xcf (afischer)



LEGEND

- Pit
- Tailings
- Pond
- Diversion

NOTE

Refer to Figures 3-1 and 3-2 for Down Valley Tailings Containment instrument location details.

REFERENCE

Ortho-image obtained from Google © 2007 Data SIO, NOAA, U.S. Navy, NGA, GEBCO Image © 2011 DigitalGlobe.
Projection: UTM Zone 8 Datum: NAD 83

500 0 500
SCALE 1:20,000 METRES

Fig. 2 Original Source: Figure 2-1 General Arrangement Plan Golder 2011. 2010 Annual Geotechnical Dam Inspection, Faro Mine Complex, Faro, Yukon

FIGURE 2

PROJECT
DENISON ENVIRONMENTAL SERVICES
FARO MINE COMPLEX
YUKON

TITLE
FARO SITE AIR PHOTO

Golder Associates
Greater Vancouver Office, B.C.

PROJECT No. 10-1427-0032			PHASE No. 2000	
DESIGN	WJP	08FEB11	SCALE AS SHOWN	REV. 0
GIS	AL	08FEB11	FIGURE 2-1	
CHECK	WJP	28FEB11		
REVIEW	JAH	28FEB11		

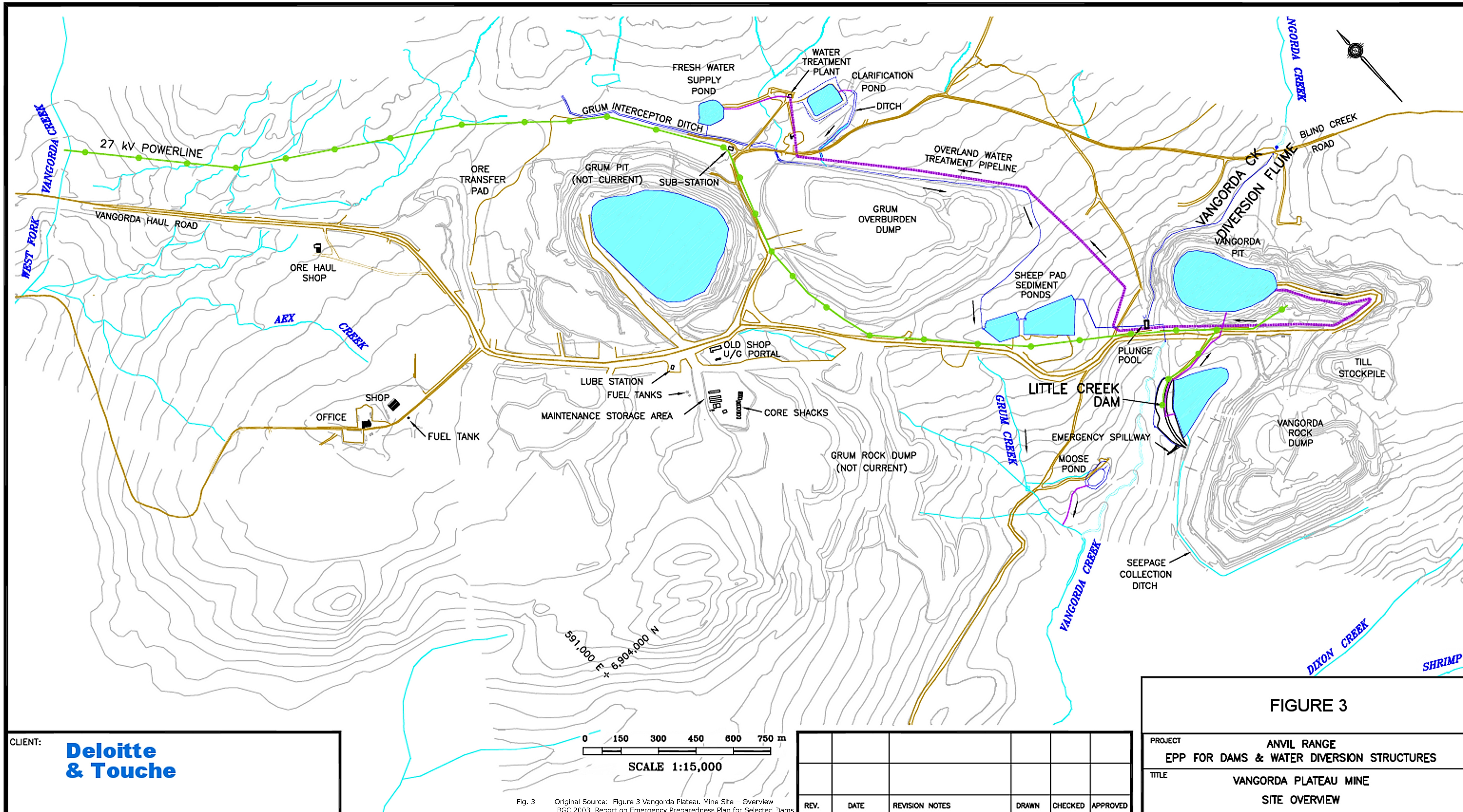


Fig. 3 Original Source: Figure 3 Vangorda Plateau Mine Site – Overview BGC 2003. Report on Emergency Preparedness Plan for Selected Dams and Water Diversion Structures

CLIENT: **Deloitte & Touche**

NOTE: BASE MAP FIGURE PROVIDED BY GARTNER LEE LTD.

LEGEND:
- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- EFFLUENT PIPELINE
- PIPELINE
- POWERLINE
- WATER TREATMENT PIPELINE
- SURFACE WATER

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED

SCALE:	AS SHOWN
DATE:	OCTOBER 2003
DRAWN:	GEJ
DESIGNED:	KM
CHECKED:	HHH/JWC
APPROVED:	JWC

FIGURE 3

PROJECT: ANVIL RANGE EPP FOR DAMS & WATER DIVERSION STRUCTURES

TITLE: VANGORDA PLATEAU MINE SITE OVERVIEW

PROJECT No.	FIGURE No.	REV.
0257-018-02	3	0

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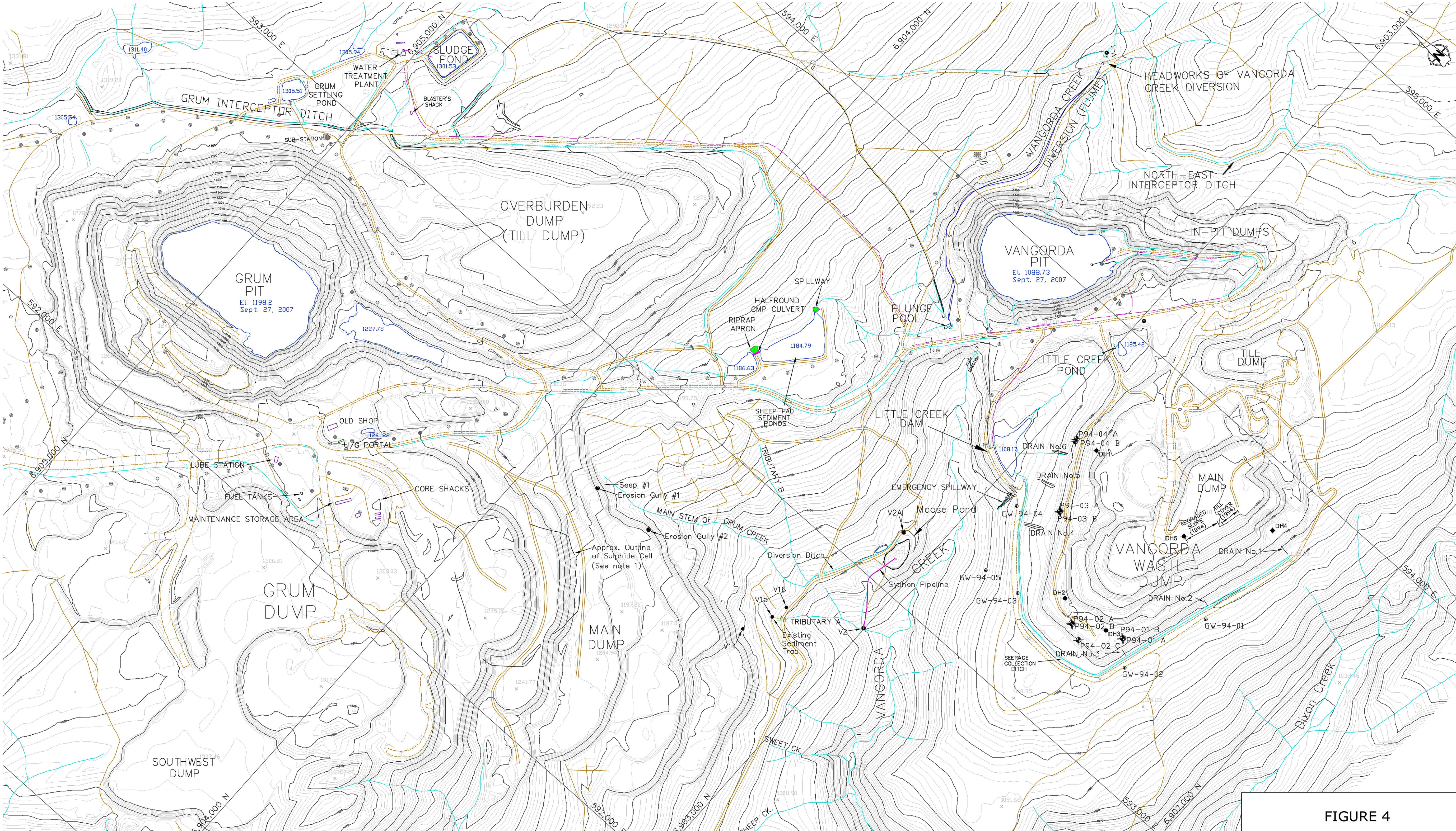
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone: (403) 250 5185



Map Scale: 1:2500
Contour Interval: 2m
Date of Photography: 03/07/25
Scale of Photography: 1:20000
Survey control derived from existing 1:20000 photography
Survey control based on: UTM Projection, NAD27
Compiled by The ORTHOSHOP, Calgary, September 2003
WO 8856

0 100 200 300 400 500
Scale 1:10,000

Fig 4. Original Source: Figure 2 2011 Geotechnical Inspection. Waste and Water Management Facilities Vangorda/Grum

SRK Consulting
Engineers and Scientists
Vancouver

Denison Environmental Services

FIGURE 4

2010 Vangorda Annual Inspection

General Arrangement Plan

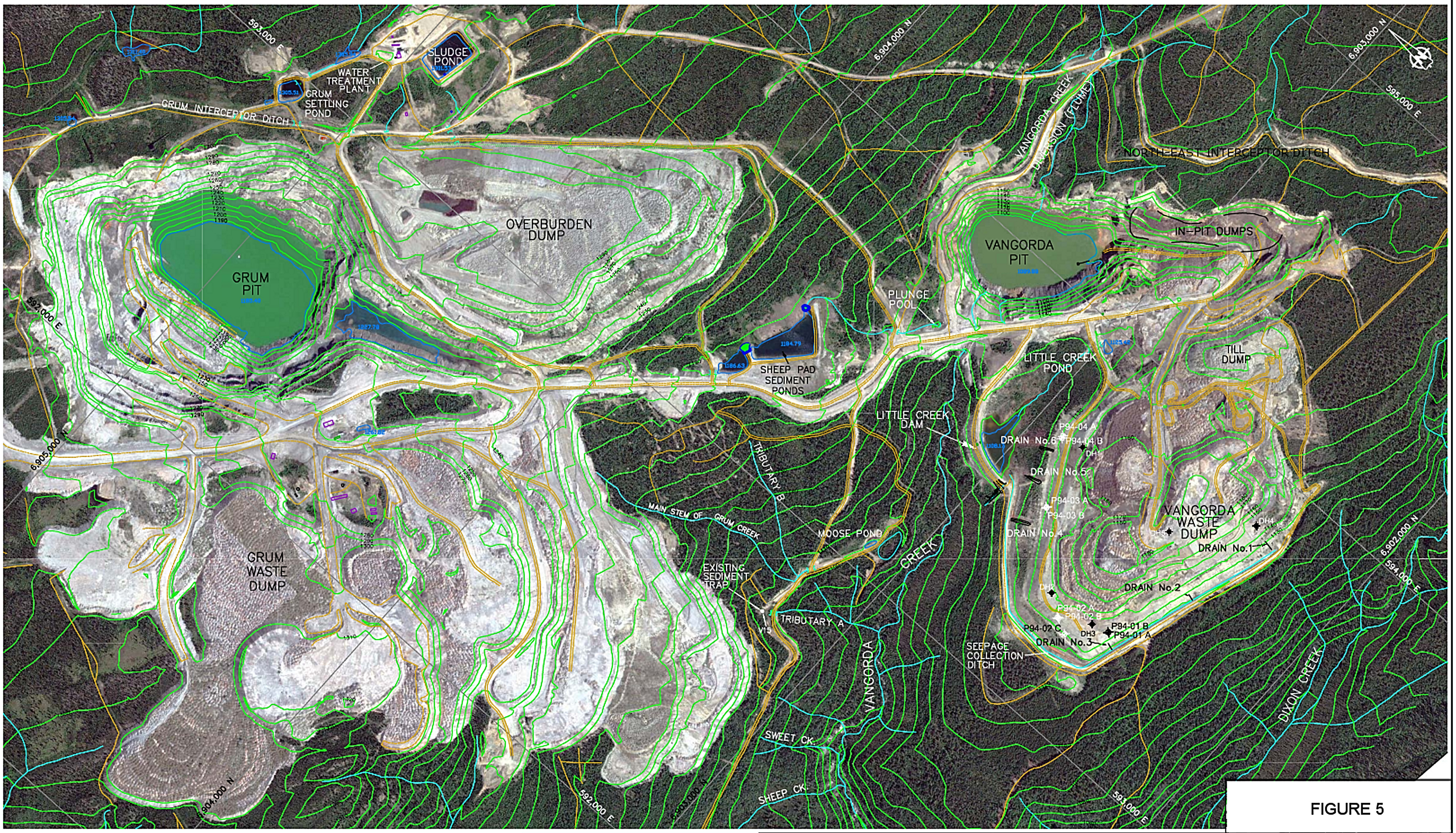
SRK JOB NO.: 1CD009.003
FILE NAME: site_plan.dwg

FARO MINE COMPLEX

DATE:	APPROVED:	FIGURE:
Feb. 2011		2

J:\01_SITES\FARO\1107_1CD009.003_2010 Geot_Insp\040_AutoCAD\site_plan.dwg

Z:\MWCR\M09770A01-GovtYukon-FaroSiteGeotech\300 Design\Figures\GIMP_edited_files\Figure_5_Vangorda_Plateau_Site_Air_Photo.xcf (afischer)



Map Scale: 1:2500
Contour Interval: 2m
Date of Photography: 18/09/09
Survey control derived from existing 1:20000 photography
Survey control based on: UTM Projection, NAD27

0 100 200 300 400 500
Scale 1:10,000

Fig. 5 Original Source: Figure 3 Photo-Rectified Mosaic, with Contours, of Vangorda Plateau Area SRK 2011. 2010 Annual Inspection – Waste and Water Management Facilities – Vangorda/Grum

srk consulting

Denison Environmental Services

SRK JOB NO.: 1CD009.005

FILE NAME: site_plan_photo.dwg

FARO MINE COMPLEX

FIGURE 5

2011 Vangorda Geotechnical Inspection

VANGORDA PLATEAU SITE AIR PHOTO

DATE: July 2011 | APPROVED: PMH | FIGURE: 3

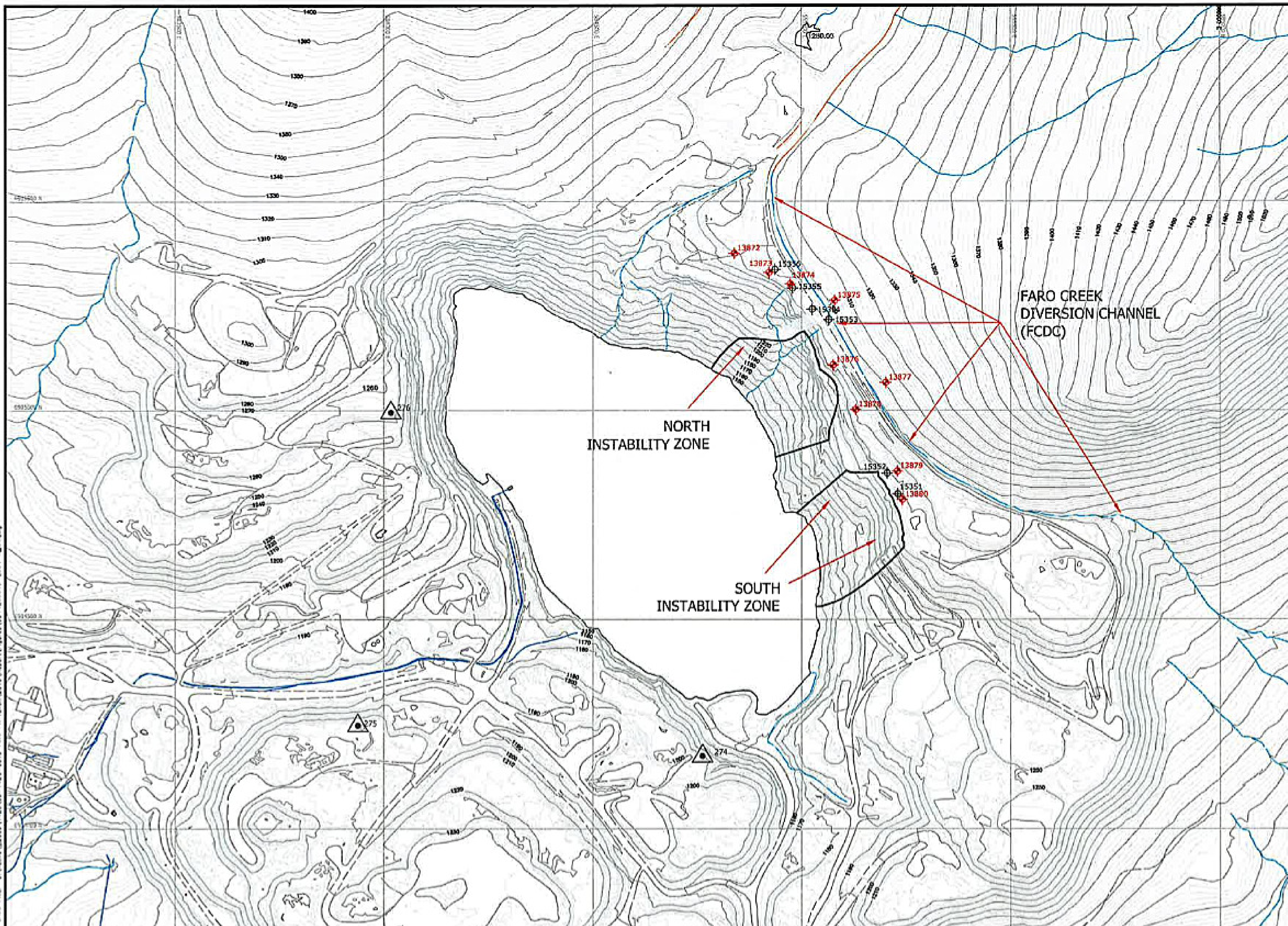


Fig. 6 Original Source: Figure 1 - 2001 Review of Pit Slope Monitoring Data

NOTES:

1) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.

LEGEND:

- 13678 MONITORING SURVEY PRISMS
- 13912 SLOPE MOVEMENT OBSERVATIONS - REFERENCE BARS
- 274 OBSERVATION POINTS FIXED LOCATION

DRAWING NO.	REFERENCES	REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

STAMP

FIGURE 6

PROJECT

**DENISON ENVIRONMENTAL SERVICES
YUKON, FARO PIT**

TITLE

REVIEW OF PIT SLOPE MONITORING DATA SITE PLAN

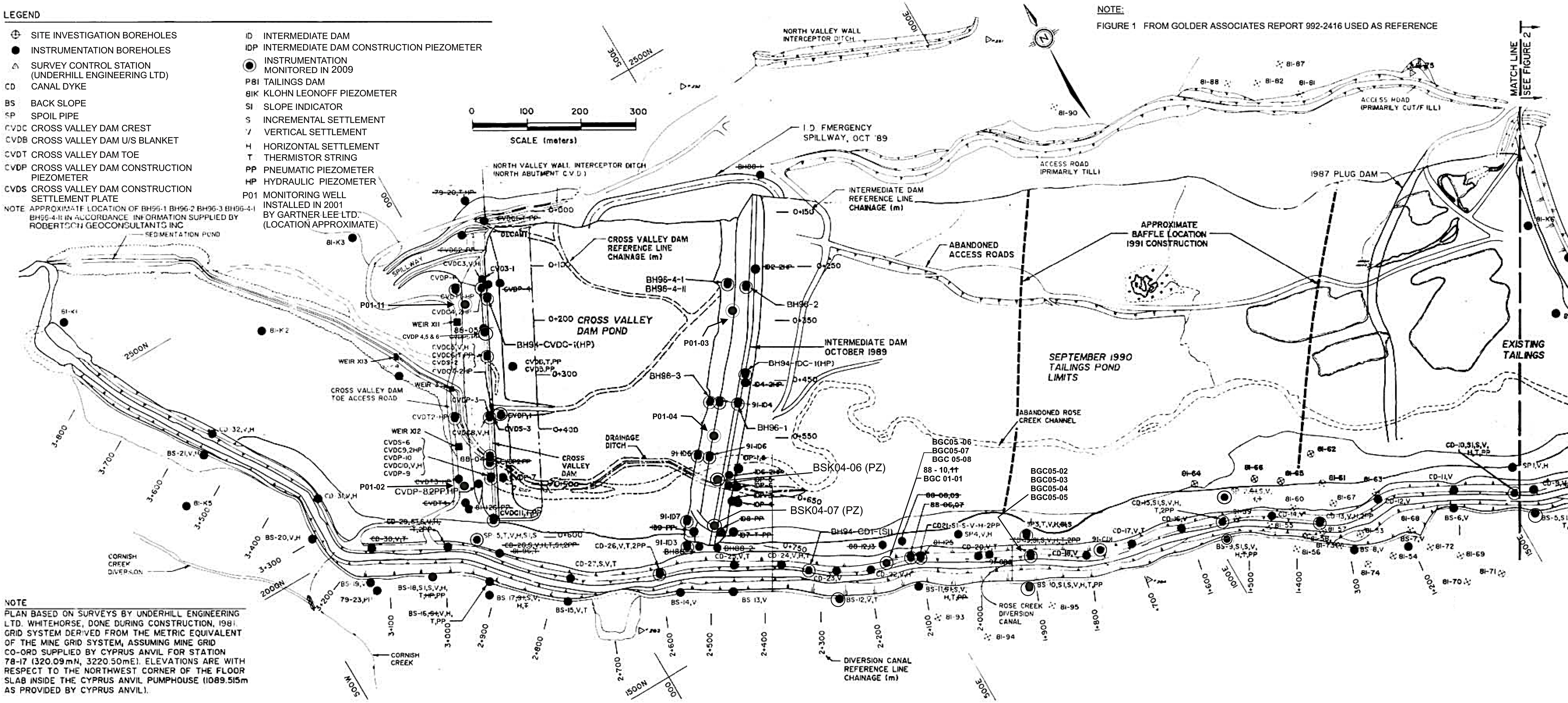
Golder Associates

PROJECT No.		09-1426-0019	FILE No.	0914260019-2001-A_01
DESIGN	EK	14DEC10	SCALE	AS SHOWN REV.
CADD	EK	14DEC10	FIGURE 1	
CHECK	EK	14DEC10		
REVIEW	AVC	14DEC10		

LEGEND

- SITE INVESTIGATION BOREHOLES
- INSTRUMENTATION BOREHOLES
- SURVEY CONTROL STATION (UNDERHILL ENGINEERING LTD)
- CD CANAL DYKE
- BS BACK SLOPE
- SP SPOIL PIPE
- CVDC CROSS VALLEY DAM CREST
- CVDB CROSS VALLEY DAM U/S BLANKET
- CVDT CROSS VALLEY DAM TOE
- CVDP CROSS VALLEY DAM CONSTRUCTION PIEZOMETER
- CVDS CROSS VALLEY DAM CONSTRUCTION SETTLEMENT PLATE
- NOTE APPROXIMATE LOCATION OF BH96-1 BH96-2 BH96-3 BH96-4-I BH96-4-II IN ACCORDANCE INFORMATION SUPPLIED BY ROBERTSON GEOCONSULTANTS INC.
- ID INTERMEDIATE DAM
- IDP INTERMEDIATE DAM CONSTRUCTION PIEZOMETER
- INSTRUMENTATION MONITORED IN 2009
- P8I TAILINGS DAM
- 8IK KLOHN LEONOFF PIEZOMETER
- SI SLOPE INDICATOR
- S INCREMENTAL SETTLEMENT
- V VERTICAL SETTLEMENT
- H HORIZONTAL SETTLEMENT
- T THERMISTOR STRING
- PP PNEUMATIC PIEZOMETER
- HP HYDRAULIC PIEZOMETER
- P01 MONITORING WELL INSTALLED IN 2001 BY GARTNER LEE LTD. (LOCATION APPROXIMATE)

NOTE:
FIGURE 1 FROM GOLDER ASSOCIATES REPORT 992-2416 USED AS REFERENCE



NOTE
PLAN BASED ON SURVEYS BY UNDERHILL ENGINEERING LTD. WHITEHORSE, DONE DURING CONSTRUCTION, 1981. GRID SYSTEM DERIVED FROM THE METRIC EQUIVALENT OF THE MINE GRID SYSTEM, ASSUMING MINE GRID CO-ORD SUPPLIED BY CYPRUS ANVIL FOR STATION 78-17 (320.09mN, 3220.50mE). ELEVATIONS ARE WITH RESPECT TO THE NORTHWEST CORNER OF THE FLOOR SLAB INSIDE THE CYPRUS ANVIL PUMPHOUSE (1089.515m AS PROVIDED BY CYPRUS ANVIL).

Fig. 7 Original Source: Figure 2 - 2009 Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 7

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	N/A
DATE:	FEB 2010
DRAWN:	TMW
DESIGNED:	TMW
CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: Denison Environmental Services

PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: DOWN VALLEY TAILINGS CONTAINMENT INSTRUMENT LOCATION 1 OF 2

PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	2	0

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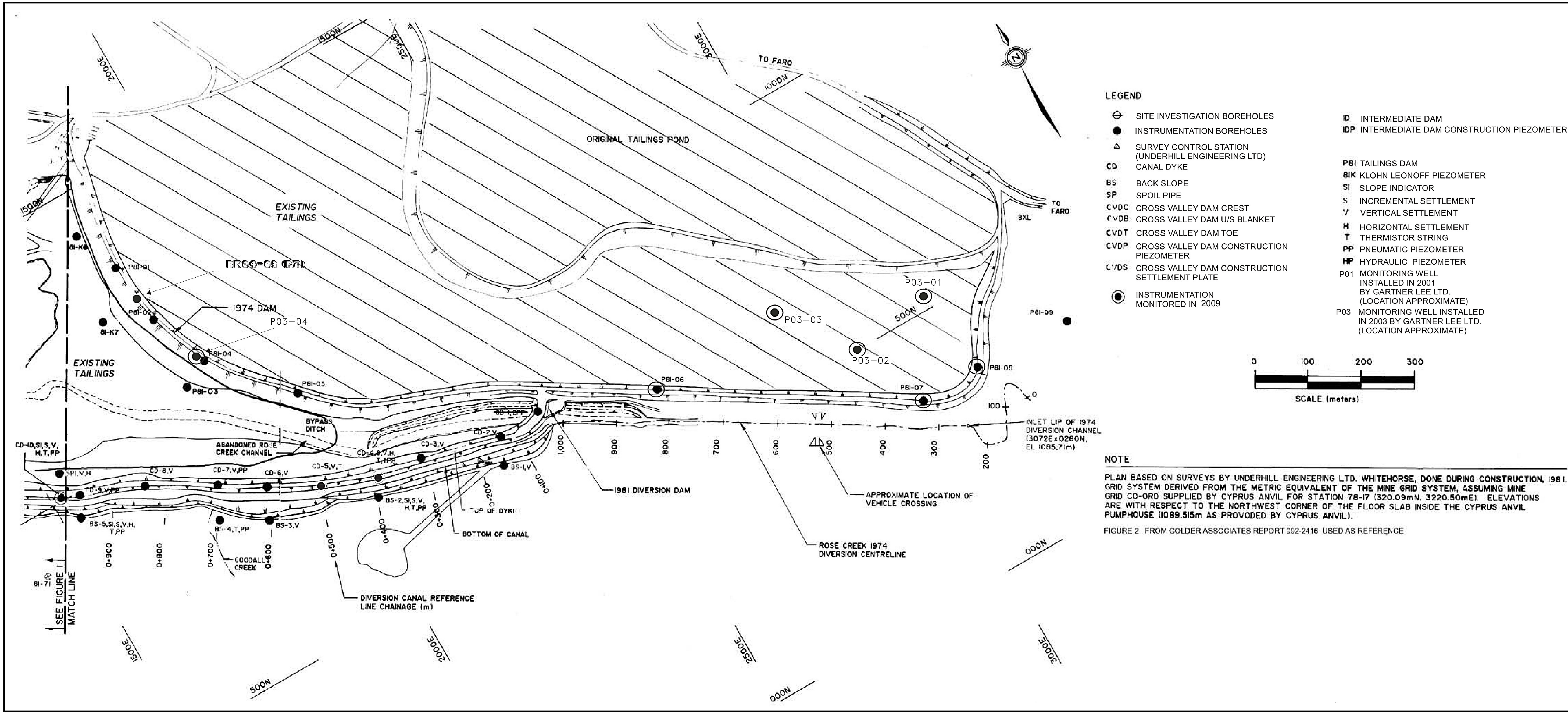

Fig. 8 Original Source: Figure 3 - 2009 Annual Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 8

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	N/A
DATE:	FEB 2010
DRAWN:	TMW
DESIGNED:	TMW
CHECKED:	HHH
APPROVED:	GWF

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BGC ENGINEERING INC.
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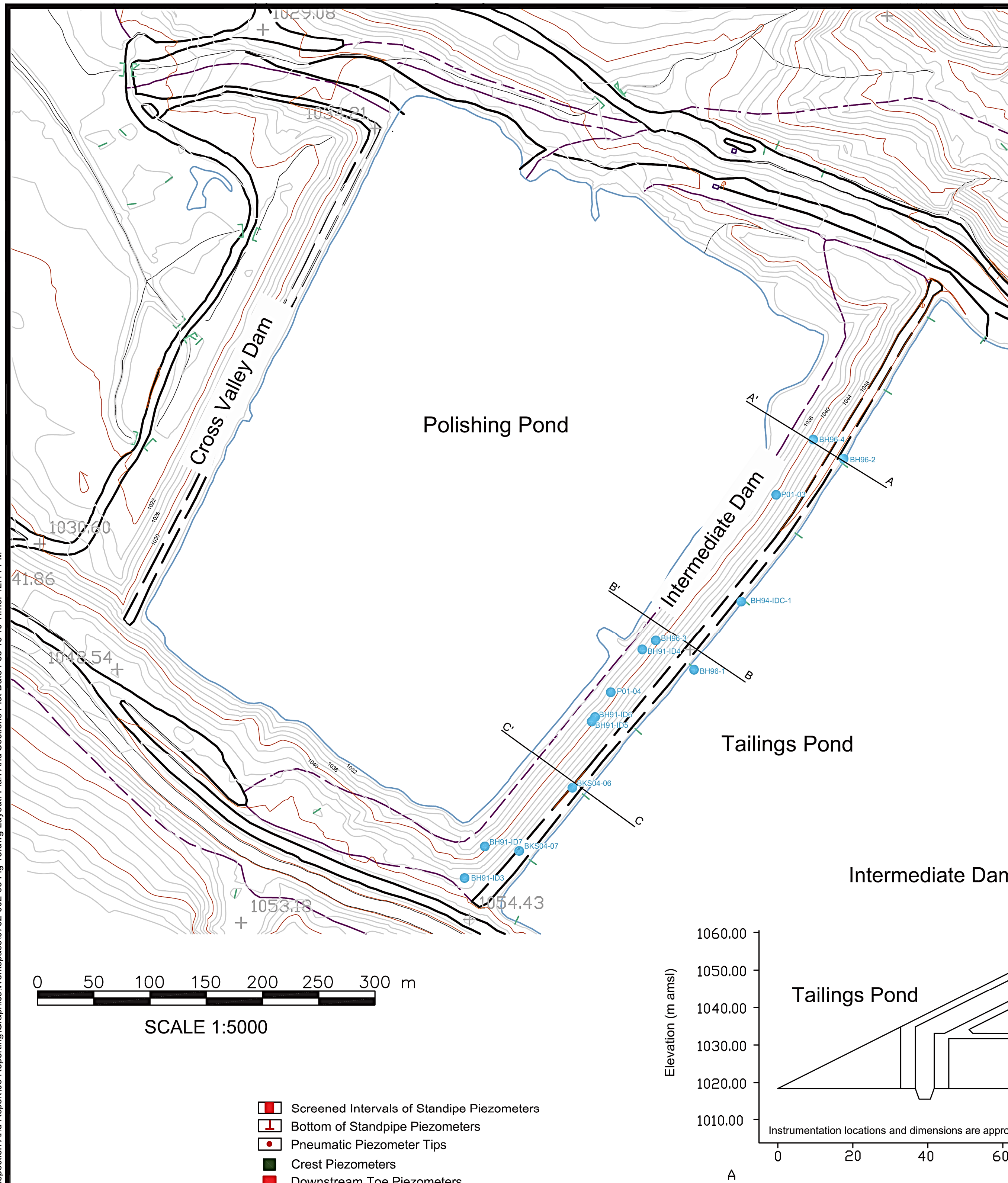
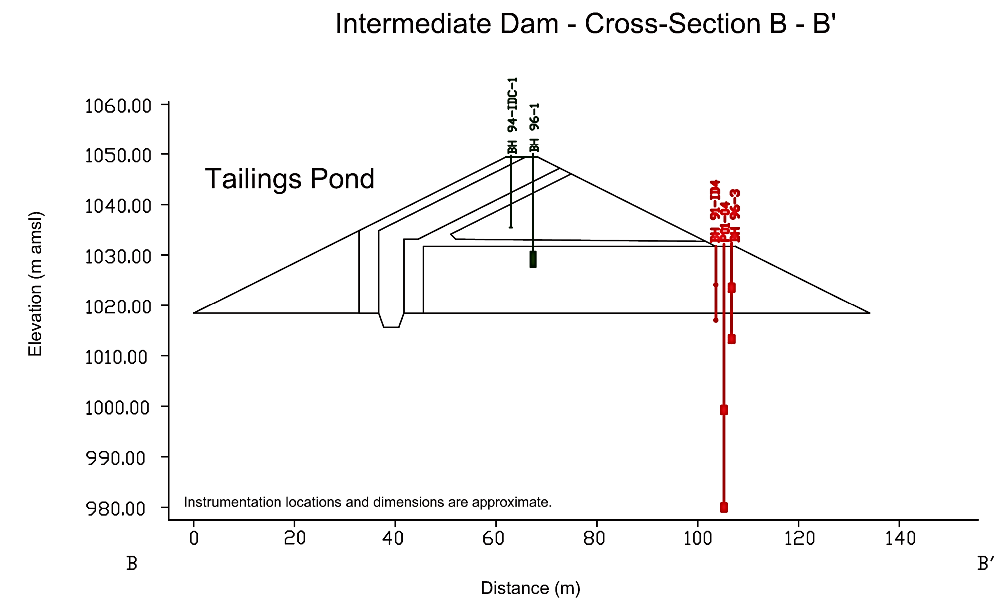
CLIENT: Denison Environmental Services

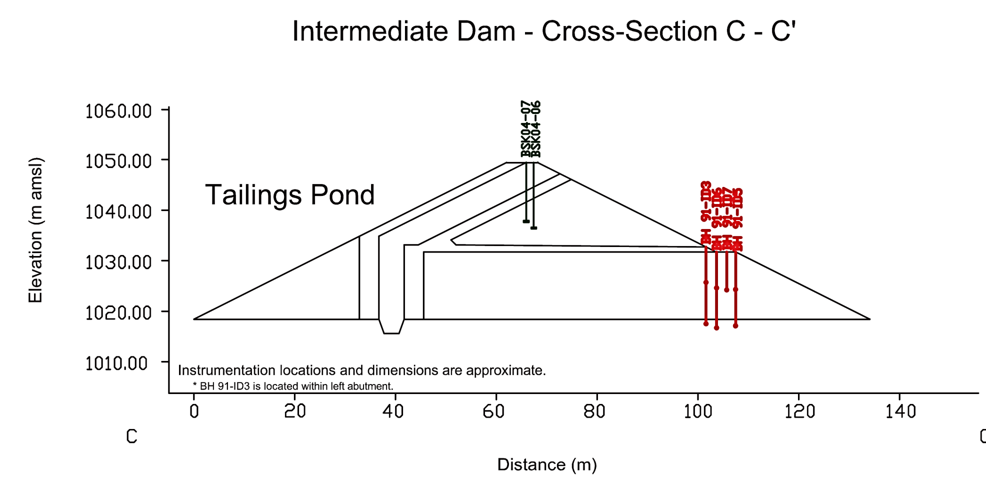
PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: DOWN VALLEY TAILINGS CONTAINMENT INSTRUMENT LOCATION 2 OF 2

PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	3	0







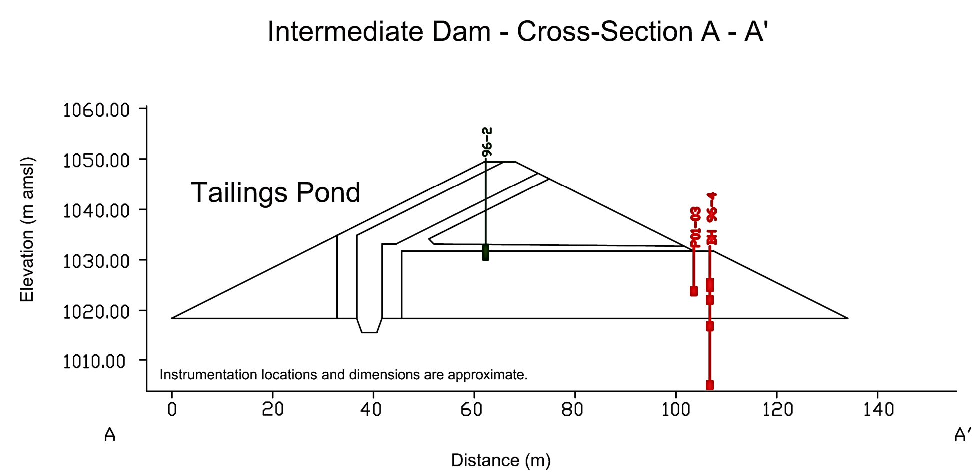


Fig. 9 Original Source: Figure 18 - 2009 Annual Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 9

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	AS SHOWN
DATE:	FEB 2010
DRAWN:	JL
DESIGNED:	TMW
CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

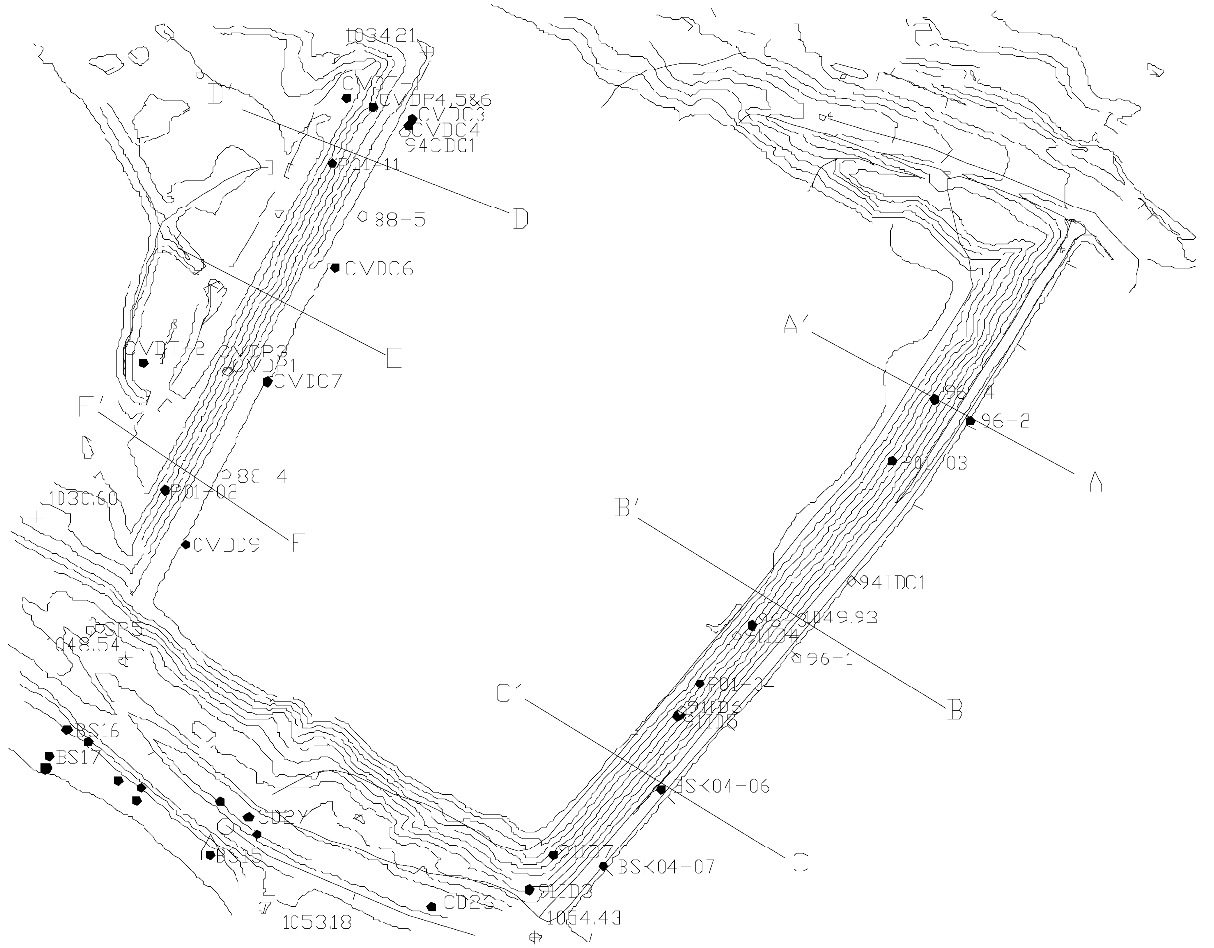
CLIENT: Denison Environmental Services

PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

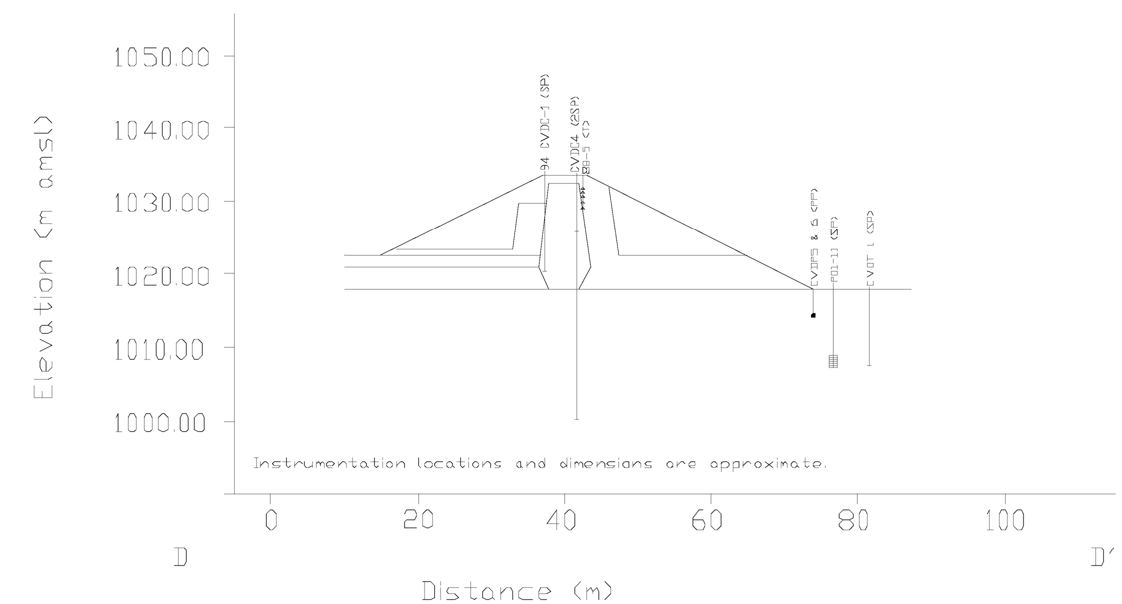
TITLE: SECTION VIEW OF INTERMEDIATE DAM

PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	18	0

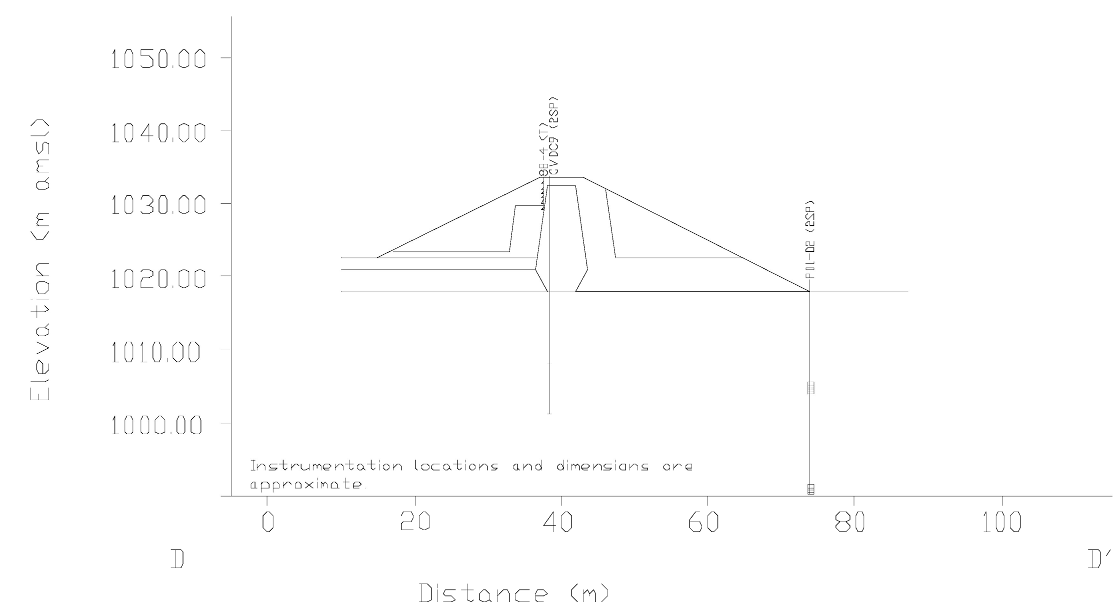
DWG TO BE READ WITH BGC REPORT TITLED " 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENT REVIEW" DATED FEB 2010



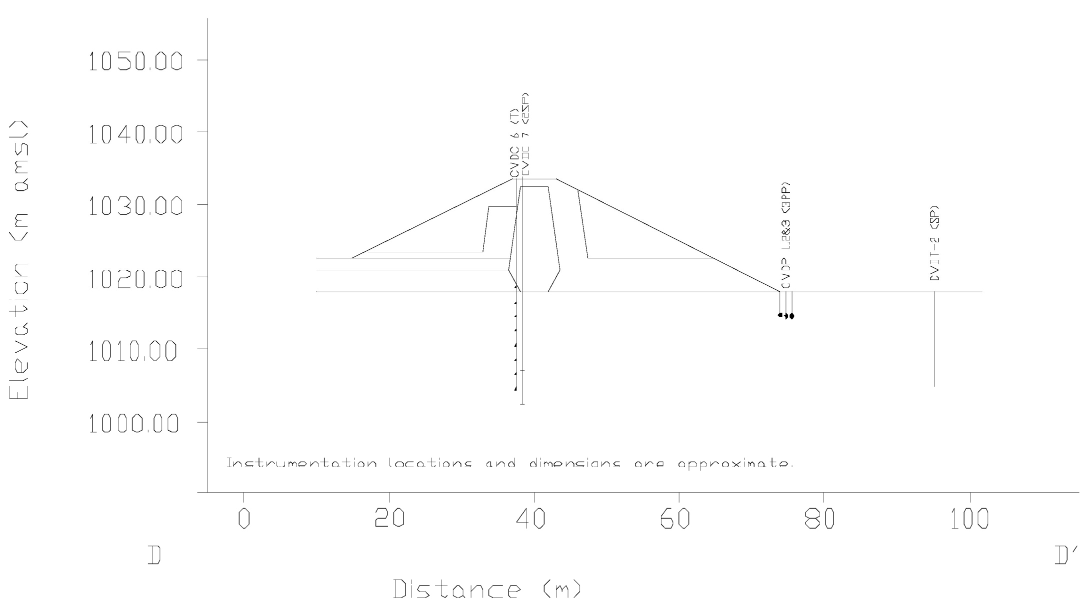
Cross Valley Dam - Cross-Section D - D'



Cross Valley Dam - Cross-Section F - F'



Cross Valley Dam - Cross-Section E - E'



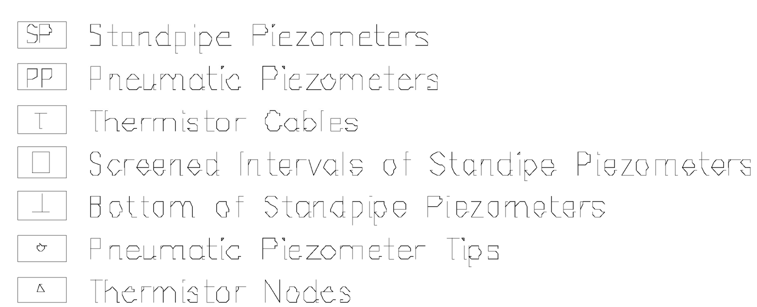


Fig. 10 Original Source: Figure 24 - 2009 Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 10

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	N/A
DATE:	FEB 2010
DRAWN:	TMW
DESIGNED:	TMW
CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: Denison Environmental Services

PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: SECTION VIEW OF CROSS VALLEY DAM

PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	24	0

Denison Environmental Services

Faro Mine Closure

Faro Mine Complex: 2010 Geotechnical Monitoring Sites

Fig. 11 Original Source: Figure 2-7 - Denison Environmental Services Working Figure.

FIGURE 11

Figure #:

2-7

Faro Mine Complex:

Inset 5a:

Grum Pit Crest – East Wall

Data Sources & Disclaimers:

Basemap: Orthomapping & Digital Elevation Mapping (1m) Provided by Yukon Government

Projection: UTM Zone 8

Datum: NAD 83

Created By: JP

Reviewed By: JC

Date: February 24, 2011

Revision: 0

Denison Environmental Services

FIGURE 12

LEGEND

- Piezometer Location
- Monitoring Well Location (1994)
- Monitoring Well Location (2010)
- Monitoring Well Location (2009)

Contour Interval: 2m
Survey control based on: UTM Projection, NAD83
Based on The ORTHOSHOP, Calgary, September 2003

0 50 100 150 200 250
Scale in Metres

Fig. 12 Original Source: Figure 4 - 2011 Geotechnical Inspection Waste and Water Management Facilities Vangorda/Grum

srk consulting

Denison Environmental Services

2011 Vangorda Geotechnical Inspection

General Arrangement Plan
Vangorda Waste Rock Dump

SRK JOB NO.: 1CD009.005
FILE NAME: site_plan nod 83.dwg

FARO MINE COMPLEX

DATE: July 2011 | APPROVED: JK | FIGURE: 4

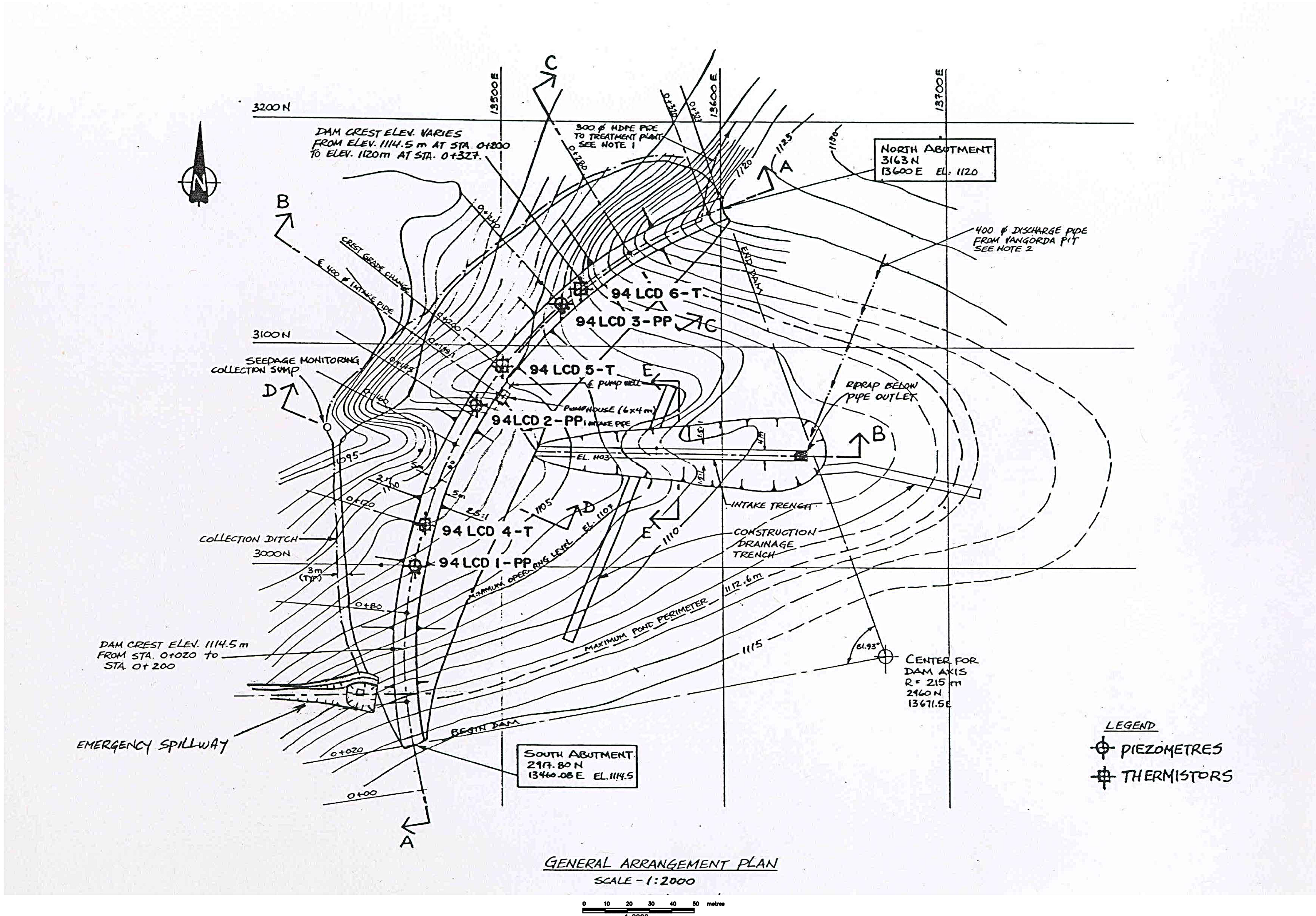


Fig. 13 Original Source: Figure 10 - 2011 Geotechnical Inspection Waste and Water Management Facilities Vangorda/Grum

srk consulting	Denison Environmental Services	FIGURE 13
SRK JOB NO.: 1CD009.005	FARO MINE COMPLEX	2011 Vangorda Geotechnical Inspection
FILE NAME: FIG-10.dwg		LITTLE CREEK DAM GENERAL ARRANGEMENT PLAN
		DATE: July 2011 · APPROVED: PMH · FIGURE: 10

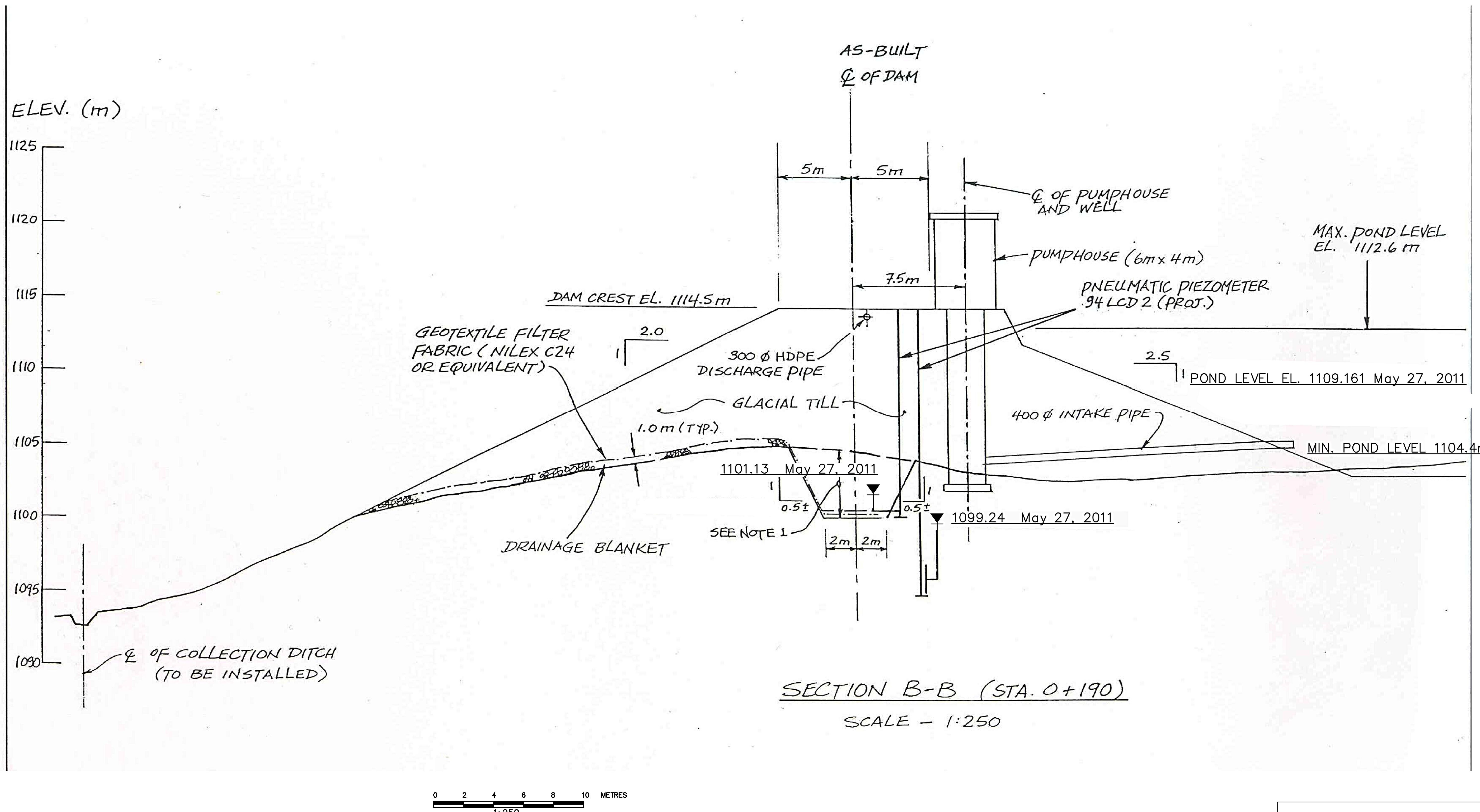


Fig. 14 Original Source: Figure 11 - 2011 Geotechnical Inspection Waste and Water Management Facilities Vangorda/Grum

srk consulting

Denison Environmental Services

SRK JOB NO.: 1CD009.005

FILE NAME: FIG-11.dwg

FARO MINE COMPLEX

FIGURE 14

2011 Vangorda Geotechnical Inspection

LITTLE CREEK DAM
SECTION B-B

DATE:	APPROVED:	FIGURE:
July 2011	PMH	11

J:\01_SITES\FARO\2210_1CD009.005 _Vangorda 2011 Geotech Inspection\040_AutoCad\FIG-11.dwg

APPENDIX I

2011 Site Visit Photographs

Faro Pit

Photo 1 Faro Pit east wall as seen from "eye-in-the-sky" (September 20, 2011)

Photo 2 East wall of Faro Pit as seen from south (September 21, 2011)

Faro Creek Diversion Channel

Photo 3 Faro Creek Diversion Ditch above Faro Pit, looking upstream (September 20, 2011)

Photo 4 Faro Creek Diversion Ditch above Faro Pit, looking downstream (September 20, 2011)

North Valley Wall Interceptor Ditch

Photo 5 **Interceptor ditch near beginning reach – looking upstream (August 23, 2011)**

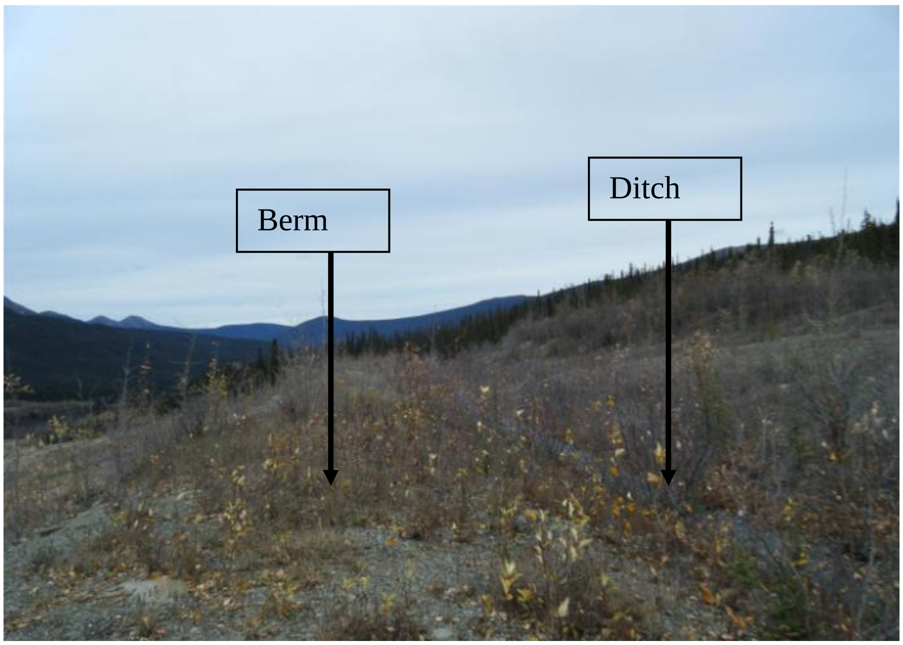


Photo 6 **Middle Reach of North Valley Wall Interceptor Ditch near its downstream end. Note vegetation growth on berm and in ditch. (September 21, 2011)**

North Valley Wall Interceptor Ditch

Photo 7 Lower reach of North Valley Wall Interceptor Ditch adjacent to Cross Valley Pond (September 20, 2011)

Photo 8 Culvert discharge from Interceptor Ditch adjacent to Cross Valley Pond (August 23, 2011)

North Valley Wall Interceptor Ditch

Photo 9 **Interceptor Ditch culverts across access road below Cross Valley Dam (September 20, 2011)**

Photo 10 **Interceptor Ditch below Cross Valley Dam, looking downstream (September 20, 2011)**

Rose Creek Diversion Channel

Photo 11 Rose Creek North Fork culvert under main road (September 21, 2011)

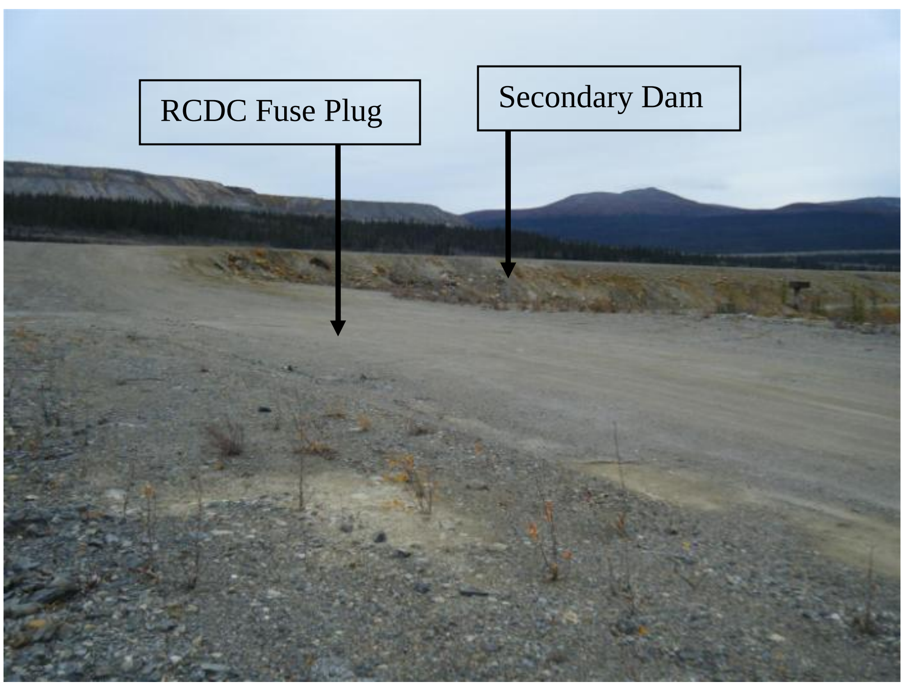


Photo 12 Rose Creek Diversion Channel Fuse Plug, looking towards Secondary Dam (September 21, 2011)

Rose Creek Diversion Channel

Photo 13 Rose Creek Diversion Channel downstream of Fuse Plug (September 21, 2011)

Photo 14 Rose Creek Diversion Channel downstream of Cross Valley Dam (September 21, 2011)

Rose Creek Diversion Channel

Photo 15 Rose Creek Diversion Channel (September 21, 2011)

Photo 16 Downstream end of Rose Creek Diversion Channel (September 21, 2011)

North Fork Rock Drain

Photo 17 Wood debris on upstream slope of Access Road between Faro and Vangorda Plateau (August 23, 2011)

Photo 18 Downstream slope of Access Road between Faro and Vangorda Plateau (August 23, 2011)

K8 Creek Rock Drain

Photo 19 K8 Creek upstream pool (September 20, 2011)

Photo 20 K8 Creek downstream outlet (September 20, 2011)

Secondary Tailings Dam

Photo 21 Junction of Original Tailings Dam (foreground) and Secondary Tailings Dam (background, August 23, 2011)

Photo 22 North end of Original Tailings Dam - a ditch in the foreground separating the dam with north abutment (August 23, 2011)

Secondary Tailings Dam

Photo 23 Southeast corner of Secondary Dam – looking northwest (August 23, 2011)

Photo 24 Secondary Tailings Dam - Rose Creek Diversion Channel on left and tailings beach on right (August 23, 2011)

Secondary Tailings Dam

Photo 25 **Dam crest near the vicinity where the diversion channel and tailings dam alignment begin to diverge – note tailings pile along upstream crest shoulder (August 23, 2011)**

Photo 26 **North end of Secondary Dam - a ditch in the foreground separating the dam with north abutment (August 23, 2011)**

Intermediate Tailings Dam

Photo 27 **Upstream spillway approach channel at northeast abutment of Intermediate Dam (August 23, 2011)**

Photo 28 **Intermediate Dam spillway channel - looking downstream (September 21, 2011)**

Intermediate Tailings Dam

Photo 29 Upstream slope of Intermediate Dam - looking southwest (August 23, 2011)

Photo 30 Wave erosion zone on upstream slope marked by hard hat and hammer (August 23, 2011)

Intermediate Tailings Dam

Photo 31 Wave erosion zone on upstream slope near pond level marked by hard hat and hammer (August 23, 2011)

Photo 32 Northeast portion of dam crest and upstream slope (August 23, 2011)

Intermediate Tailings Dam

Photo 33 Southwest portion of dam crest and upstream slope (August 23, 2011)

Photo 34 Rill erosion along downstream slope (August 23, 2011)

Intermediate Tailings Dam

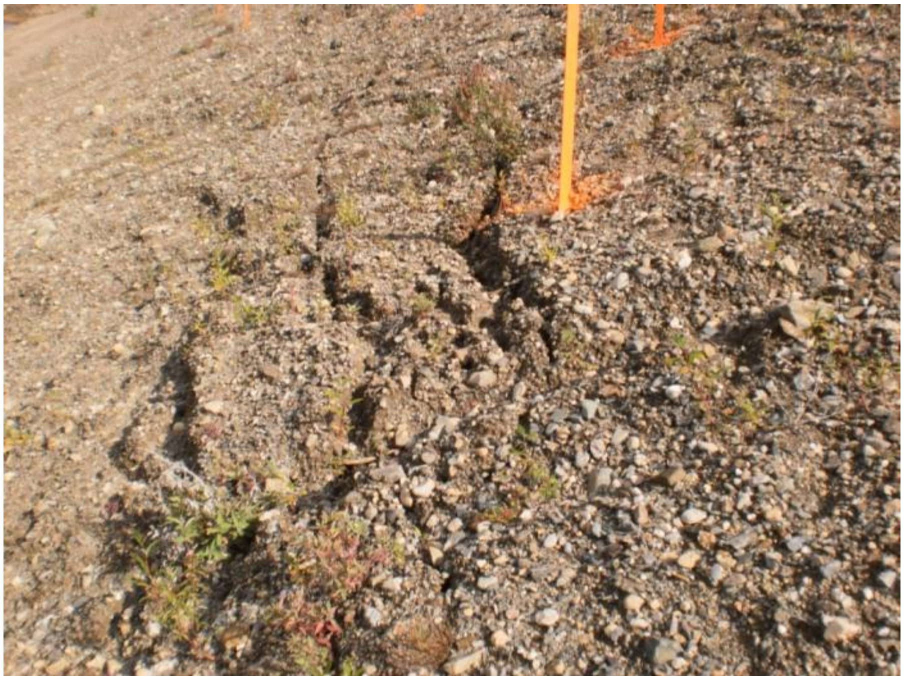


Photo 35 Close-up of horizontal cracks due to slope slump of surficial layer (August 23, 2011)

Photo 36 Gully erosion of downstream berm slope (August 23, 2011)

Intermediate Tailings Dam

Photo 37 Less rill erosion over vegetated portion of downstream slope (August 23, 2011)

Photo 38 Northeast portion of downstream dam slope (August 23, 2011)

Cross Valley Dam

Photo 39 Crest and downstream slope of northeast portion of dam - note rill and gully erosion on slope (August 23, 2011)

Photo 40 Crest and upstream slope of northeast portion of dam (August 23, 2011)

Cross Valley Dam

Photo 41 **Cross Valley Pond siphon pipeline on spillway channel (September 21, 2011)**

Photo 42 **Cross Valley Pond siphon outlet discharge (September 20, 2011)**

Grum Pit

Photo 43 Grum Pit as seen from north wall toward southeast – Grum Slot in background (September 20, 2011)

Photo 44 Grum Pit as seen from northwest wall (September 20, 2011)

Grum Pit

Photo 45 Grum Pit (September 20, 2011)

Photo 46 Grum Pit east wall - note new slump in foreground (September 20, 2011)

Vangorda Pit

Photo 47 Vangorda Pit as seen from northwest wall toward east (September 20, 2011)

Photo 48 Vangorda Pit as seen from northwest wall toward southeast (September 20, 2011)

Vangorda Waste Dump

Photo 49 Vangorda Waste Dump (September 20, 2011)

Photo 50 Vangorda Waste Dump (September 20, 2011)

Vangorda Waste Dump

Photo 51 Vangorda Waste Dump (September 20, 2011)

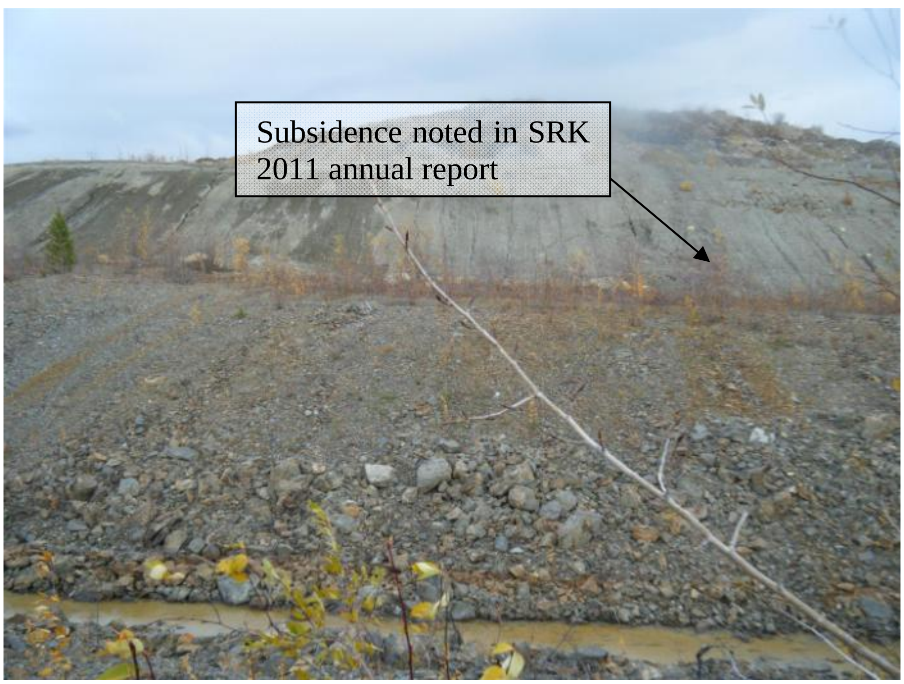


Photo 52 Vangorda Waste Dump previously noted subsidence (September 20, 2011)

Vangorda Waste Dump

Photo 53 Vangorda Waste Dump at Drain No. 6 - showing previous subsidence of dump face (September 20, 2011)

Photo 54 Vangorda Waste Dump Drain No. 1 - no weir at this drain (September 20, 2011)

Vangorda Waste Dump

Photo 55 Vangorda Waste Dump Drain No. 1 - no weir at this drain (September 20, 2011)

Photo 56 Vangorda Waste Dump Seepage Collection Ditch - looking downstream from Drain No. 1. (September 20, 2011)

Vangorda Waste Dump

Photo 57 Vangorda Waste Dump Drain No. 3 weir (September 20, 2011)

Photo 58 Vangorda Waste Dump Drain No. 3 weir - note delaminated weir plate and crooked staff gauge (September 20, 2011)

Vangorda Waste Dump

Photo 59 Vangorda Waste Dump Seepage Collection Ditch at Drain No. 3 - looking upstream (September 20, 2011)

Photo 60 Vangorda Waste Dump Seepage Collection Ditch at Drain No. 3. looking downstream (September 20, 2011)

Vangorda Waste Dump

Photo 61 **Vangorda Waste Dump Seepage Collection Ditch between Drains No. 3. and No. 4. (September 20, 2011)**

Photo 62 **Vangorda Waste Dump Drain No. 4 - no weir at this drain (September 20, 2011)**

Vangorda Waste Dump

Photo 63 Vangorda Waste Dump Drain No. 5. Weir – weir plate split into two pieces at the V-notch (September 20, 2011)

Photo 64 Vangorda Waste Dump Drain No. 6. weir (September 20, 2011)

Grump Pit Interceptor Ditch

Photo 65 Upstream end of Grum Interceptor Ditch (September 20, 2011)

Photo 66 Grum Interceptor Ditch (September 20, 2011)

Grump Pit Interceptor Ditch

Photo 67 Grum Interceptor Ditch (September 20, 2011)

Photo 68 Grum Interceptor Ditch near Grum Water Treatment Plant (WTP), looking downstream (September 20, 2011)

Grump Pit Interceptor Ditch

Photo 69 Grum Interceptor Ditch along toe of Overburden Dump. Note vegetation test plots on dump face

Photo 70 Grum Overburden Dump with vegetation test plots on dump face - Grum Interceptor Ditch in foreground (September 201, 2011)

North-East Diversion Ditch above Vangorda Pit

Photo 71 North-East Interceptor Ditch near its upstream end. Excavator bucket marks indicate recent cleaning of the ditch (September 20, 2011)

Photo 72 North-East Interceptor Ditch (September 20, 2011)

North-East Diversion Ditch above Vangorda Pit

Photo 73 North-East Interceptor Ditch - note slumped side slope (September 20, 2011)

Photo 74 North-East Interceptor Ditch at its downstream end (September 20, 2011)

Vangorda Creek (Flume) Diversion

Photo 75 Vangorda Creek above Vangorda Flume Headworks (September 20, 2011)

Photo 76 Vangorda Flume emergency spillway intake culverts (August 23, 2011)

Vangorda Creek (Flume) Diversion

Photo 77 Vangorda Flume intake culvert (September 20, 2011)

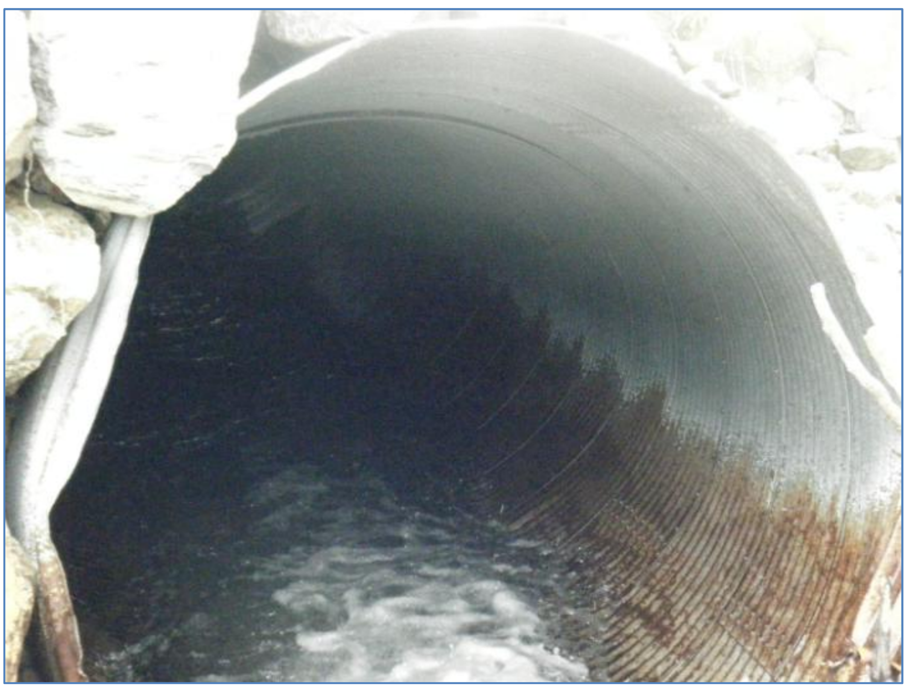


Photo 78 Upstream end of Vangorda Flume intake culvert - first pipe joint appears to be separated (September 20, 2011)

Vangorda Creek (Flume) Diversion

Photo 79 Vangorda Flume at upstream end (September 20, 2011)

Photo 80 Vangorda Flume intake culvert as seen from downstream end - first pipe joint appears to be separated (September 20, 2011)

Vangorda Creek (Flume) Diversion

Photo 81 Vangorda Flume (September 20, 2011)

Photo 82 Vangorda Flume (September 20, 2011)

Vangorda Creek (Flume) Diversion

Photo 83 Downstream end of Vangorda Flume above plunge pool (September 20, 2011)

Photo 84 Vangorda Flume Plunge Pool and culvert to Vangorda Creek Diversion drop box (September 20, 2011)

Vangorda Creek (Flume) Diversion

Photo 85 Upstream end of culvert to Vangorda Creek Diversion drop box - first pipe joint appears to be separated. (September 20, 2011)

Photo 86 Vangorda Creek Diversion outfall at Vangorda Creek downstream of drop box (September 20, 2011)

Little Creek Dam

Photo 87 Dam crest/upstream slope and pond (August 23, 2011)

Photo 88 Culvert emergency spillway at left (south) abutment (August 23, 2011)

Little Creek Dam

Photo 89 Crest and downstream slope/berm - emergency spillway in foreground (August 23, 2011)

Photo 90 Downstream slope and berm (August 23, 2011)

Little Creek Dam

Photo 91 Crest and downstream slope/berm (August 23, 2011)

Photo 92 Gully erosions on downstream slope

Little Creek Dam

Photo 93 Dam crest and upstream slope - rill erosions in the foreground (August 23, 2011)

Photo 94 Dam crest and upstream slope near the north end (August 23, 2011)

Sheep Pad Sediment Ponds

Photo 95 Weir below Sheep Pad Sediments Ponds (September 20, 2011)

Photo 96 Culvert downstream of Sheep Pad Sediments Ponds weir

Sheep Pad Sediment Ponds

Photo 97 Culvert and ditch downstream of Sheep Pad Sediments Ponds weir - Vangorda Plunge Pool culvert in background (September 20, 2011)

Grum Settling Pond

Photo 98 Grum Settling Pond (September 20, 2011)

Photo 99 Grum Settling Pond (September 20, 2011)

Grum Settling Pond

Photo 100 Grum Settling Pond spillway channel, looking downstream towards Grum Interceptor Ditch (September 20, 2011)

V-15 Seepage Collection Ditch

Photo 101 V-15 Pond (September 20, 2011)

Photo 102 V-15 Pond and V-15 Diversion Ditch to Moose Pond (September 20, 2011)

V-15 Seepage Collection Ditch

Photo 103 V-15 Diversion Ditch to Moose Pond (September 20, 2011)

Photo 104 V-15 Diversion Ditch looking downstream towards Moose Pond (September 20, 2011)

V-15 Seepage Collection Ditch

Photo 105 V-15 Pump Sump under construction (September 20, 2011)

Photo 106 V-15 Diversion Ditch (August 23, 2011)

V-15 Seepage Collection Ditch

Photo 107 V-15 Diversion Ditch near downstream end (August 23, 2011)

Photo 108 V-15 Diversion Ditch at its downstream end near Moose Pond (September 20, 2011)

V-15 Seepage Collection Ditch

Photo 109 Downstream portion of V-15 Ditch discharge channel

Moose Pond

Photo 110 Moose Pond with new sediments deposited during 2011 spring excess runoff (August 23, 2011)

Photo 111 Moose Pond seen from downstream esker ridge top (August 23, 2011)

Moose Pond

Photo 112 Ridge top of downstream esker (August 23, 2011)

Photo 113 Downstream bank slope of esker

Moose Pond

Photo 114 Close-up of esker slope showing alternating layers of coarse gravels and silty sands (August 23, 2011)

Photo 115 Disturbed bank slope and fallen trees caused by excess seepage issuing from esker downstream of Moose Pond during 2011 spring runoff event (August 23, 2011)

Sludge Pond Embankment-Vangorda Water Treatment Plant

Photo 116 Grum Sludge Pond (September 20, 2011)

Photo 117 Grum Sludge Pond (September 20, 2011)

Sludge Pond Embankment-Vangorda Water Treatment Plant

Photo 118 Grum Sludge Pond (September 20, 2011)

APPENDIX II

Instrumentation Plots

SITE	STRUCTURE	DATA INCLUDED HEREIN	SECTION NUMBER
Faro	II-A: Faro Pit	Pond level	A.1
		Pit wall regression	A.2
		Pit wall prism monitoring	A.3
	II-B: Faro Creek Diversion Channel	Staff gauge flow measurement	B.1
	II-C: Rose Creek Diversion Channel	Staff gauge flow measurement	C.1
	II-D: Canal Dyke	Piezometers	D.1
		Thermistors	D.2
		Inclinometers (included in separate electronic file)	D.3
	II-E: North Fork Rock Drain	Staff gauge measurement	E.1
	II-F: Secondary Tailings Impoundment	Piezometers	F.1
	II-G: Intermediate Dam	Piezometers	G.1
		Pond level (Intermediate pond)	G.2
	II-H: Cross Valley Dam	Piezometers	H.1
		Thermistors	H.2
		Pond level (polishing pond)	H.3
		Downstream weir flow measurement	H.4
Vangorda	II-I: Grum Pit	Pond level	I.1
		Displacement monitoring	I.2
		Piezometers (cut slot)	I.3
	II-J: Vangorda Pit	Pond level	J.1
	II-K: Vangorda Waste Rock Dump	Weir flow measurement and Visual drain monitoring	K.1
		Piezometers	K.2
	II-L: Little Creek Dam	Pond level	L.1
		Piezometers	L.2
		Thermistors	L.3

APPENDIX II-A

Faro Pit

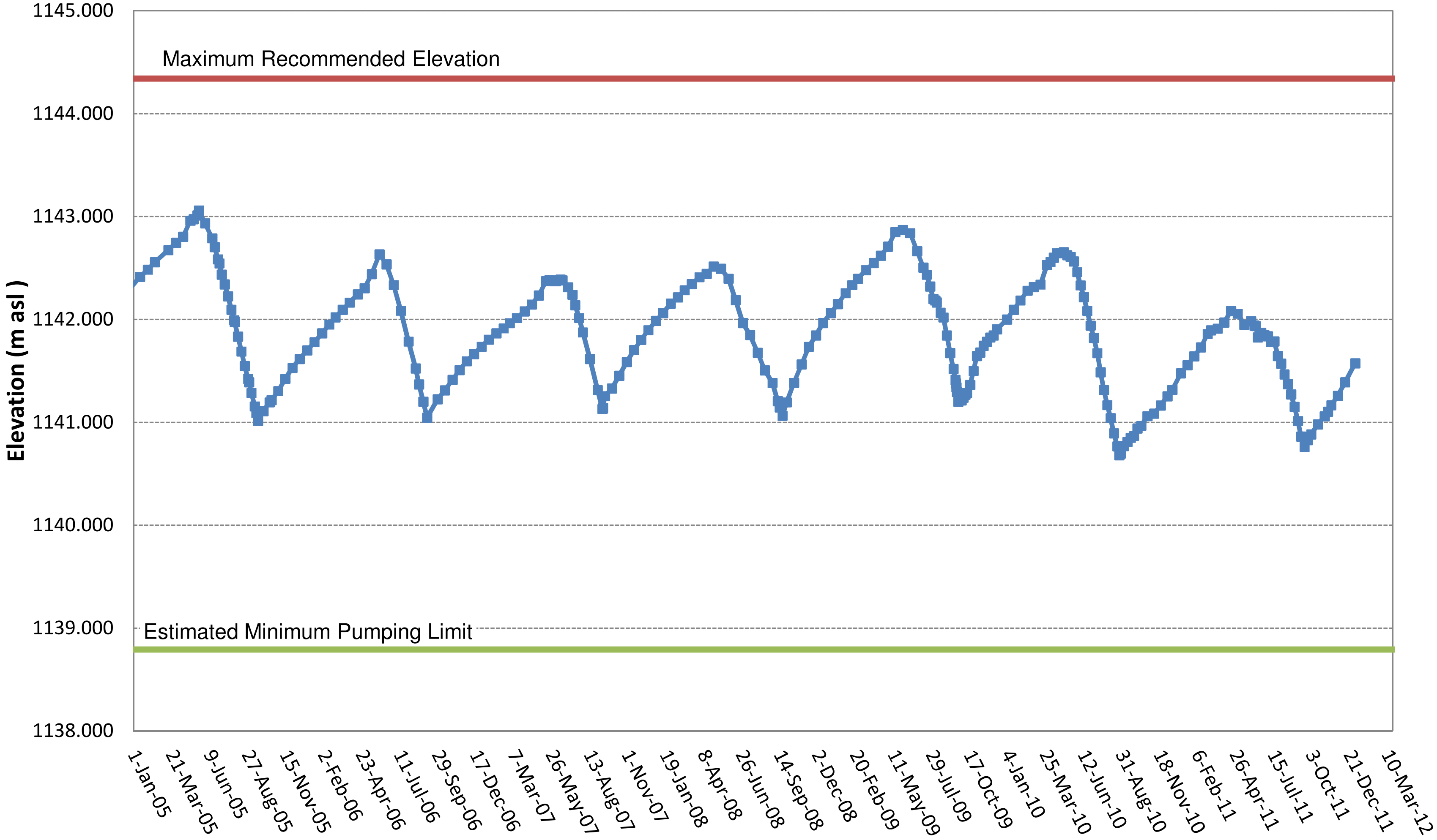
A.1 - Pond Level

A.2 - Pit Wall Regression

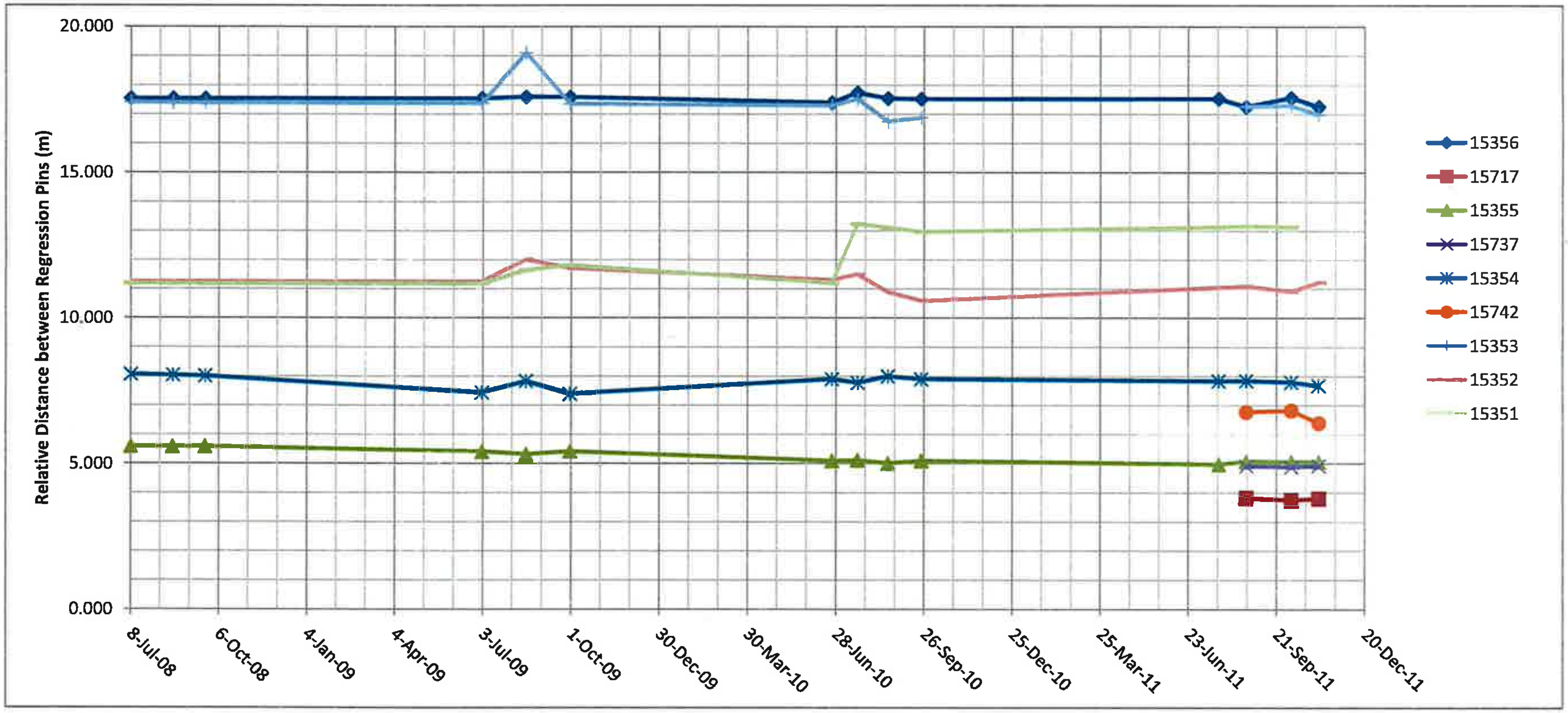
A.3 - Pit Wall Prism Monitoring

A.1 - Pond Level

Faro Pit Water Elevations



A.2 - Pit Wall Regression



20.000
15.000
10.000
5.000
0.000
Relative Distance between Regression Pins (m)
8-Jul-08
6-Oct-08
4-Jan-09
4-Apr-09
3-Jul-09
1-Oct-09
30-Dec-09
30-Mar-10
28-Jun-10
26-Sep-10
25-Dec-10
25-Mar-11
23-Jun-11
21-Sep-11
20-Dec-11
15356
15717
15355
15737
15354
15742
15353
15352
15351

A.3 - Pit Wall Prism Monitoring

Coordinates (Monitoring Points) August 2009 01-Aug-09 Changes Between August 2009 and August 2006

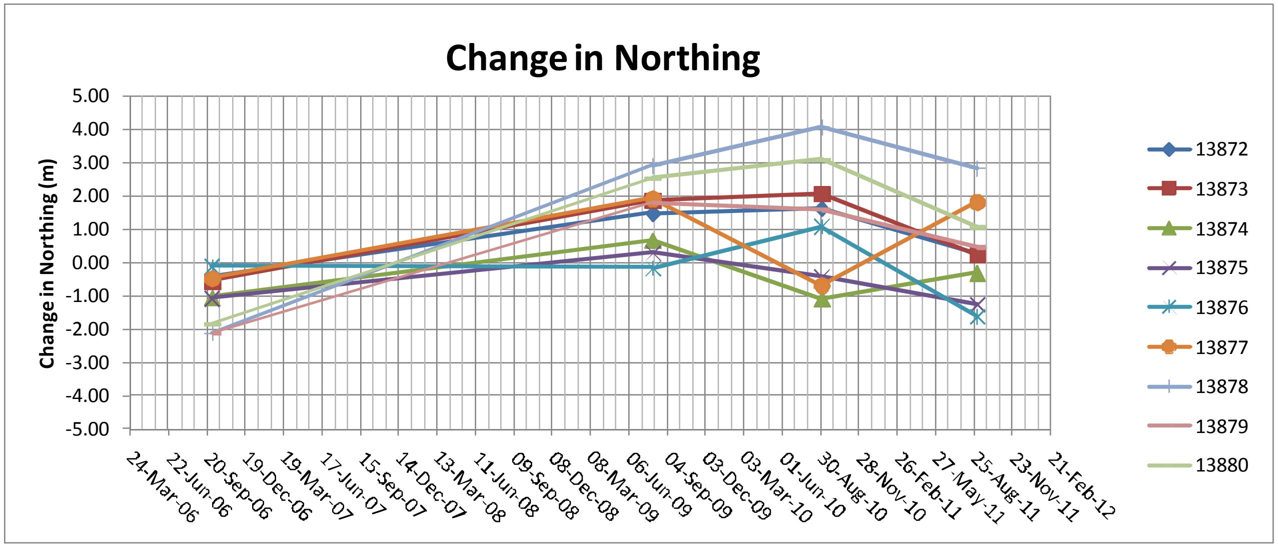
Point #	Northing	Easting	Elevation	σ_N (cm)	σ_E (cm)	σ_Z (cm)	Δ_N(m)	Δ_E(cm)	Δ_Z(cm)
13872	6915376.016	584838.717	1289.068	0.9	1.0	3.2	1.48	-1.41	-2.22
13873	6915330.160	584922.193	1298.200	0.9	1.0	3.2	1.87	-0.45	-6.03
13874	6915302.306	584972.841	1297.387	0.9	0.9	3.3	0.67	-1.55	-4.99
13875	6915262.939	585078.500	1303.852	1.0	0.9	3.4	0.30	-2.85	-6.77
13876	6915108.370	585074.493	1281.030	1.0	0.8	3.1	-0.16	-0.01	-9.95
13877	6915066.804	585200.621	1300.452	1.1	0.8	3.3	1.92	-0.36	-0.77
13878	6915002.363	585128.755	1280.709	1.0	0.8	3.1	2.92	-1.37	5.89
13879	6914854.644	585228.540	1274.949	1.1	0.7	3.0	1.81	-0.71	-5.09
13880	6914786.552	585240.522	1269.126	1.1	0.7	2.9	2.54	-0.26	-3.95

Coordinates (Monitoring Points) September 2010 01-Sep-10 Changes Between September 2010 and August 2006

Point #	Northing	Easting	Elevation	σ_N (cm)	σ_E (cm)	σ_Z (cm)	Δ_N(cm)	Δ_E(cm)	Δ_Z(cm)
13872	6915376.017	584838.715	1289.073	0.81	0.91	2.98	1.630	-1.640	-1.680
13873	6915330.162	584922.186	1298.246	0.85	0.88	2.99	2.070	-1.060	-1.370
13874	6915302.288	584972.853	1297.365	0.87	0.87	3.03	-1.090	-0.290	-7.250
13875	6915262.932	585078.501	1303.913	1.11	1.46	4.10	-0.430	-2.670	-0.670
13876	6915108.383	585074.485	1281.028	0.89	0.77	2.90	1.090	-0.840	-10.120
13877	6915066.778	585200.616	1300.455	0.98	0.78	3.05	-0.680	-0.860	-0.530
13878	6915002.375	585128.754	1280.727	0.91	0.73	2.83	4.080	-1.480	7.650
13879	6914854.642	585228.544	1275.018	0.97	0.69	2.78	1.600	-0.350	1.780
13880	6914786.558	585240.513	1269.161	1.23	1.03	3.08	3.100	-1.160	-0.450

Coordinates (Monitoring Points) September 2010 2011 01-Sep-11 Changes Between August 2011 and August 2006

Point #	Northing	Easting	Elevation	σ_N (cm)	σ_E (cm)	σ_Z (cm)	Δ_N(cm)	Δ_E(cm)	Δ_Z(cm)
13872	6915376.004	584838.718	1289.076	0.604	0.653	1.456	0.29	-1.31	-1.44
13873	6915330.143	584922.190	1298.250	0.621	0.647	1.488	0.24	-0.68	-1.00
13874	6915302.296	584972.842	1297.378	0.632	0.644	1.508	-0.30	-1.40	-5.92
13875	6915262.923	585078.492	1303.853	0.660	0.644	1.564	-1.26	-3.60	-6.70
13876	6915108.356	585074.495	1281.032	0.642	0.602	1.448	-1.62	0.18	-9.74
13877	6915066.803	585200.619	1300.452	0.682	0.607	1.522	1.82	-0.59	-0.82
13878	6915002.362	585128.751	1280.711	0.651	0.584	1.416	2.84	-1.78	6.06
13879	6914854.631	585228.532	1274.975	0.673	0.567	1.396	0.46	-1.47	-2.46
13880	6914786.538	585240.518	1269.139	0.673	0.558	1.359	1.08	-0.68	-2.62


Change in Northing
Change in Northing (m)
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4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
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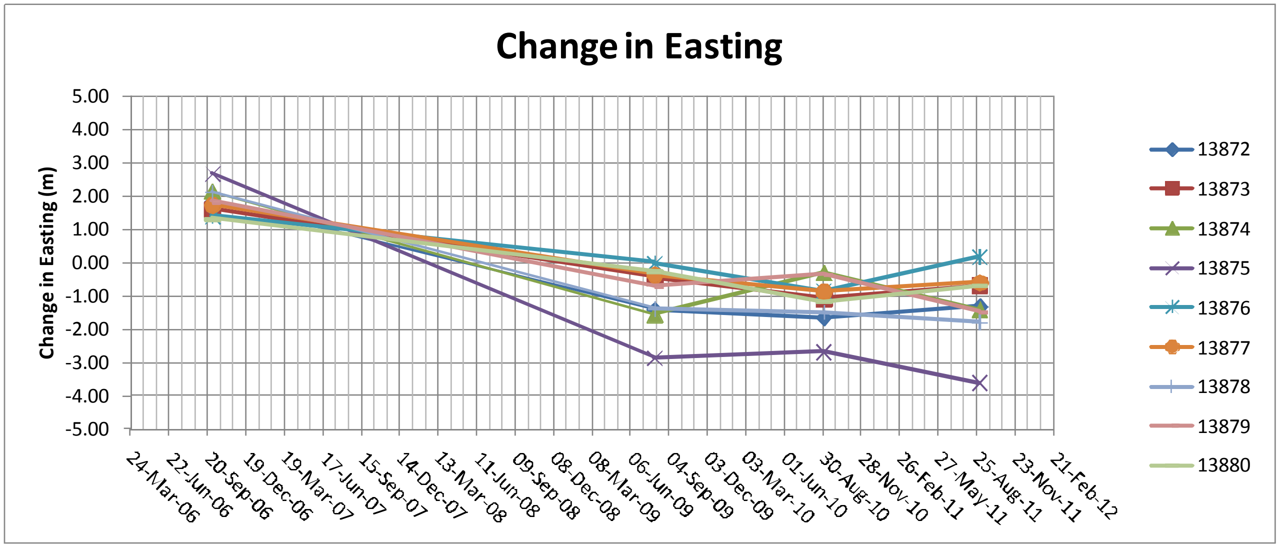
-4.00
-5.00
24-Mar-06
22-Jun-06
20-Sep-06
19-Dec-06
19-Mar-07
17-Jun-07
15-Sep-07
14-Dec-07
13-Mar-08
11-Jun-08
09-Sep-08
08-Dec-08
08-Mar-09
06-Jun-09
04-Sep-09
03-Dec-09
03-Mar-10
01-Jun-10
30-Aug-10
28-Nov-10
26-Feb-11
27-May-11
25-Aug-11
23-Nov-11
21-Feb-12
13872
13873
13874
13875
13876
13877
13878
13879
13880


Change in Easting
Change in Easting (m)
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
24-Mar-06
22-Jun-06
20-Sep-06
19-Dec-06
19-Mar-07
17-Jun-07
15-Sep-07
14-Dec-07
13-Mar-08
11-Jun-08
09-Sep-08
08-Dec-08
08-Mar-09
06-Jun-09
04-Sep-09
03-Dec-09
03-Mar-10
01-Jun-10
30-Aug-10
28-Nov-10
26-Feb-11
27-May-11
25-Aug-11
23-Nov-11
21-Feb-12
13872
13873
13874
13875
13876
13877
13878
13879
13880

APPENDIX II-B

Faro Creek Diversion

B.1 – Staff Gauge Flow Measurement

B.1 - Staff Gauge Flow Measurement

Denison Environmental Services

Table H-59: Faro Creek Diversion
FCD-1 Staff Gauge Readings 2011

Date	Time	Reading (m)	Discharge (L/s)	Comment
14-Apr-11	5:00 PM			Frozen
28-Apr-11	2:25 PM			Frozen
16-May-11	3:40 PM			Frozen
25-May-11	1:31 PM	0.600		
14-Jun-11	10:36 AM	0.226		
4-Jul-11	3:01 PM	0.238		
5-Jul-11	10:05 AM	0.240		
7-Jul-11	10:00 AM	0.221		
11-Jul-11	3:35 PM	0.210		
24-Jul-11	2:57 PM	0.220		
25-Jul-11	11:00 AM	0.205		
27-Jul-11	2:11 PM	0.195		
7-Aug-11	12:30 PM	0.174		
22-Aug-11	2:00 PM	0.201		
24-Aug-11	8:25 AM	0.199		
6-Sep-11	9:50 AM	0.177		
26-Sep-11	9:06 AM	0.166		
6-Oct-11	2:08 PM	0.149		
2-Nov-11	10:30 AM	0.138		

max	0.600
min	0.138

Table H-60: Faro Creek Diversion FCD-2 Staff Gauge Readings 2011

Date	Time (PST)	Reading (m)	Discharge (L/s)	Comment
14-Apr-11	5:02 PM	Frozen		Frozen
28-Apr-11	2:21 PM	Frozen		Frozen
16-May-11	3:45 PM	Frozen		Frozen
25-May-11	1:38 PM	Iced		Iced
14-Jun-11	10:39 AM	Broken		Brace and SG broken
4-Jul-11	2:24 PM	0.335		New staff gauge installed
5-Jul-11	10:40 AM	0.350		
7-Jul-11	10:30 AM	0.305		
11-Jul-11	4:03 PM	0.293		
24-Jul-11	3:19 PM	0.300		
25-Jul-11	11:36 AM	0.284		
27-Jul-11	2:45 PM	0.269		
7-Aug-11	1:30 PM	0.238		
22-Aug-11	2:30 PM	0.268		
24-Aug-11	9:00 AM	0.264		
6-Sep-11	9:52 AM	0.170		
26-Sep-11	9:11 AM	0.210		
6-Oct-11	2:05 PM	0.198		
2-Nov-11	10:40 AM	0.195		

Table H-61: Faro Creek Diversion FCD-3 Staff Gauge Readings 2011

Date	Time (PST)	Reading (m)	Discharge (L/s)	Comment
14-Apr-11	5:03 PM			Frozen
28-Apr-11	2:19 PM			Frozen
16-May-11	3:50 PM			Icy Flow
25-May-11	1:53 PM	0.580		
14-Jun-11	10:42 AM	0.192		
4-Jul-11	2:08 PM	0.231		
5-Jul-11	11:20 AM	0.239		
7-Jul-11	11:00 AM	0.211		
11-Jul-11	4:39 PM	0.195		
24-Jul-11	3:42 PM	0.201		
25-Jul-11	1:30 PM	0.183		
27-Jul-11	3:18 PM	0.176		
7-Aug-11	1:50 PM	0.149		
22-Aug-11	3:00 PM	0.184		
24-Aug-11	9:30 AM	0.179		
6-Sep-11	9:54 AM	0.235		
26-Sep-11	9:13 AM	0.133		
6-Oct-11	1:49 PM	0.110		
2-Nov-11	10:45 AM			Dry

Table H-62: Faro Creek Diversion FCD-4 Staff Gauge Readings 2011

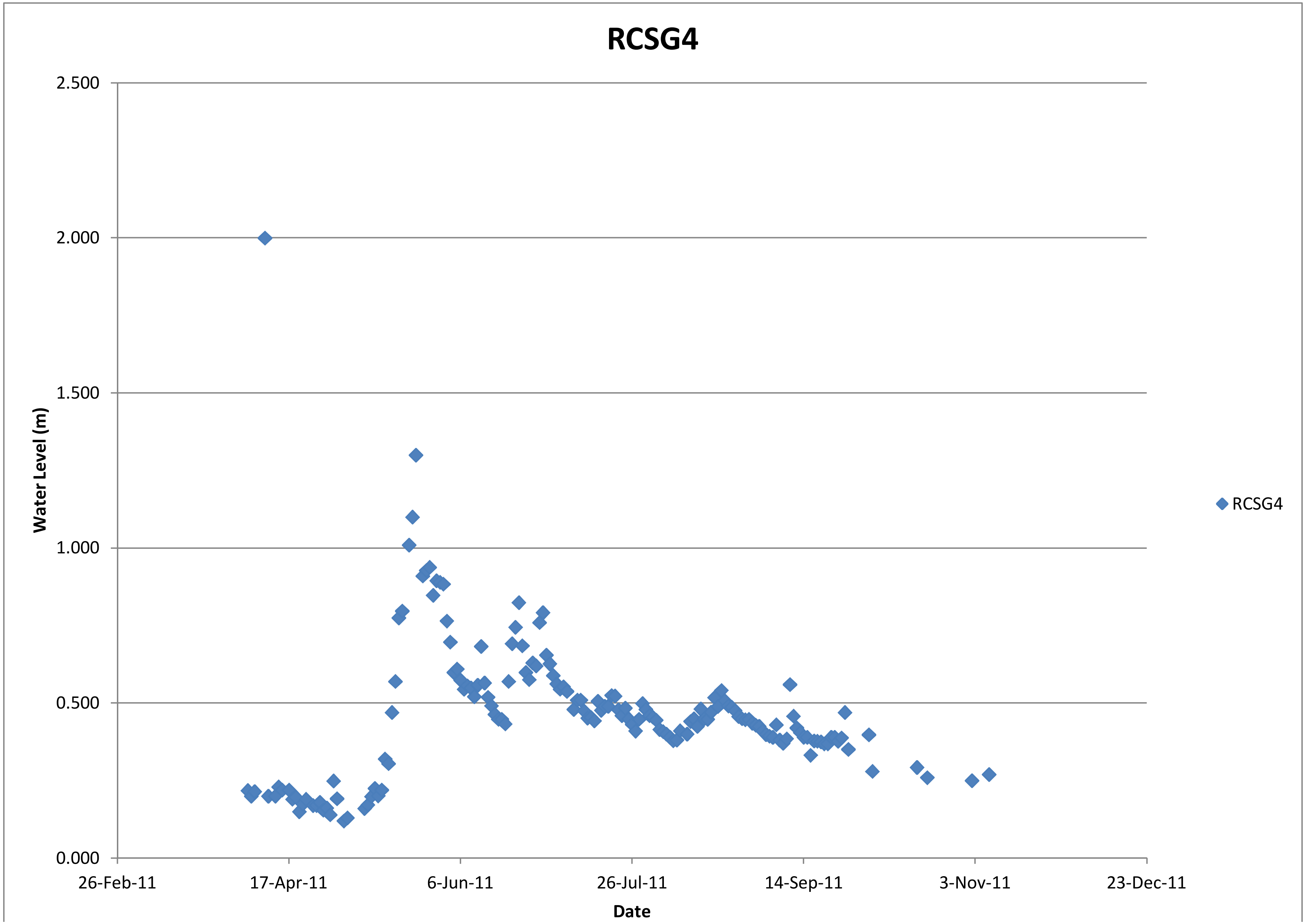
Date	Time (PST)	Reading (m)	Discharge (L/s)	Comment
14-Apr-11	17:05:00			Frozen
28-Apr-11	14:18:00			Frozen
16-May-11	15:55:00			Icy Flow
25-May-11	13:56:00	0.610		
14-Jun-11	10:45:00			SG bent up
4-Jul-11	13:14:00	0.268		New face plate
5-Jul-11	11:55:00	0.285		
7-Jul-11	11:30:00	0.250		
11-Jul-11	5:07 PM	0.240		
24-Jul-11	4:03 PM	0.250		
25-Jul-11	2:00 PM	0.225		
27-Jul-11	3:45 PM	0.218		
7-Aug-11	2:15 PM	0.185		
22-Aug-11	3:30 PM	0.219		
24-Aug-11	10:00 AM	0.215		
6-Sep-11	9:56 AM	0.260		
26-Sep-11	9:18 AM	0.161		
6-Oct-11	1:23 PM	0.170		
2-Nov-11	10:55 AM	0.157		

APPENDIX II-C

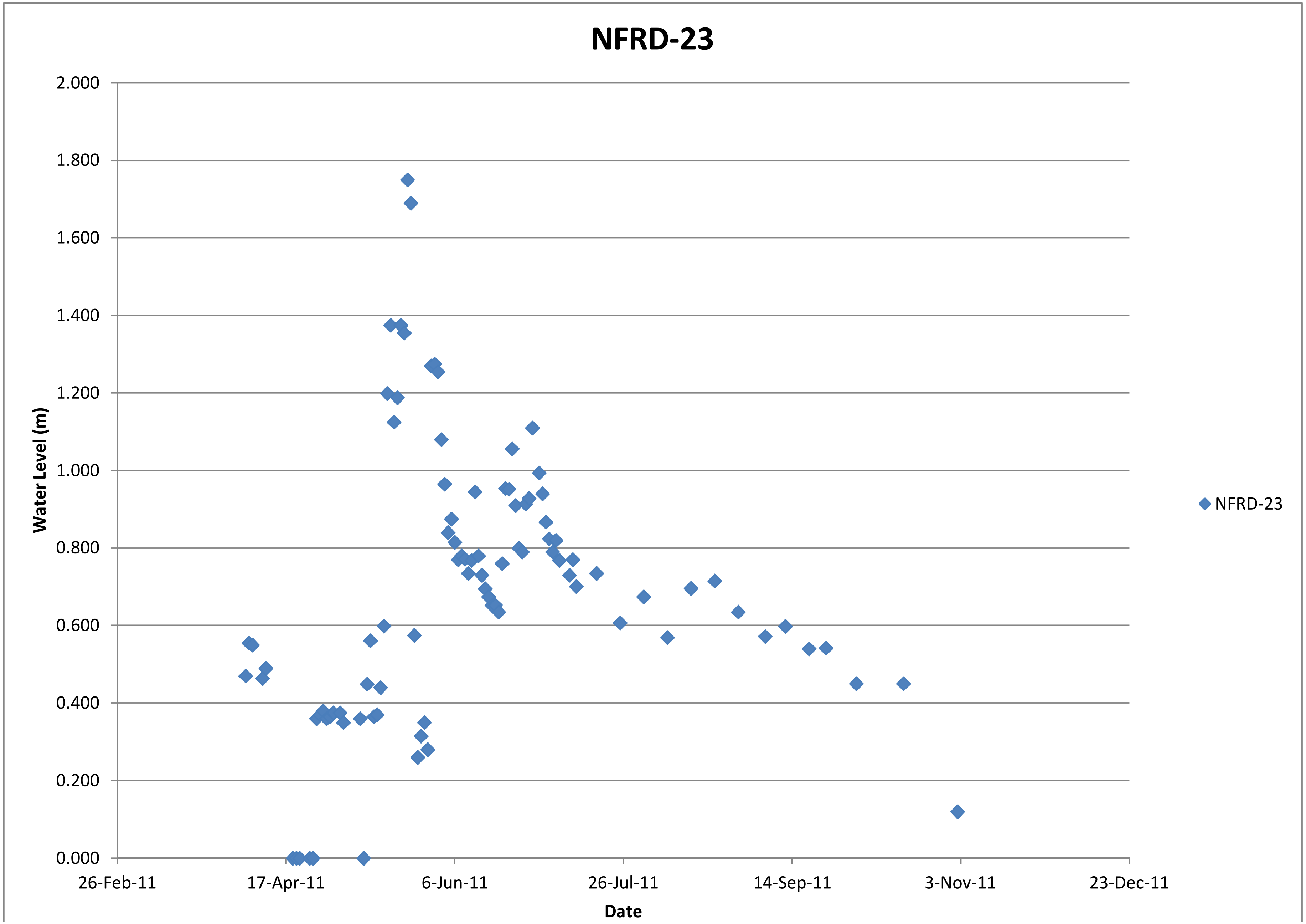
Rose Creek Diversion Canal

C.1 – Staff Gauge Flow Measurement

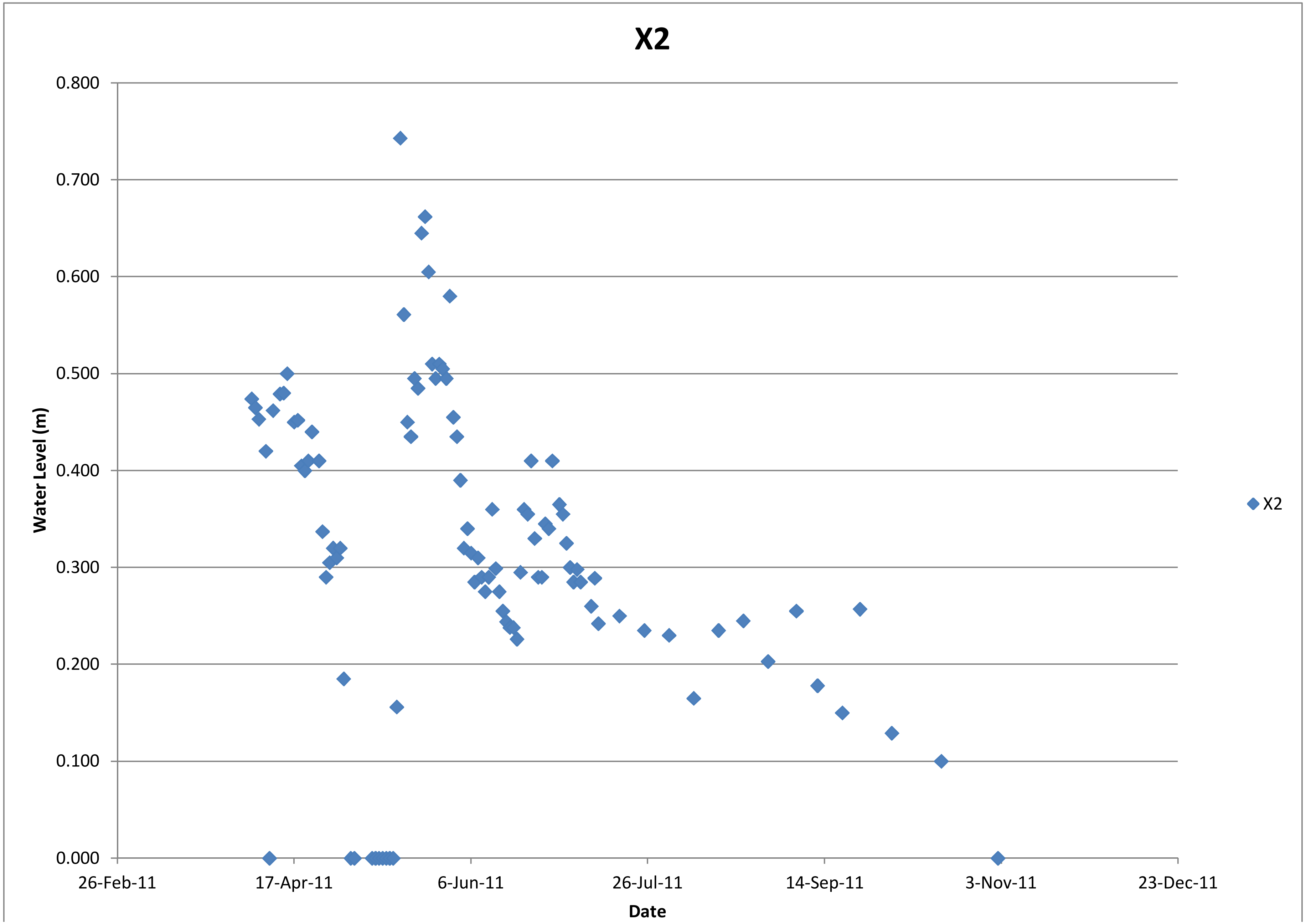
C.1 – Staff Gauge Flow Measurement



RCSG4
2.500
2.000
1.500
1.000
0.500
0.000
Water Level (m)
26-Feb-11
17-Apr-11
6-Jun-11
26-Jul-11
14-Sep-11
3-Nov-11
23-Dec-11
Date
RCSG4



NFRD-23
2.000
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Water Level (m)
26-Feb-11
17-Apr-11
6-Jun-11
26-Jul-11
14-Sep-11
3-Nov-11
23-Dec-11
Date
NFRD-23


X2
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Water Level (m)
26-Feb-11
17-Apr-11
6-Jun-11
26-Jul-11
14-Sep-11
3-Nov-11
23-Dec-11
Date
X2

APPENDIX II-D

Canal Dyke

D.1 – Piezometers

D.2 – Thermistors

D.3 – Slope Indicators

D.1 – Piezometers

Figure H-6: Diversion Canal (Canal Dyke) - Piezometers
BGC05-02/-03

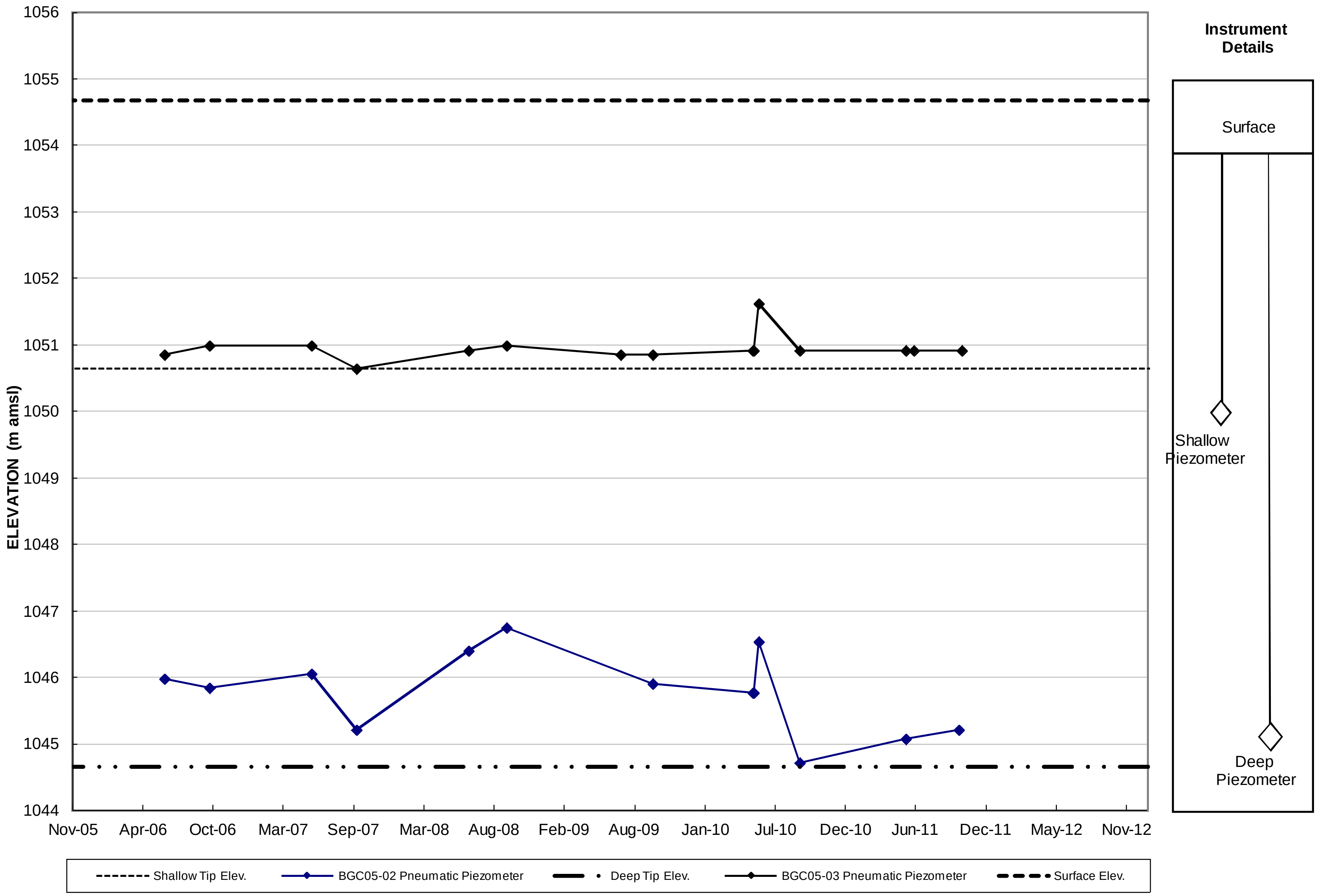


Figure H-7: Diversion Canal (Canal Dyke)
Piezometer BGC05-06 (Both Tips)

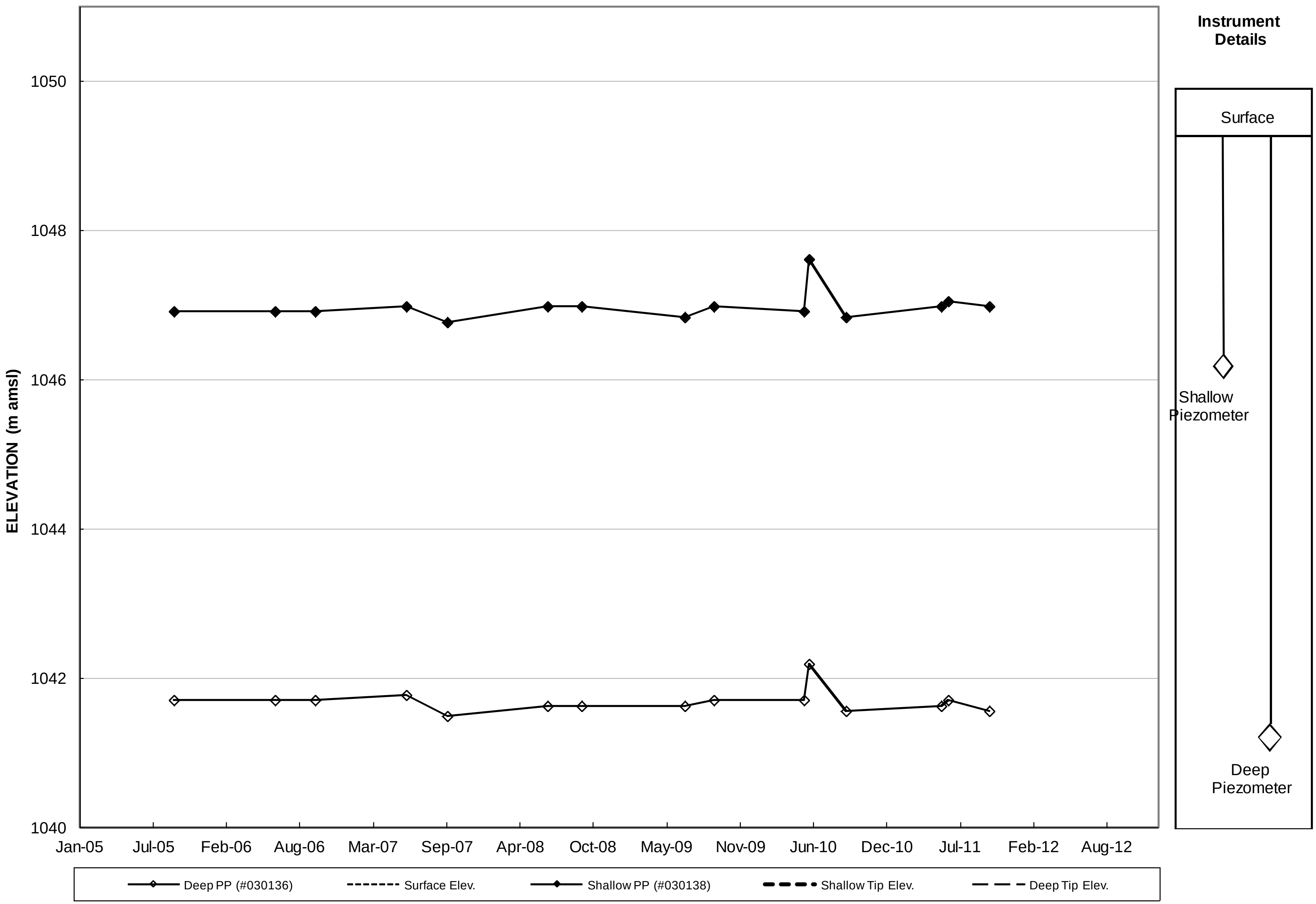


Figure H-8: Diversion Canal (Canal Dyke)
Piezometer CD-13 (Both Tips)

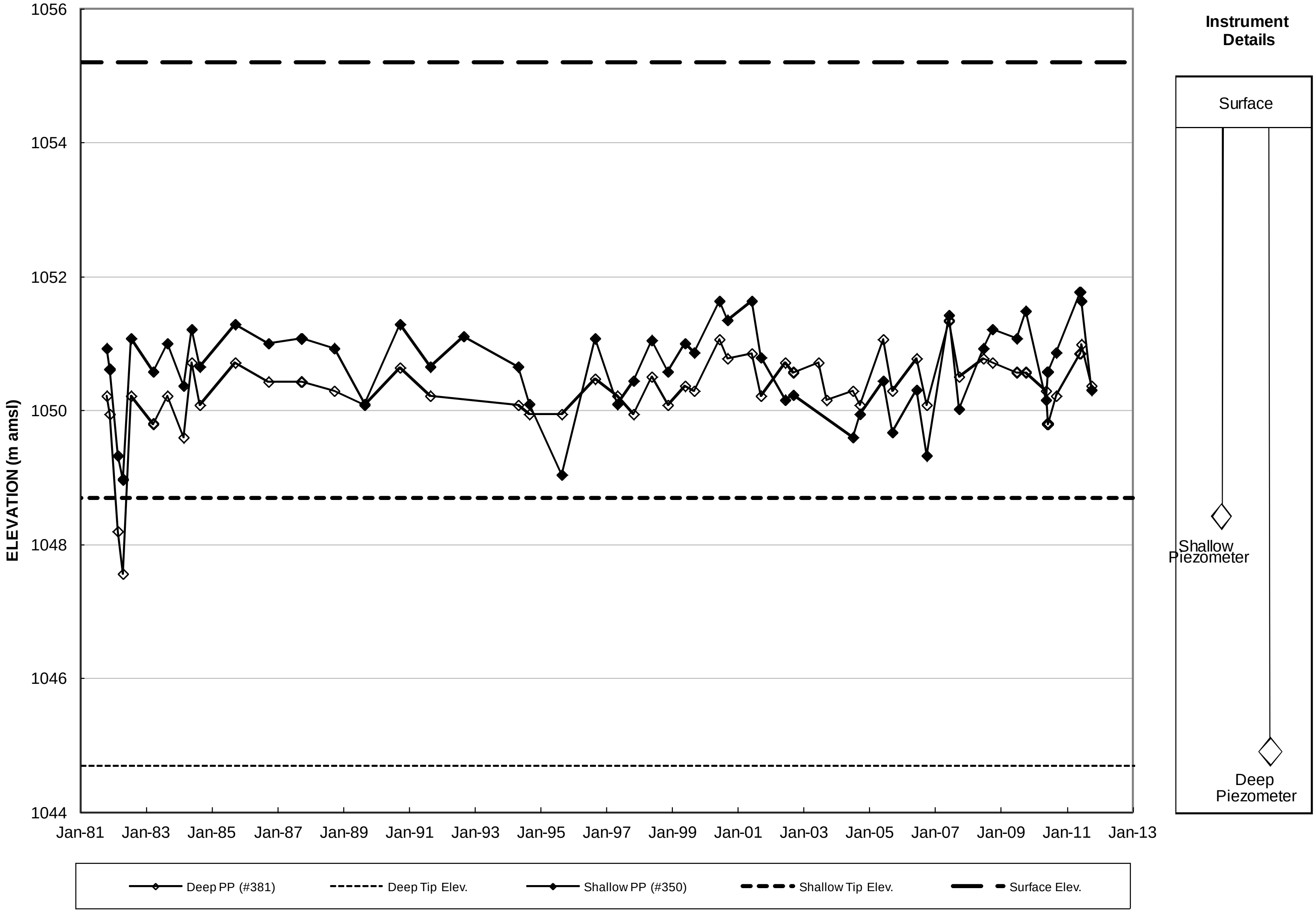


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Figure H-9: Diversion Canal (Canal Dyke)
Piezometer CD-15 (Both Tips)

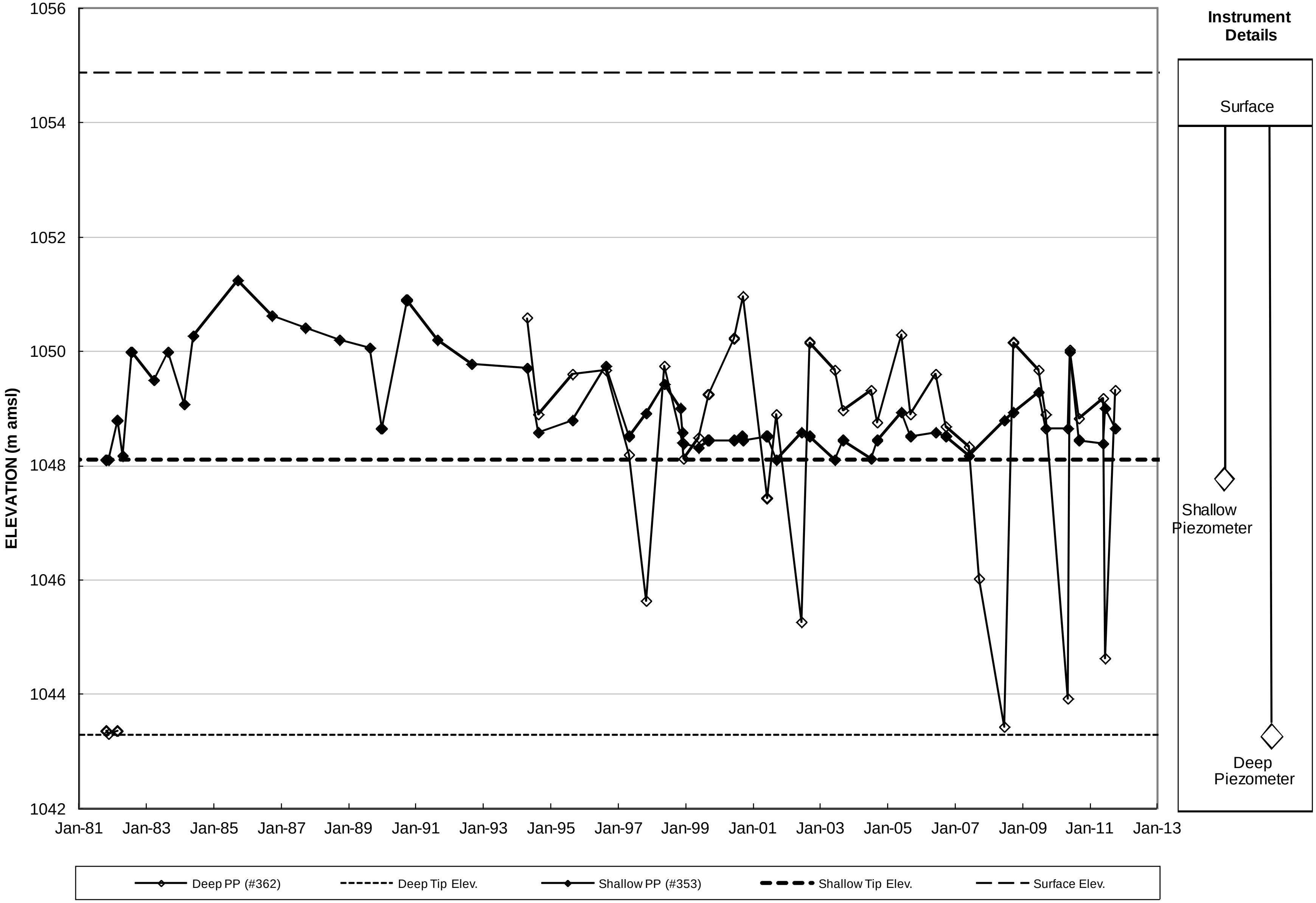


Figure H-10: Diversion Canal (Canal Dyke)
Piezometer CD-21 (Both Tips)

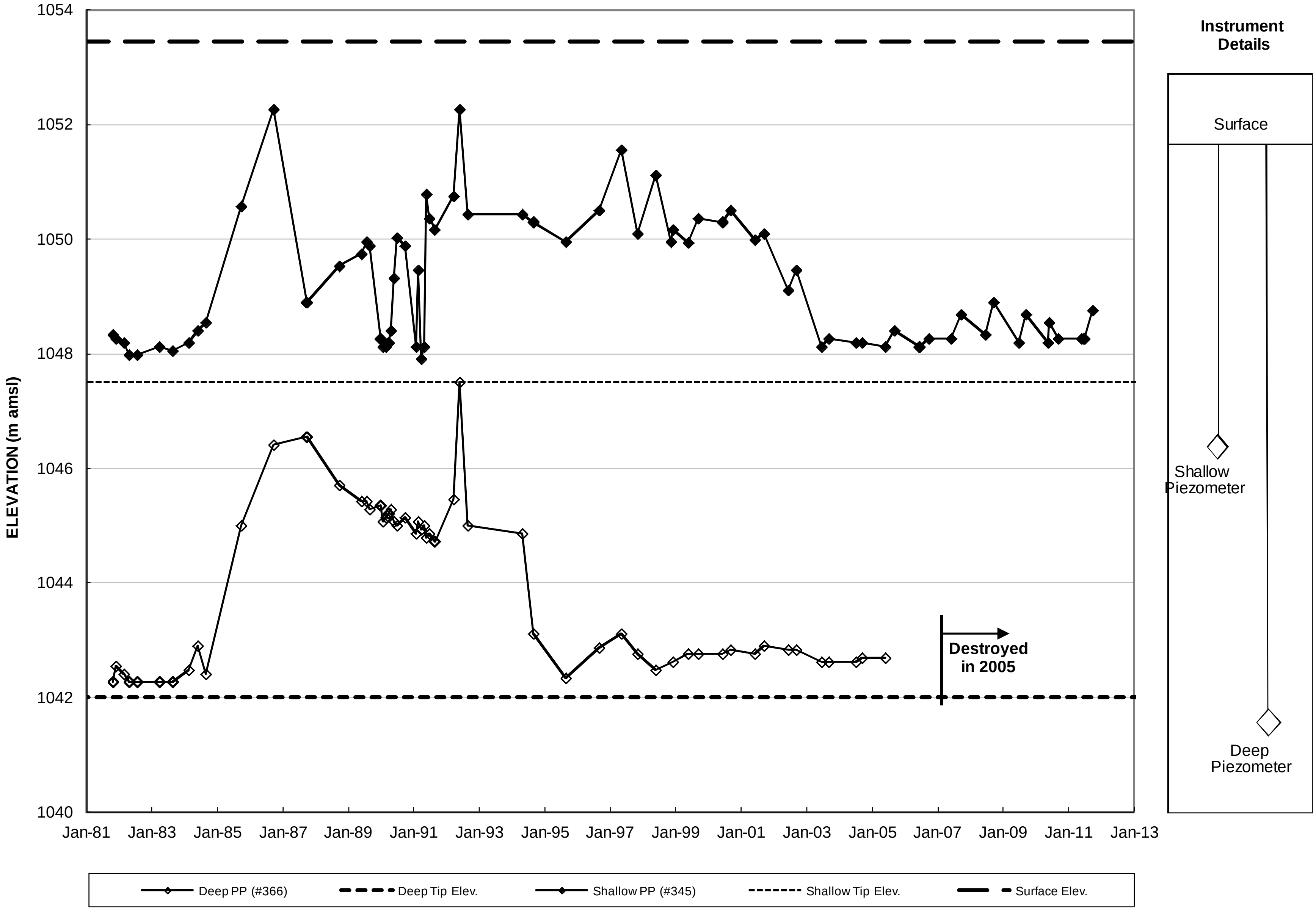
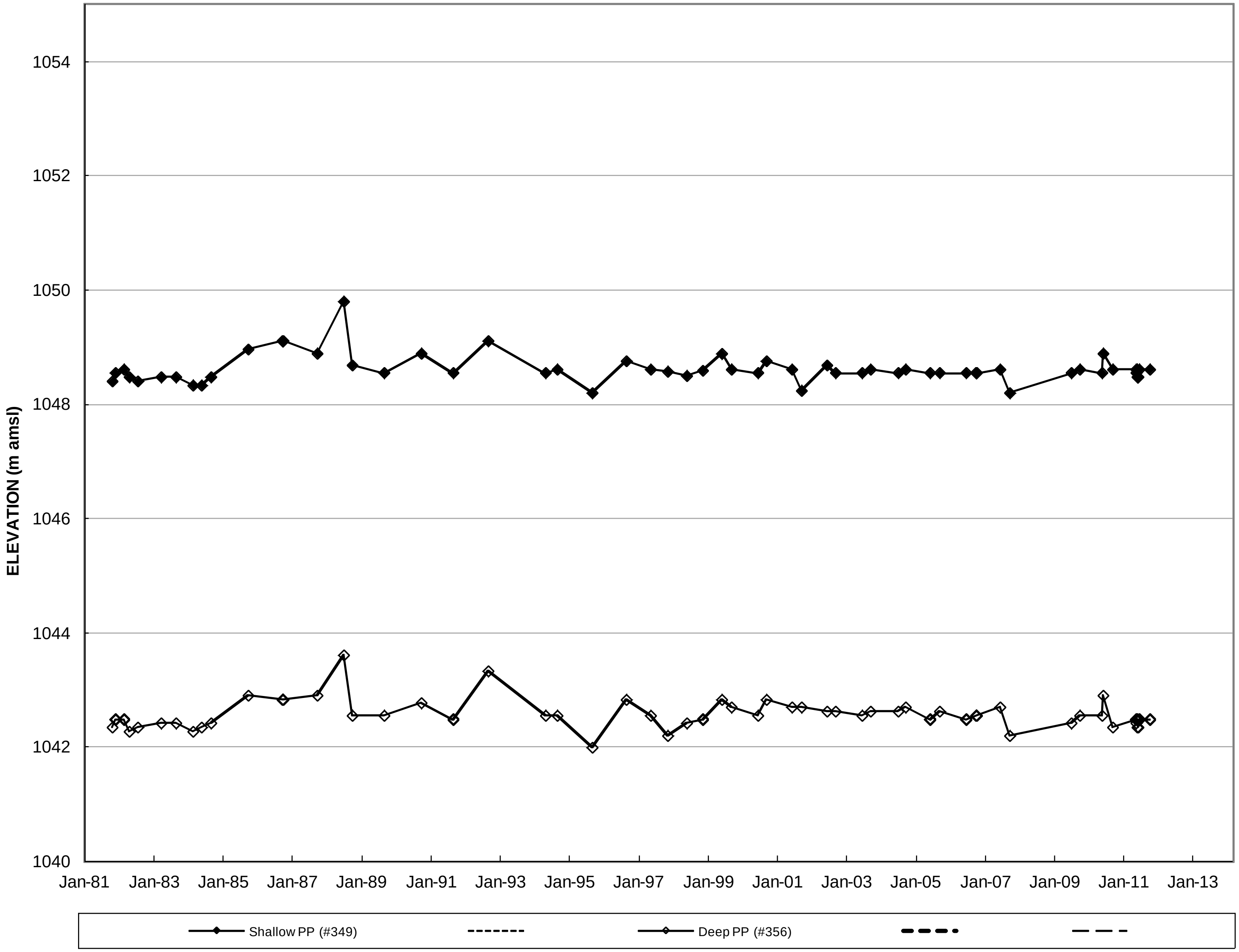
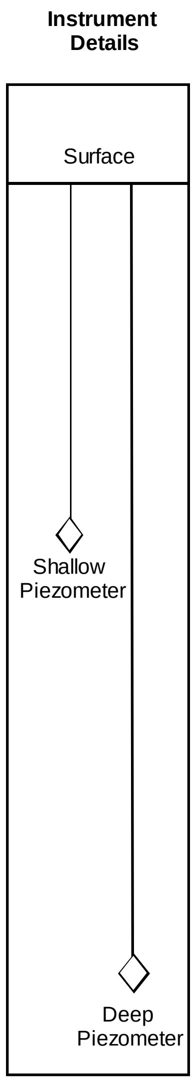


Figure H-11: Diversion Canal (Canal Dyke)
Piezometer CD-26 (Both Tips)





D.2 – Thermistors

Figure H-1: Diversion Canal (Canal Dyke)
Thermistor CD-15

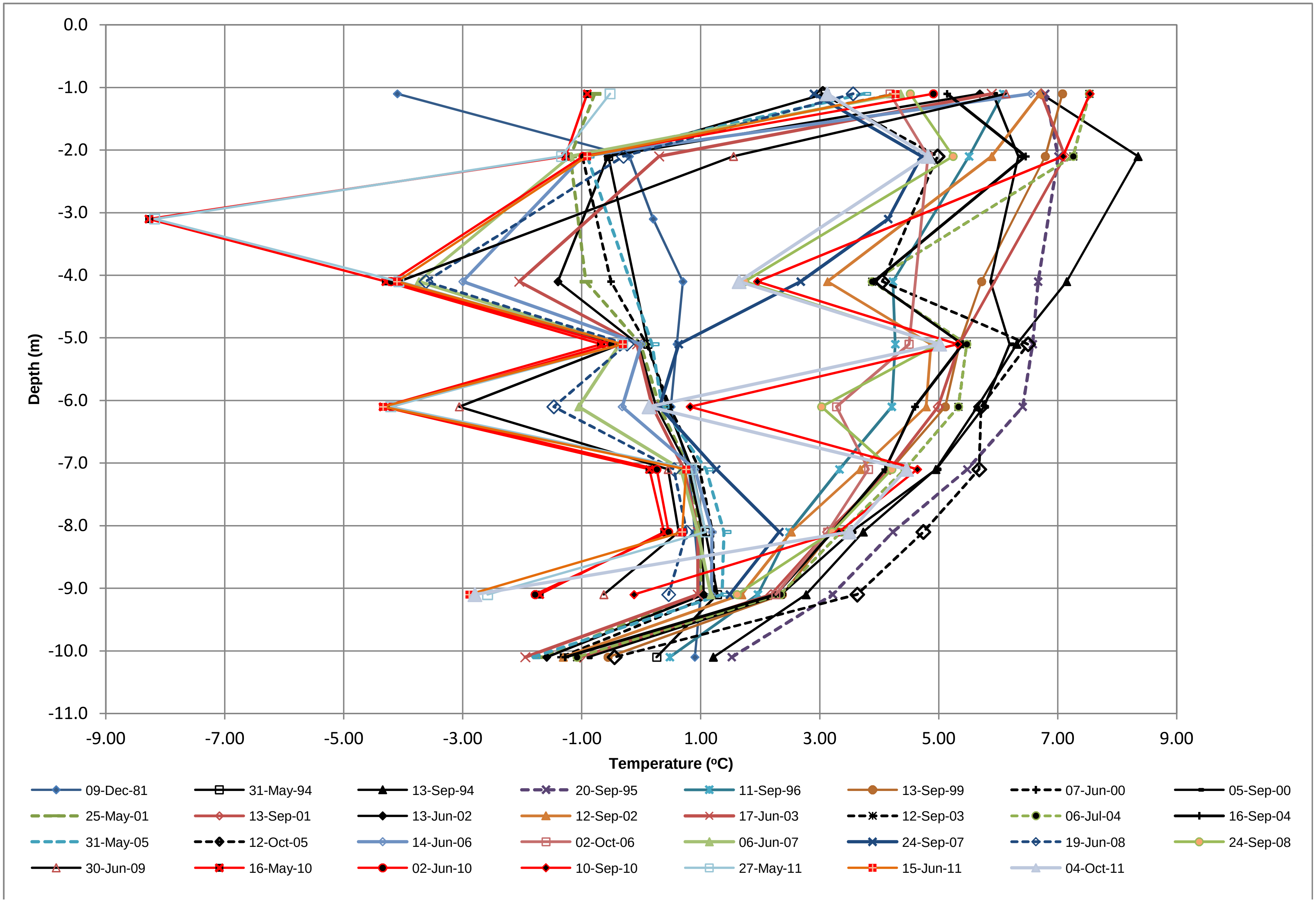


Figure H-2: Diversion Canal (Canal Dyke)
Thermistor CD-21

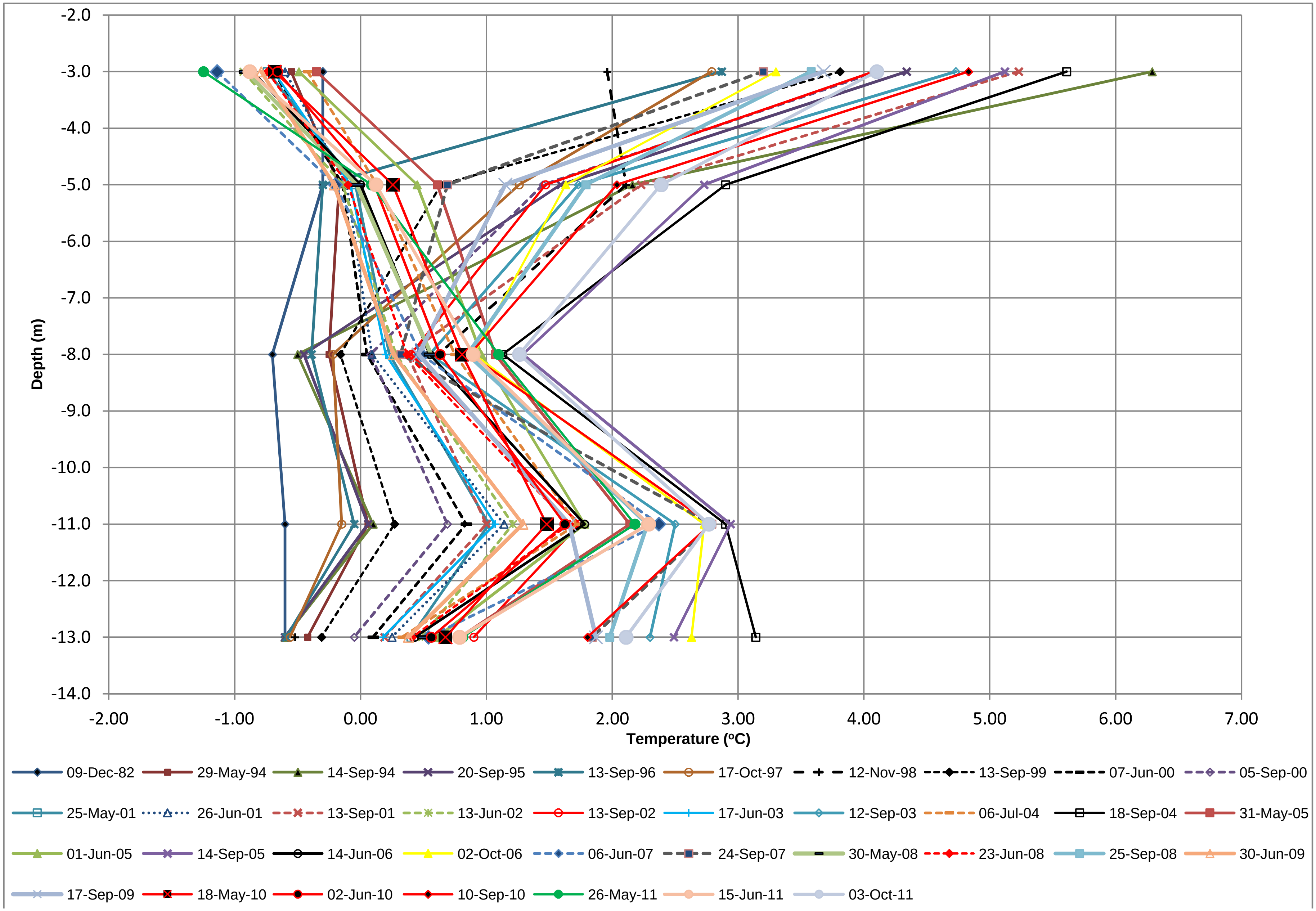


Figure H-3: Diversion Canal (Canal Dyke)
Thermistor CD-26

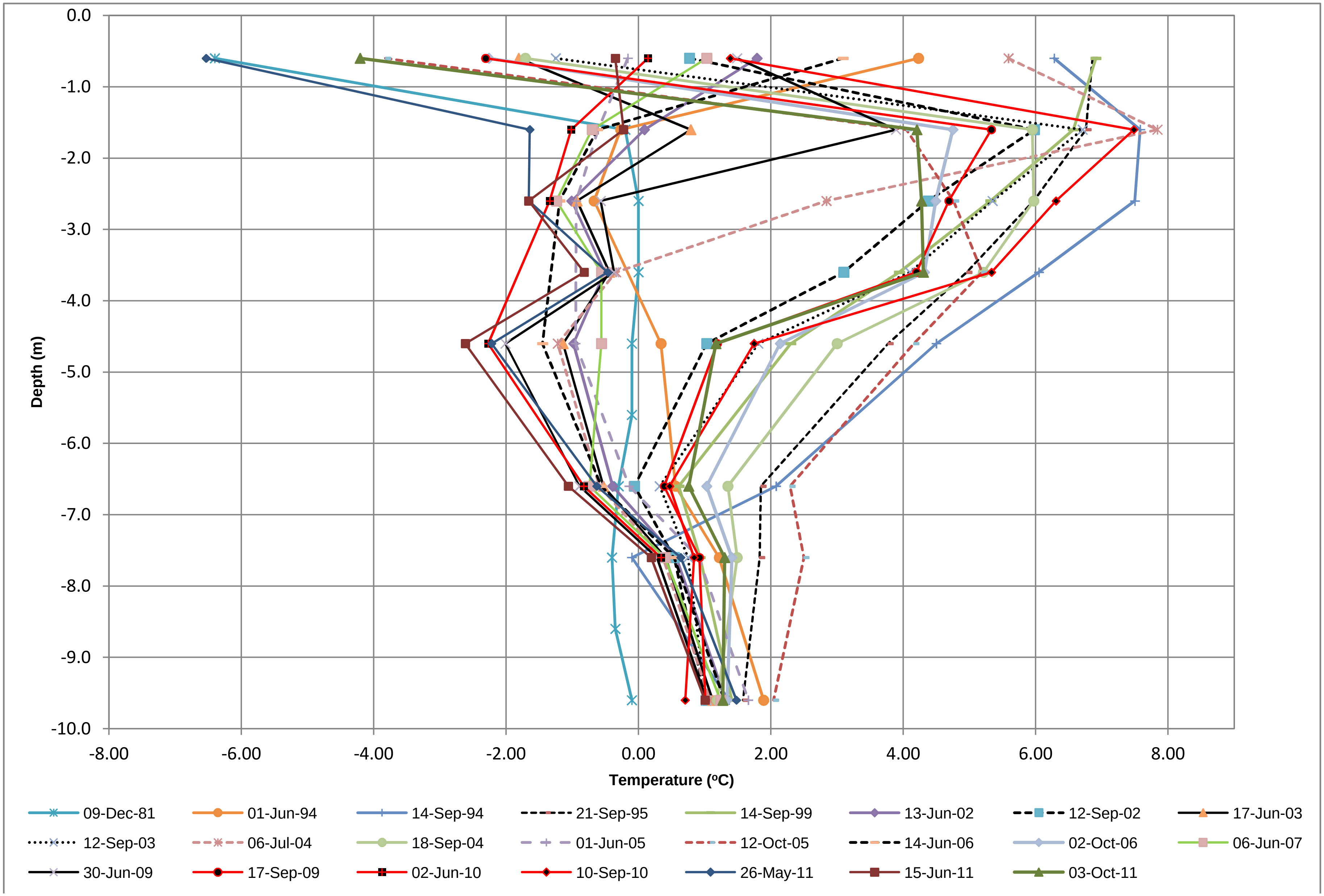


Figure H-1: Diversion Canal (Canal Dyke)
Thermistor BGC05-04

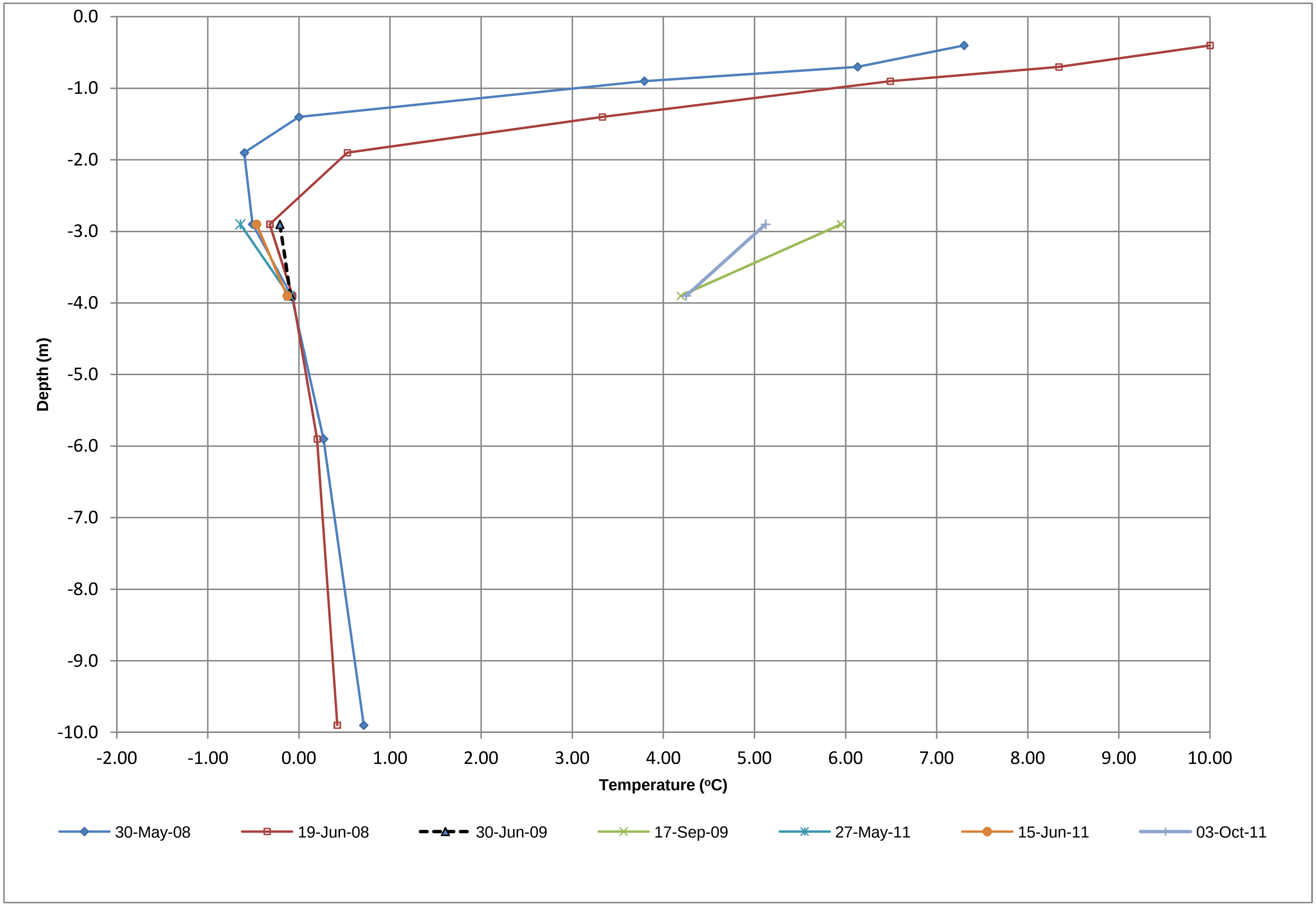


Figure H-4: Diversion Canal (Spoil Pile)
Thermistor SP-3

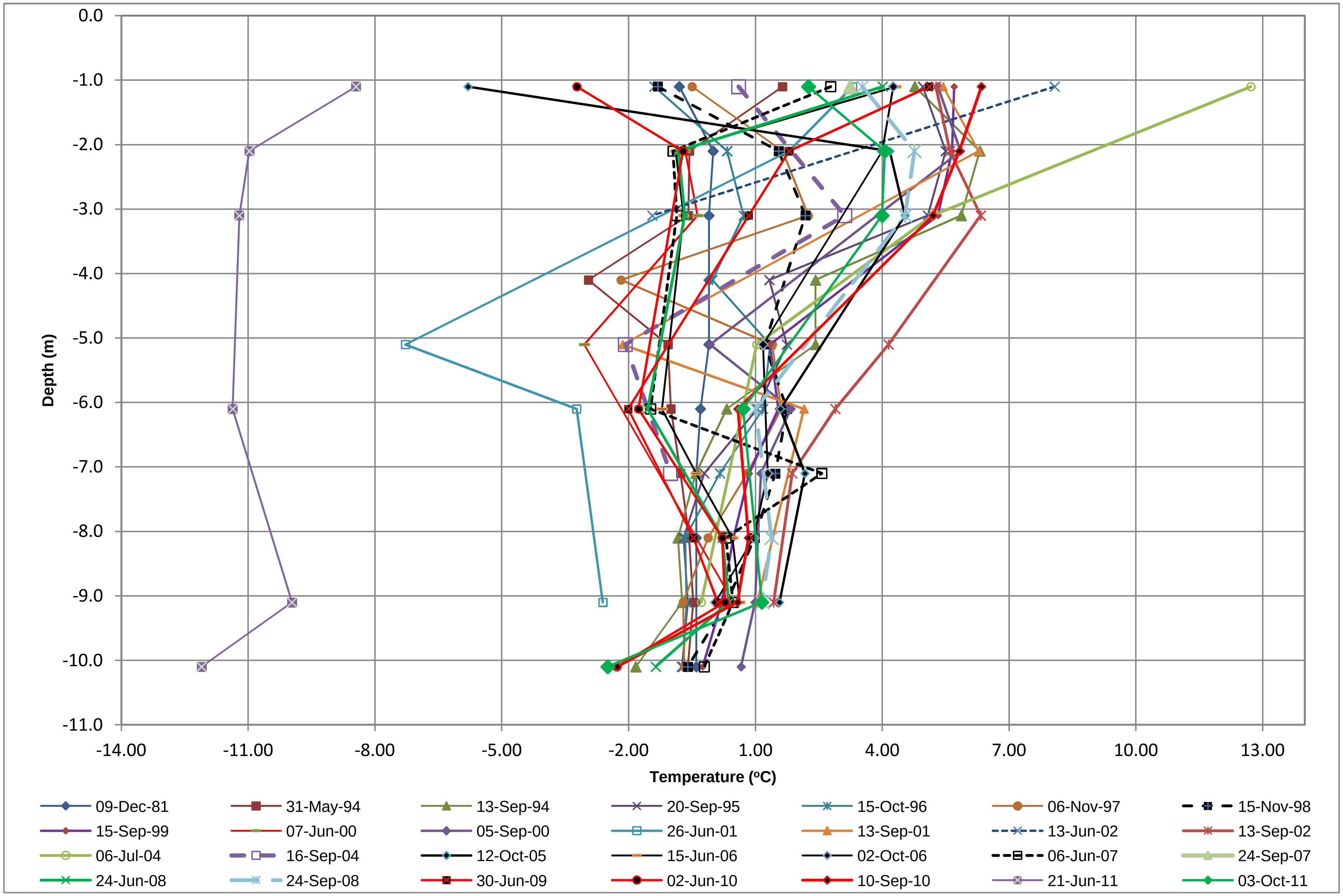


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Figure H-5: Diversion Canal (Spoil Pile)
Thermistor SP-5

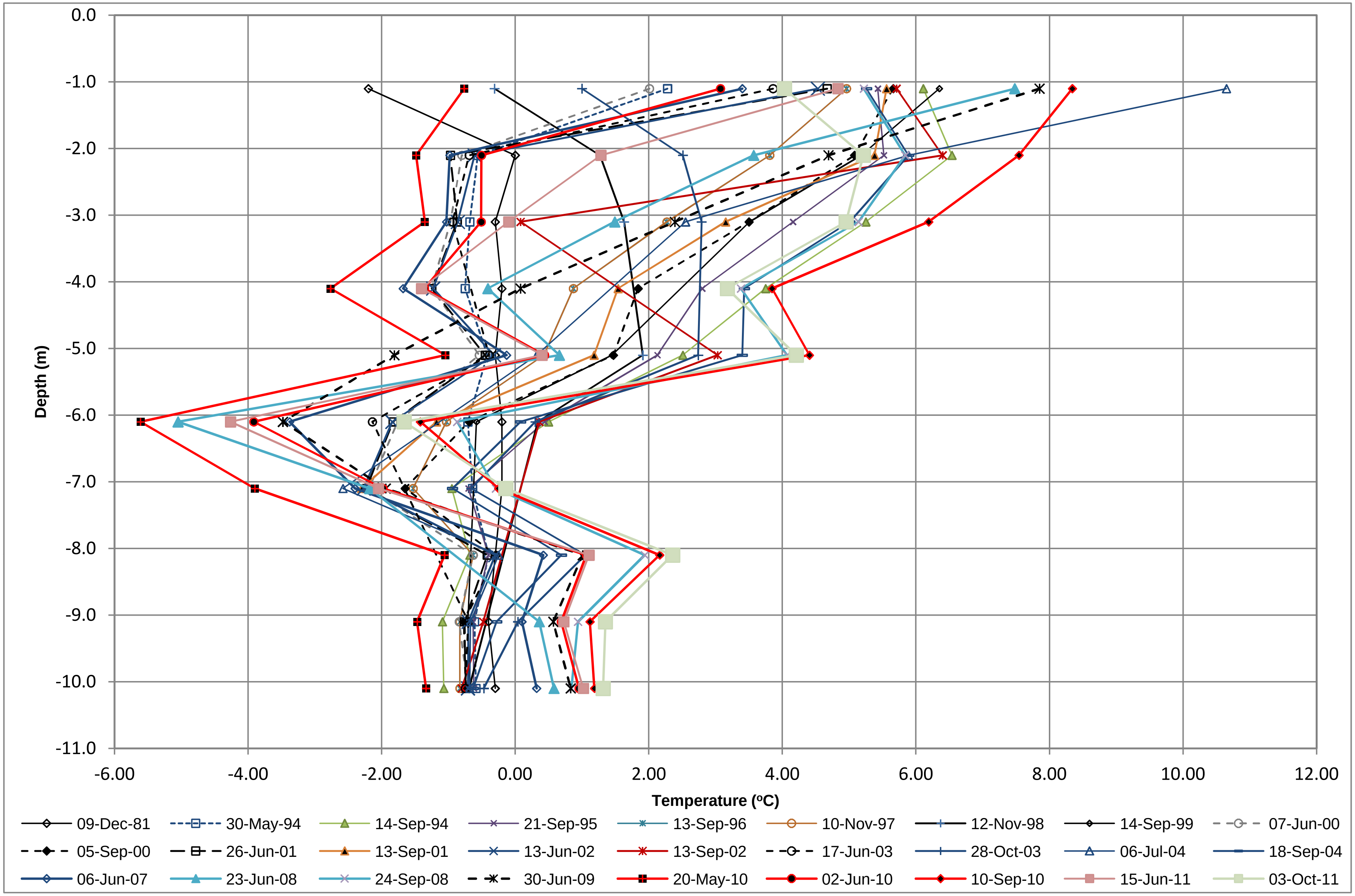

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Figure H-8: Diversion Canal (Backslope)
Thermistor BS-5

Faro Mine Closure

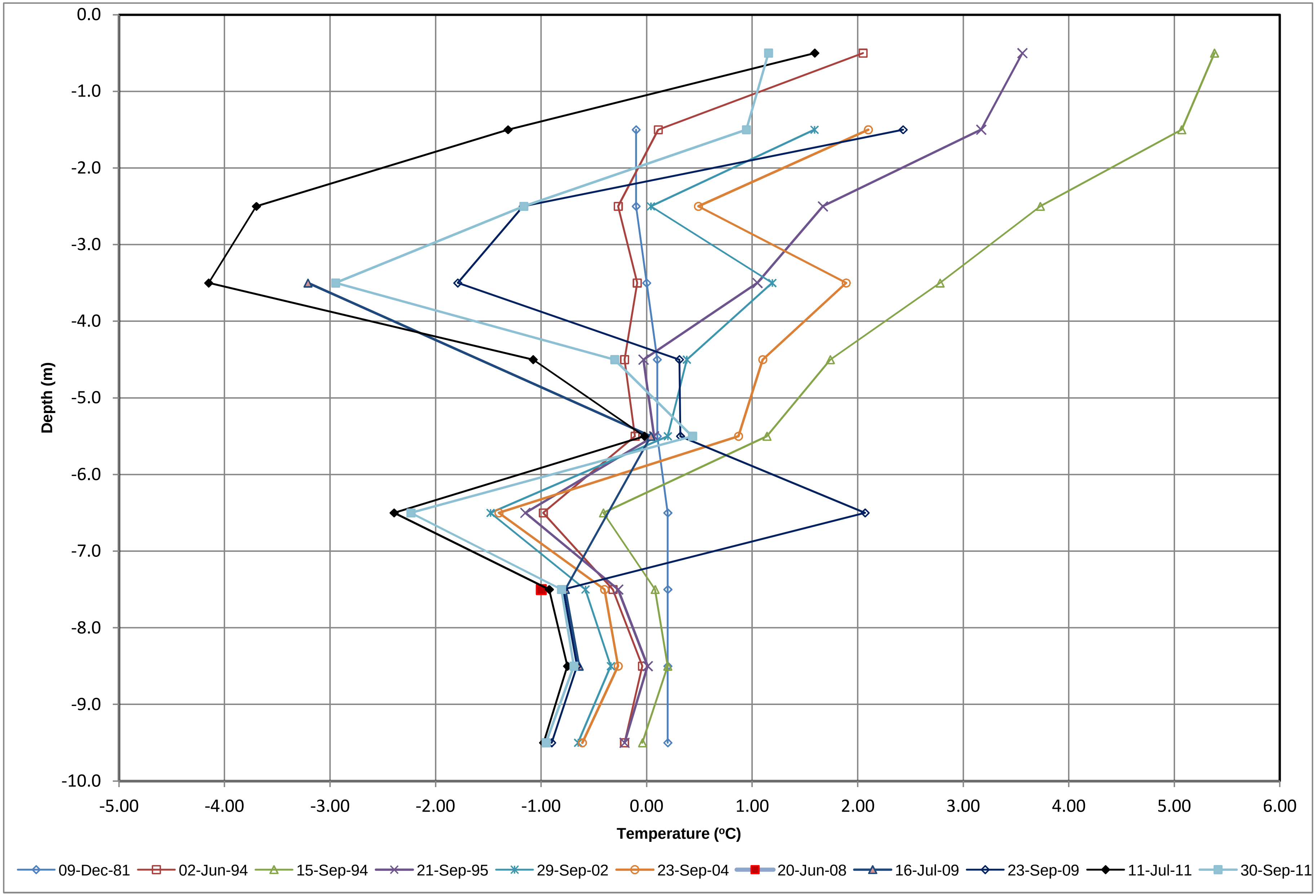


Figure H-XX: Diversion Canal (Backslope)
Thermistor BS-9

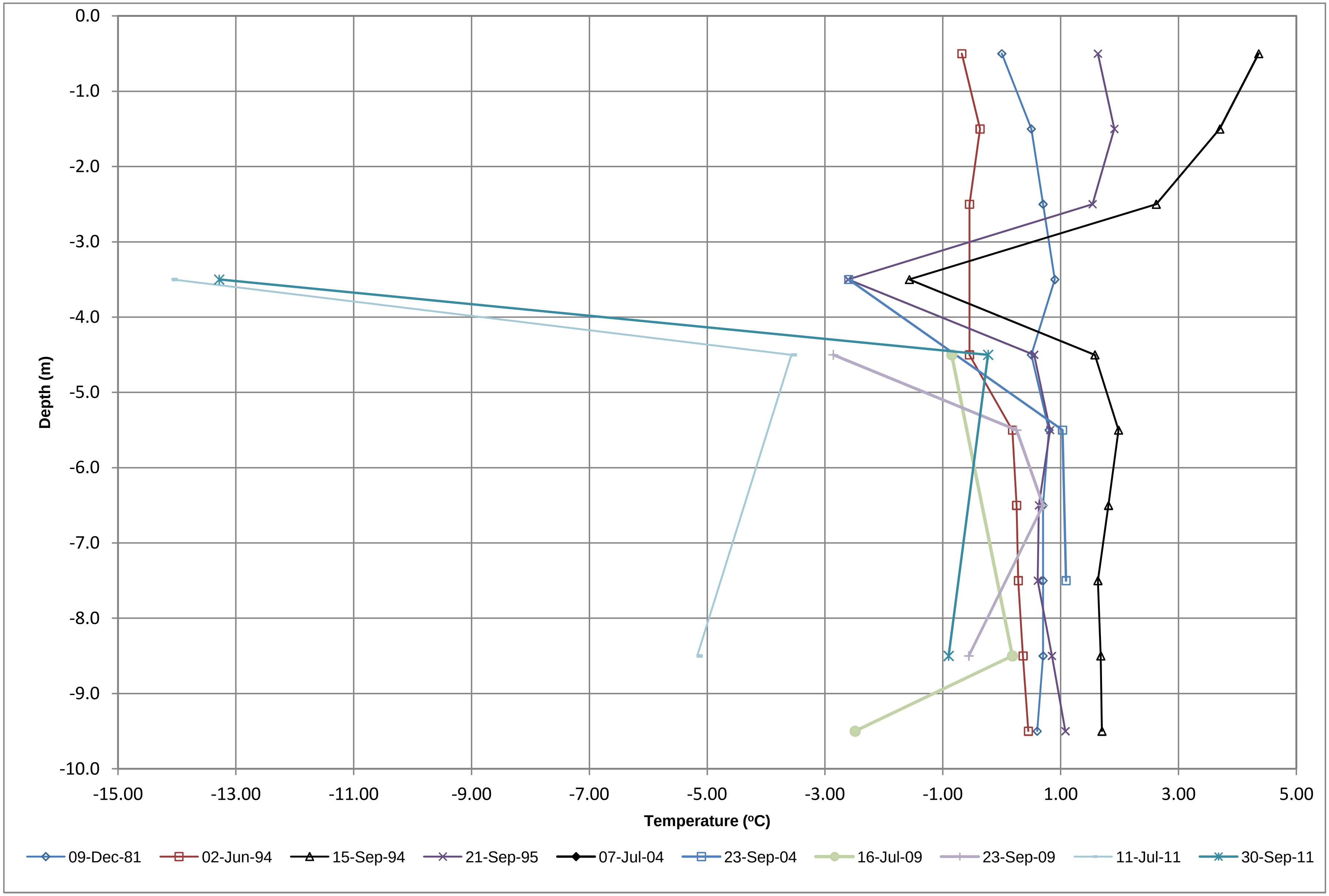


Figure H-10: Diversion Canal (Backslope)
Thermistor BS-10

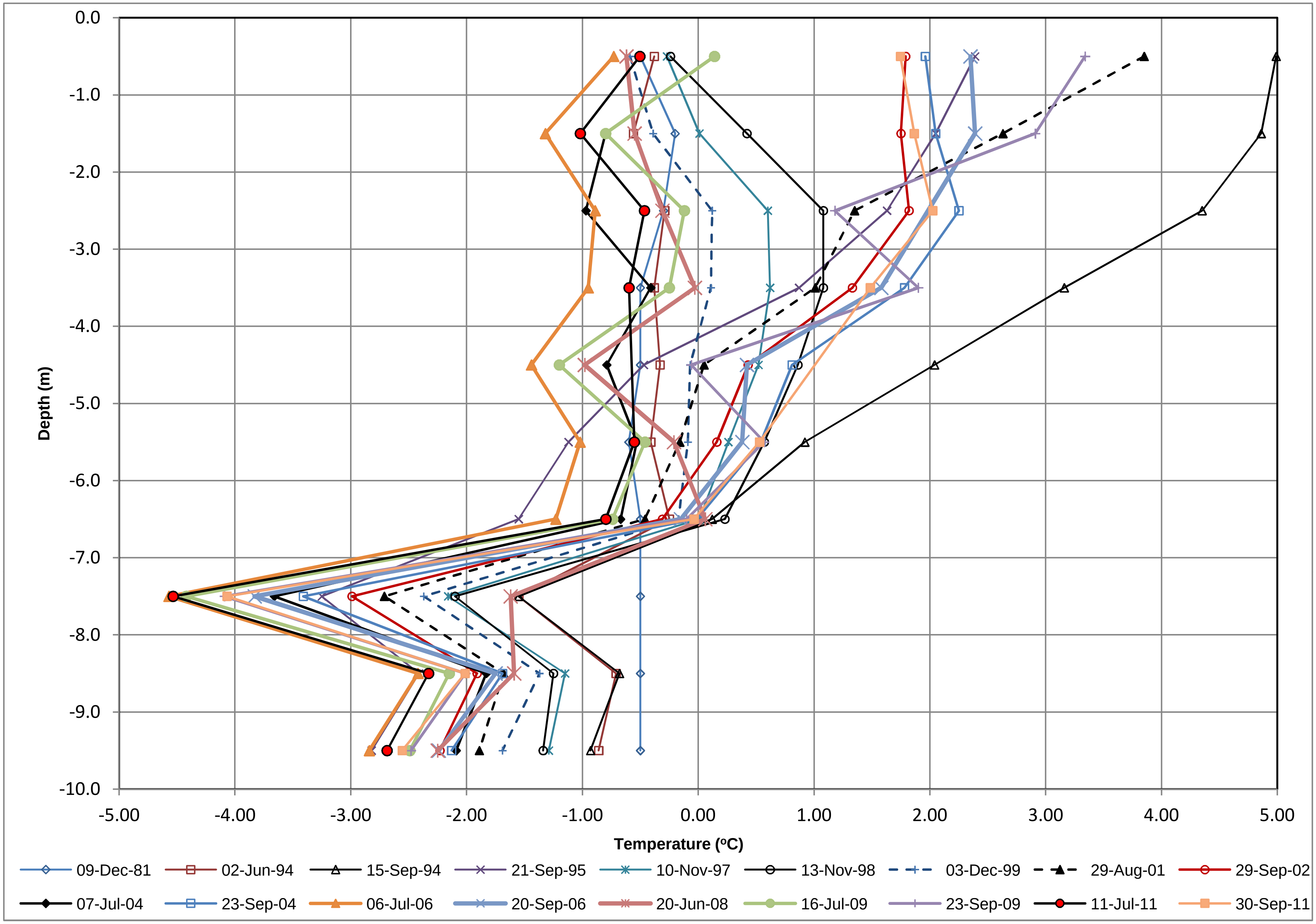


Figure H-11: Diversion Canal (Backslope)
Thermistor BS-12

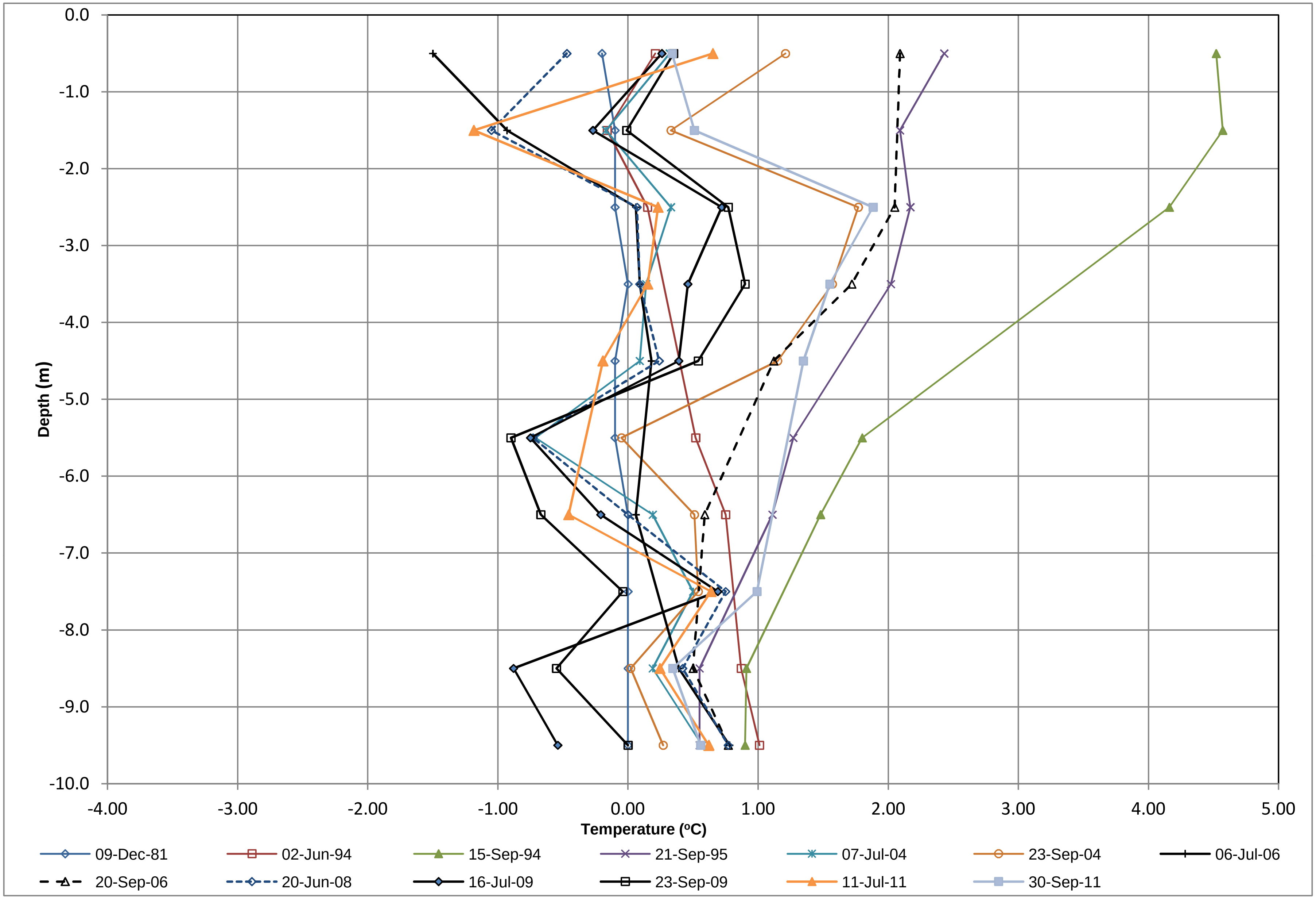


Figure X-X: Diversion Canal
Thermistor CD-10

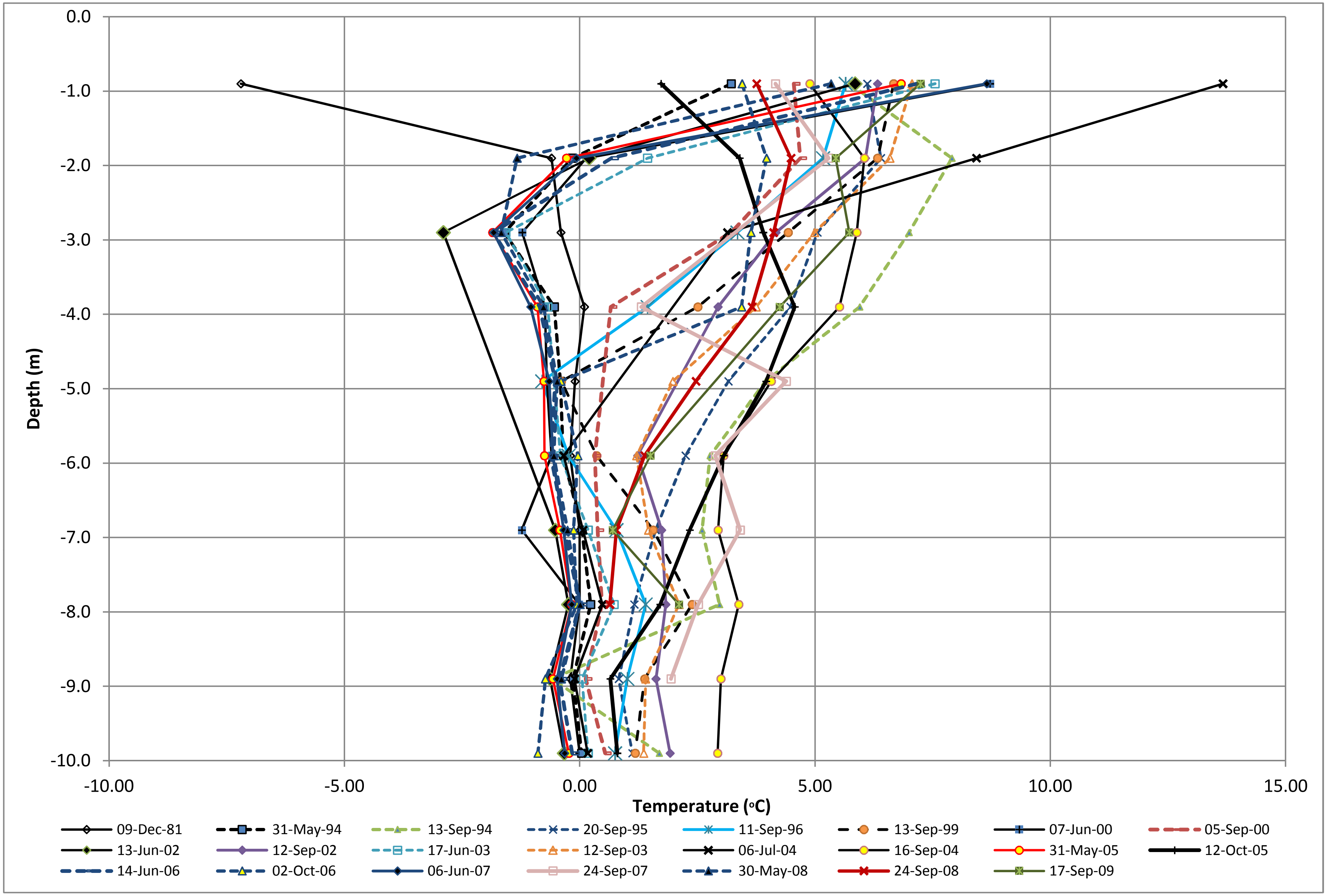
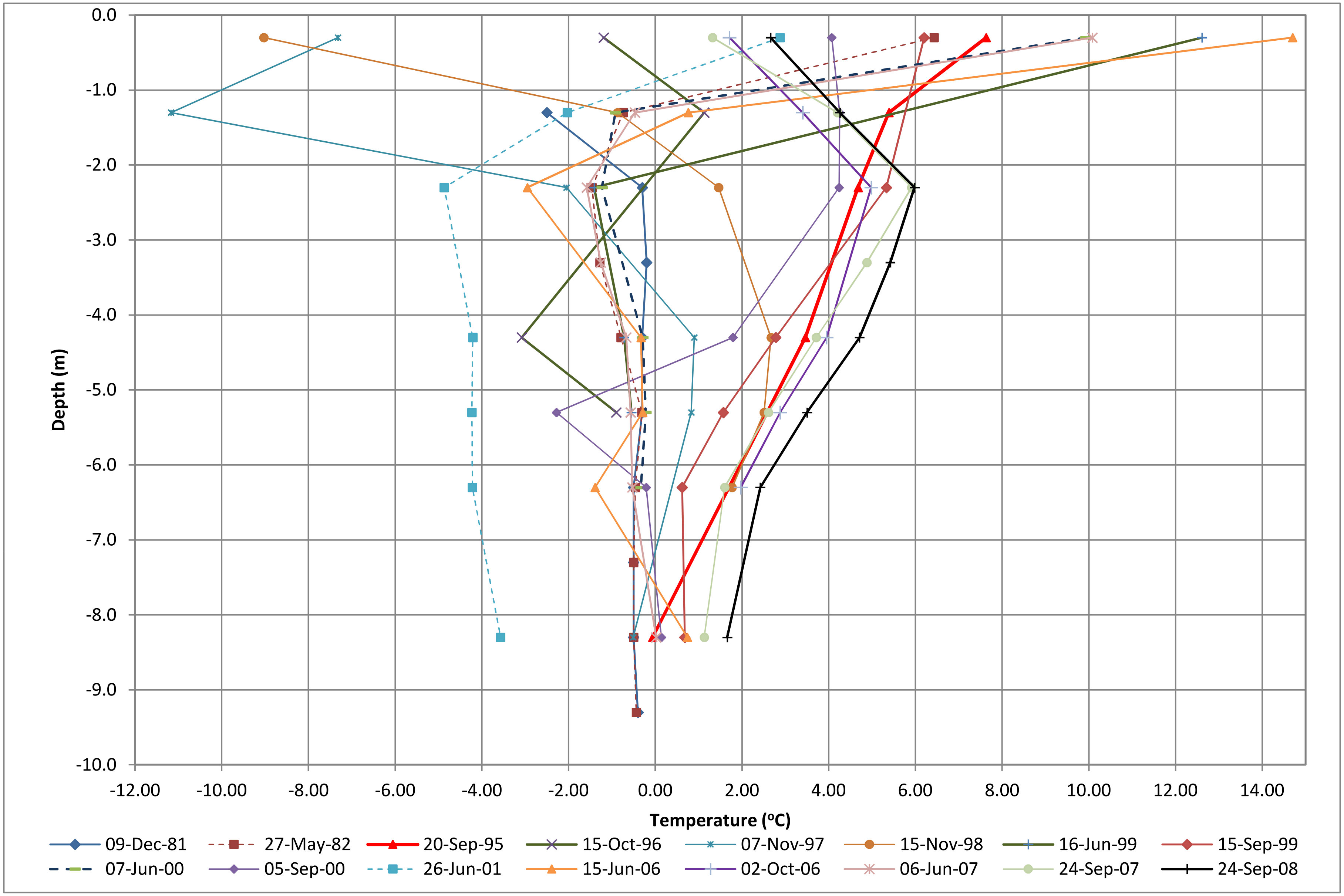


Figure X-X: Diversion Canal (Spoil Pile)
Thermistor SP-2



D.3 – Inclinometers

Electronic files (Unprocessed historical inclinometer readings are included as separate files) of 2011 Data for the following inclinometers:

Canal Dyke	Borehole_1
	BH91-CD-1 and BH94-CD-1
	BGC01-01, BGC05-05 and BGC05-08
	CD-10, CD-15, CD-19 and CD-21
Spoil Piles	SP-2 and SP-5
Backslope	BS-5, BS-9 and BS-10

APPENDIX II-E

North Fork Rock Drain

E.1 – Water Level Measurement

E.1 – Water Level Measurement

Figure x-xx: North Fork of Rose Creek
NF1 Water Elevations

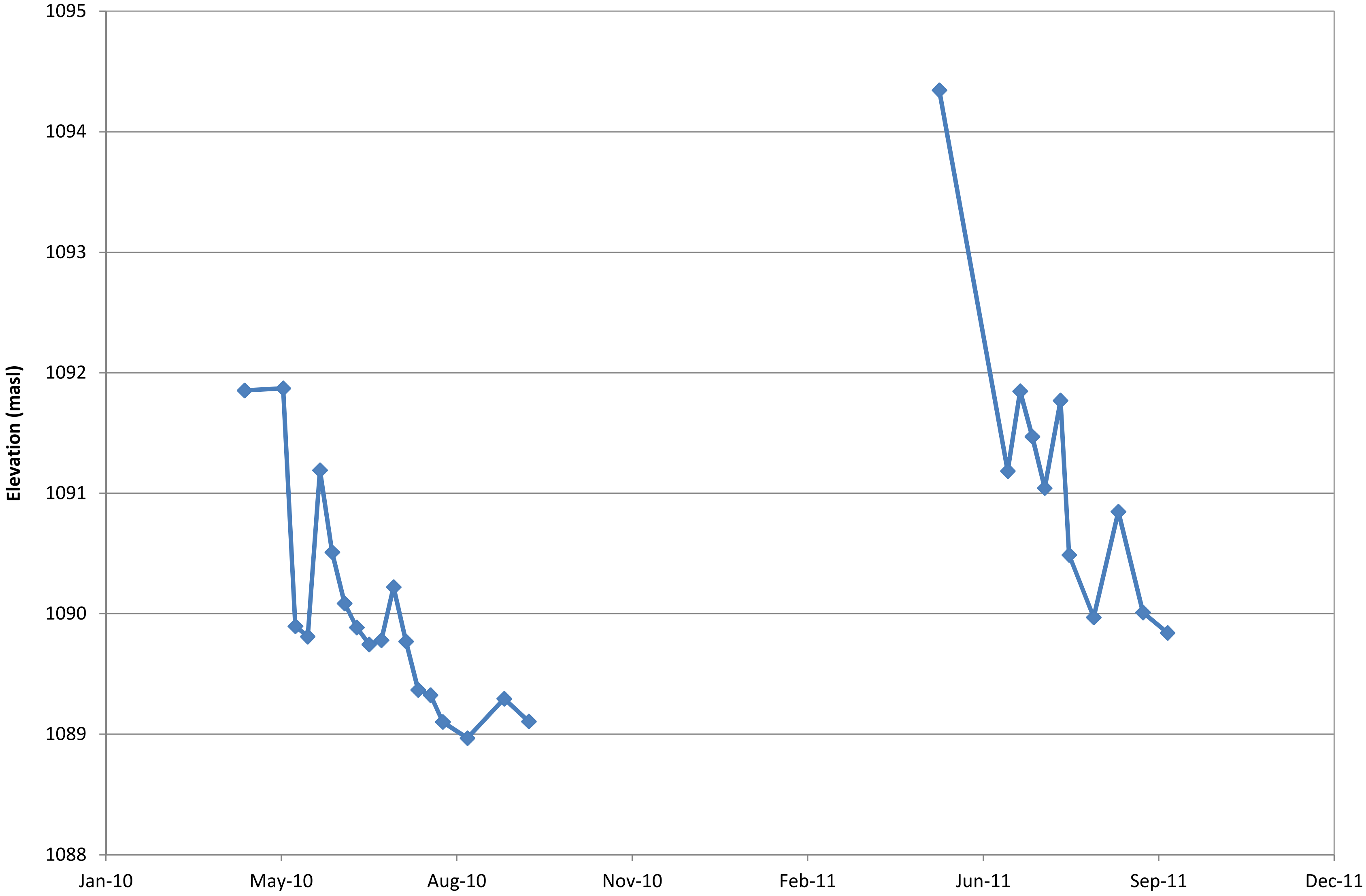
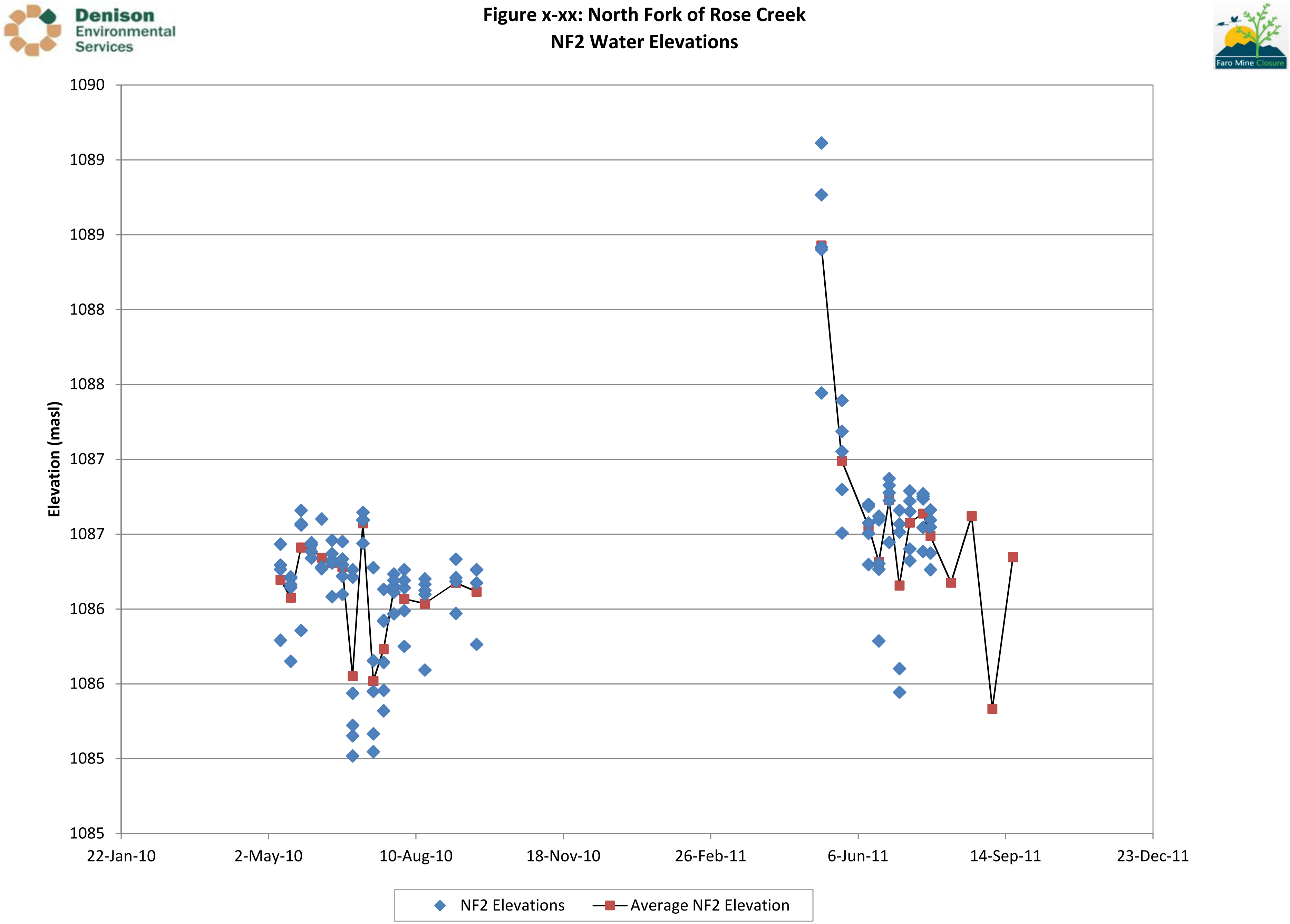


Figure x-xx: North Fork of Rose Creek
NF2 Water Elevations



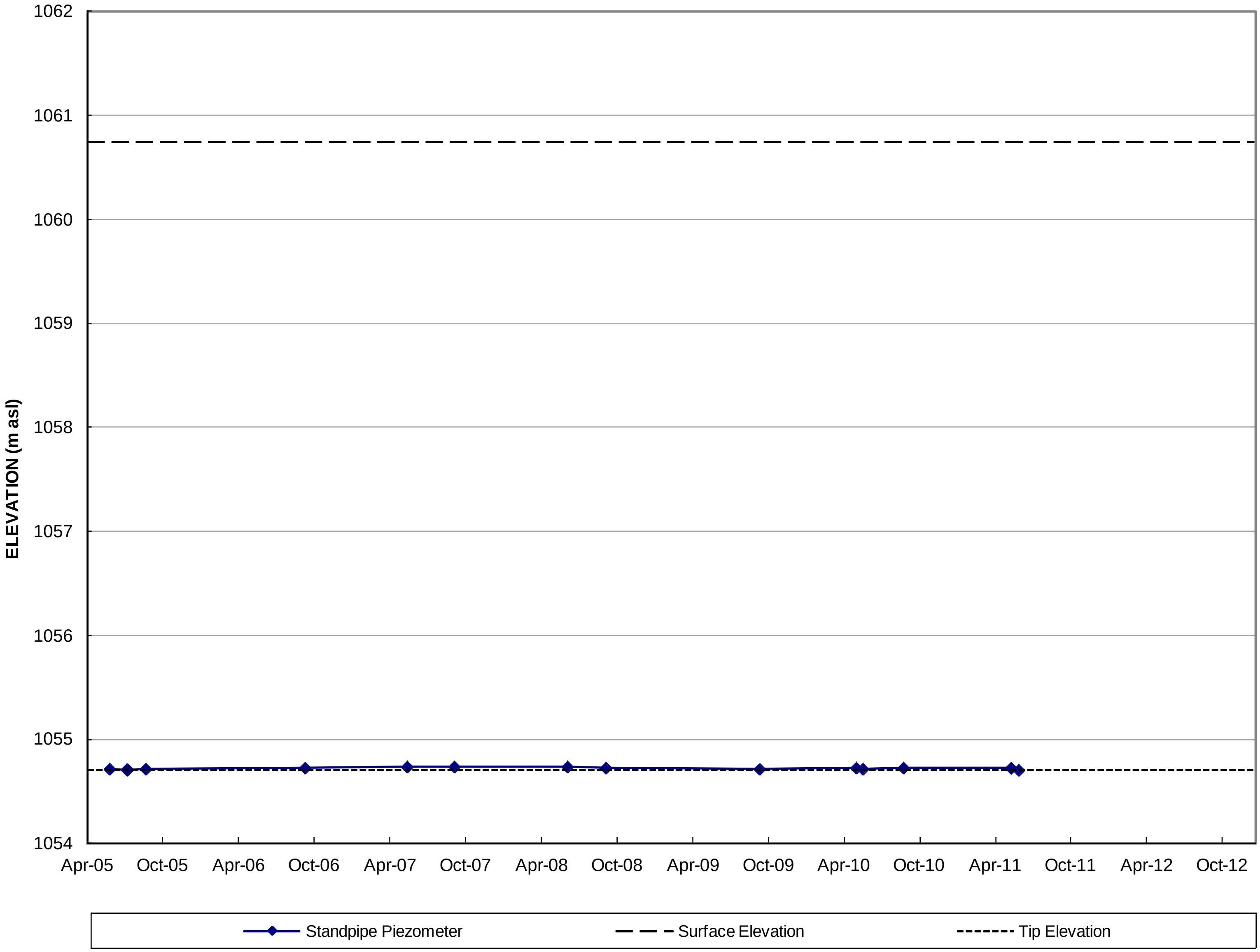
APPENDIX II-F

Secondary Tailings Impoundment

F.1 – Piezometers

F.1 – Piezometers

Figure H-38: Secondary Tailings Dam
Piezometer P81-06



Instrument Details

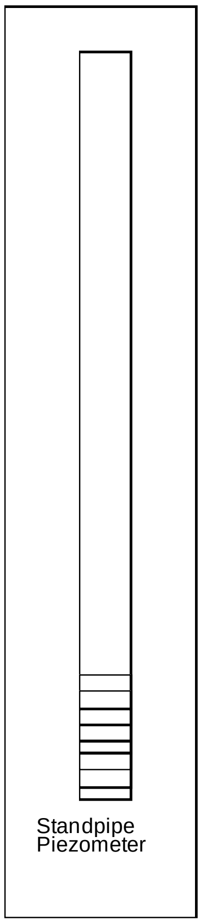


Figure H-39: Secondary Tailings Dam
Piezometer P81-07

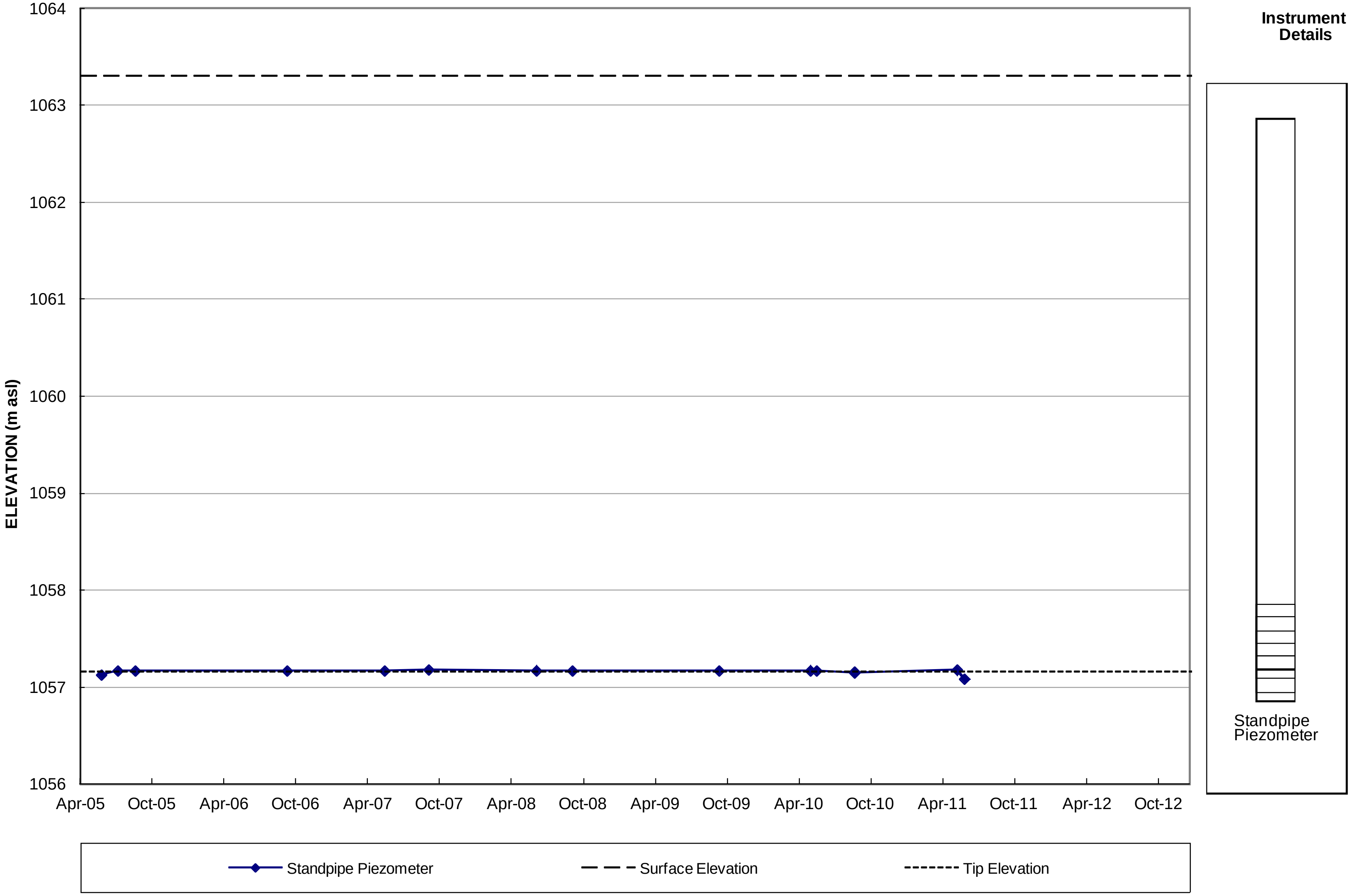


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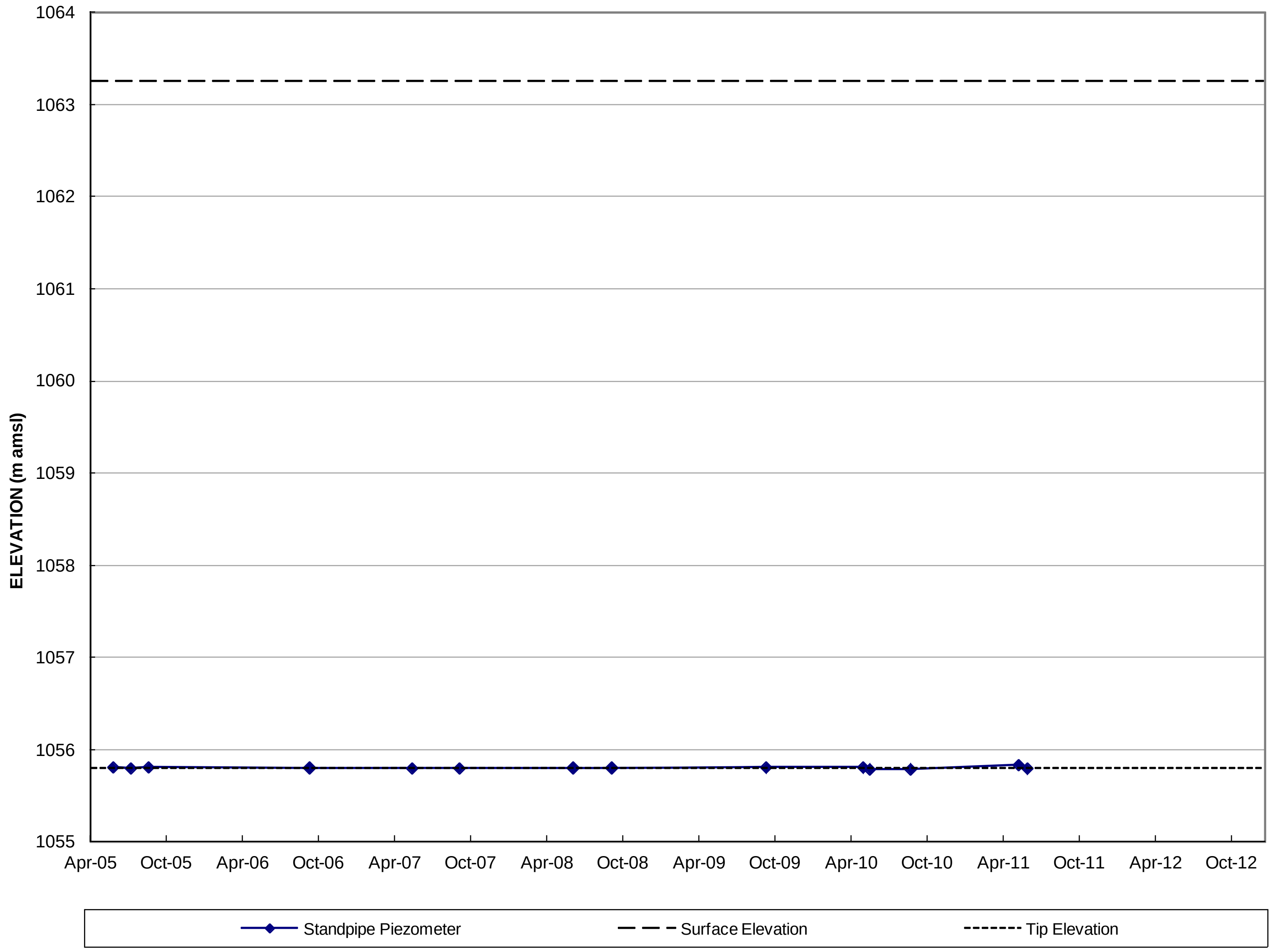
Figure H-40: Secondary Tailings Dam
Piezometer P81-08



Instrument Details

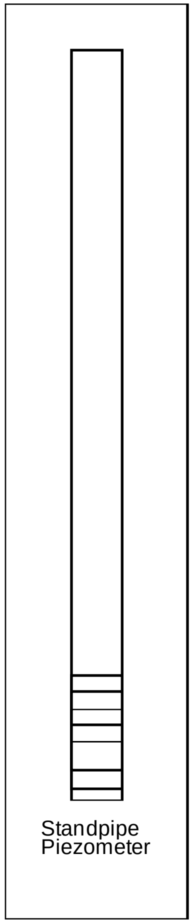


Figure 41: Secondary Tailings Dam
Piezometer P03-01

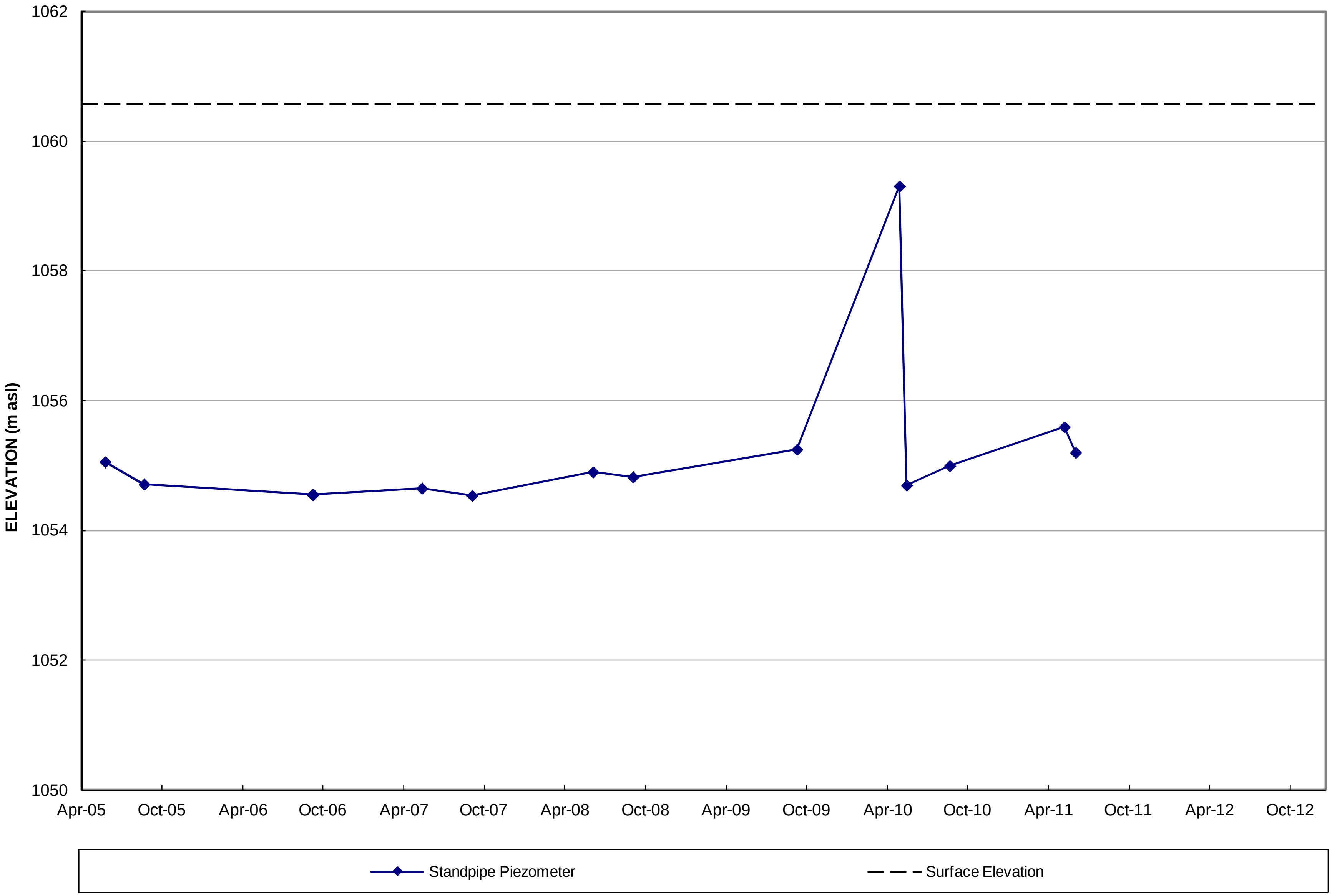


Figure H-42: Secondary Tailings Dam
Piezometer P03-02

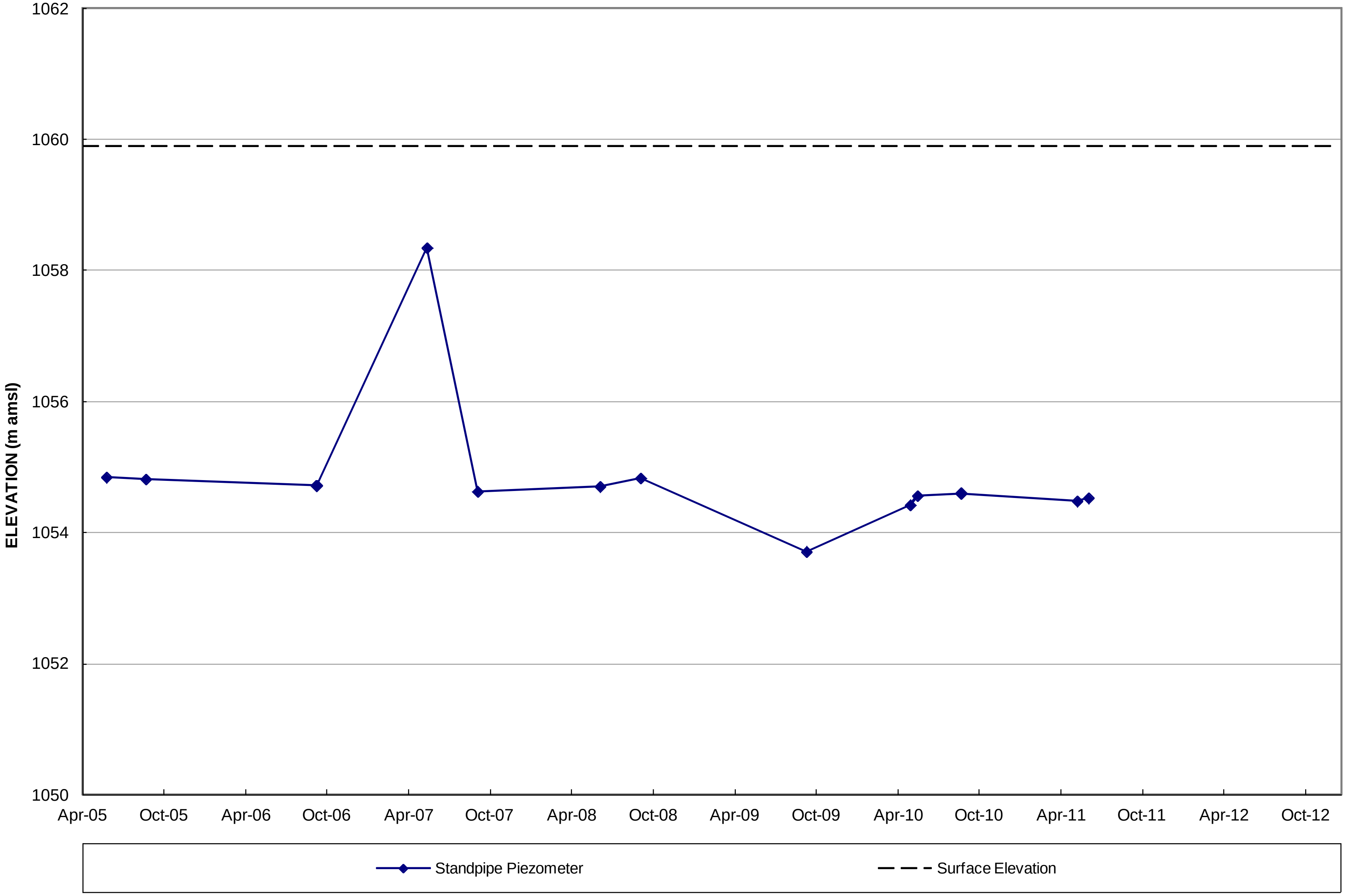
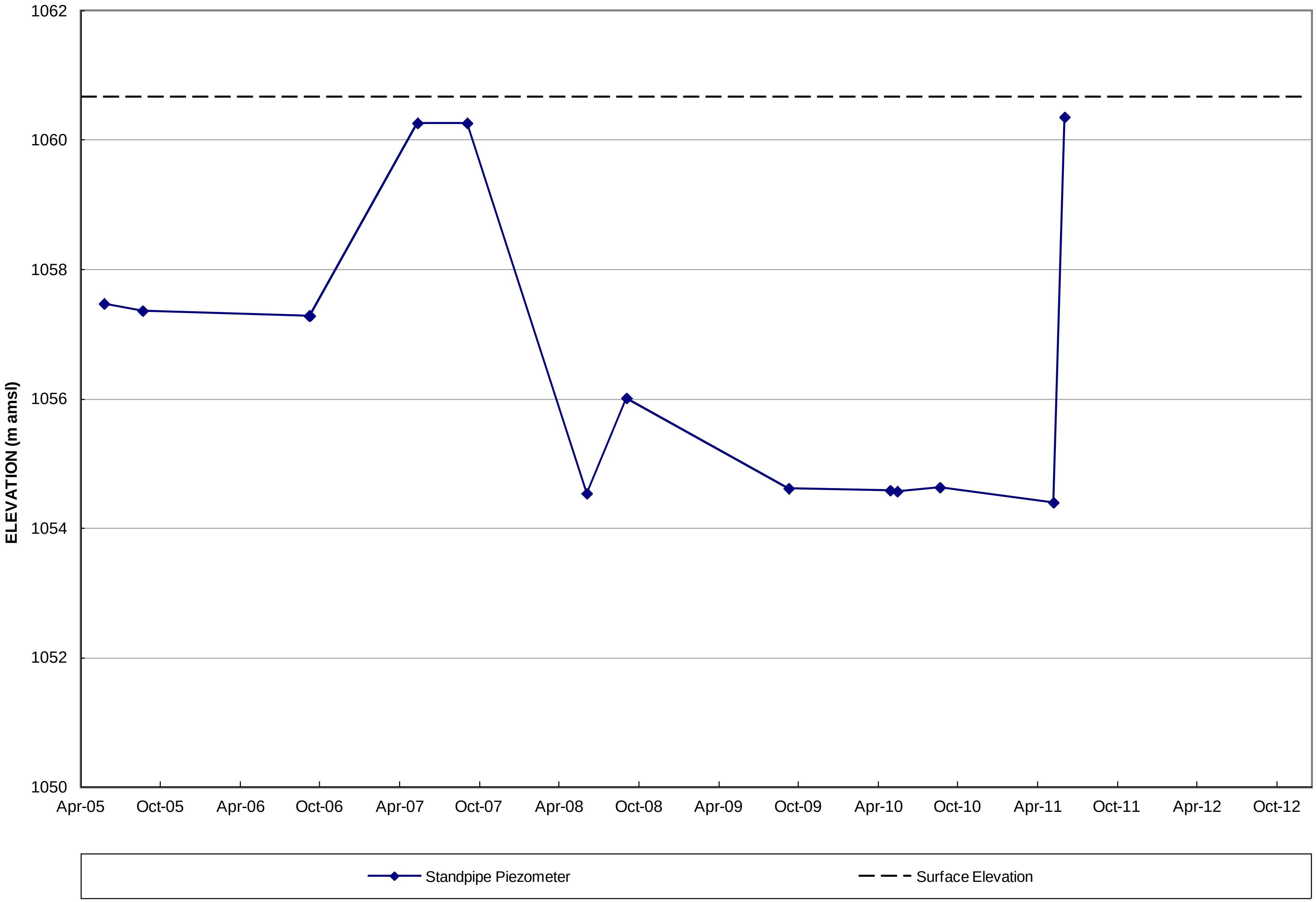


Figure H-43: Secondary Tailings Dam
Piezometer P03-03



APPENDIX II-G

Intermediate Dam

G.1 – Piezometers

G.2 – Pond Level (Intermediate Pond)

G.1 – Piezometers

Figure H-38: Intermediate Dam
Piezometers - Cross Section 'A'

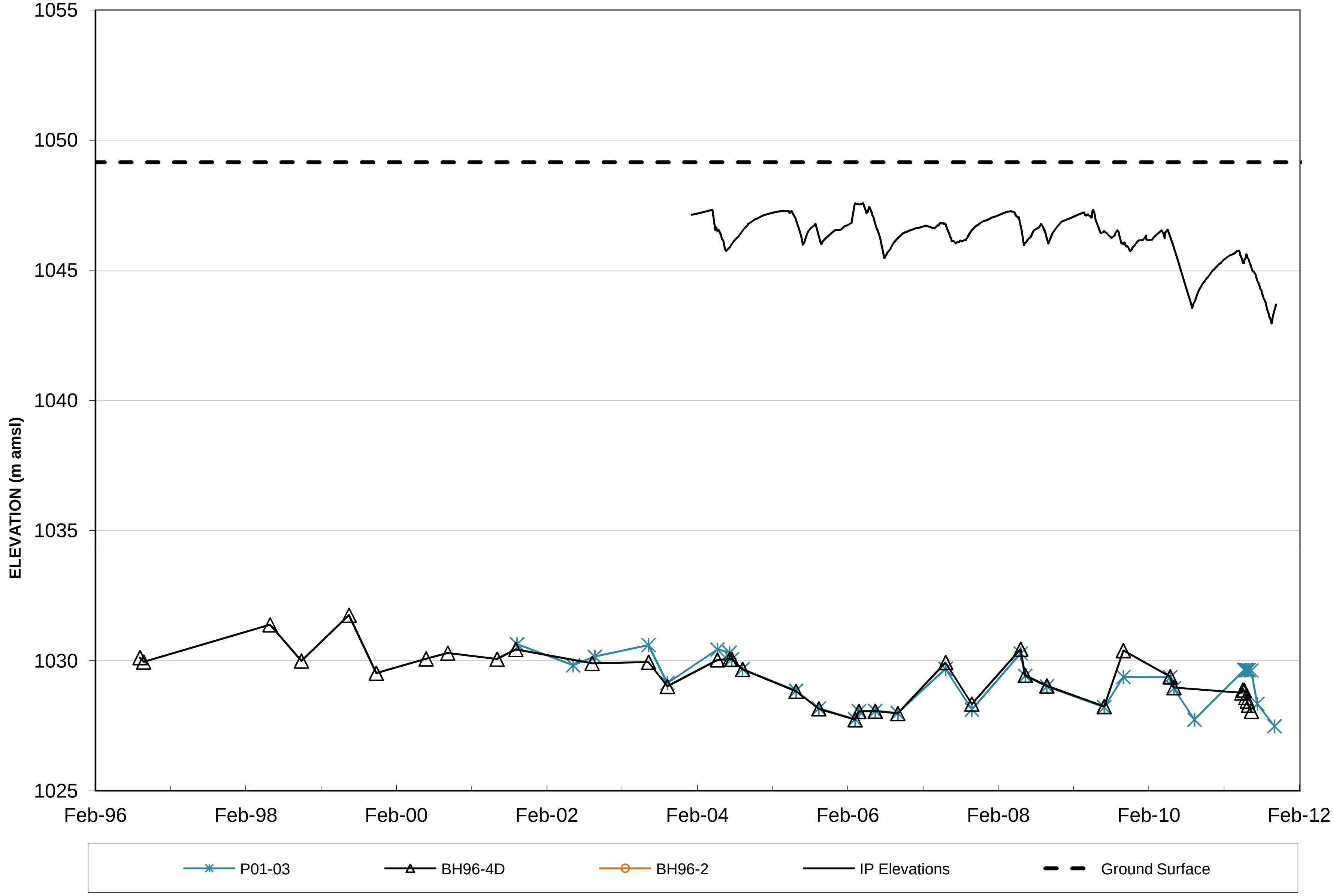


Figure H-39: Intermediate Dam Piezometers - Cross Section 'B'

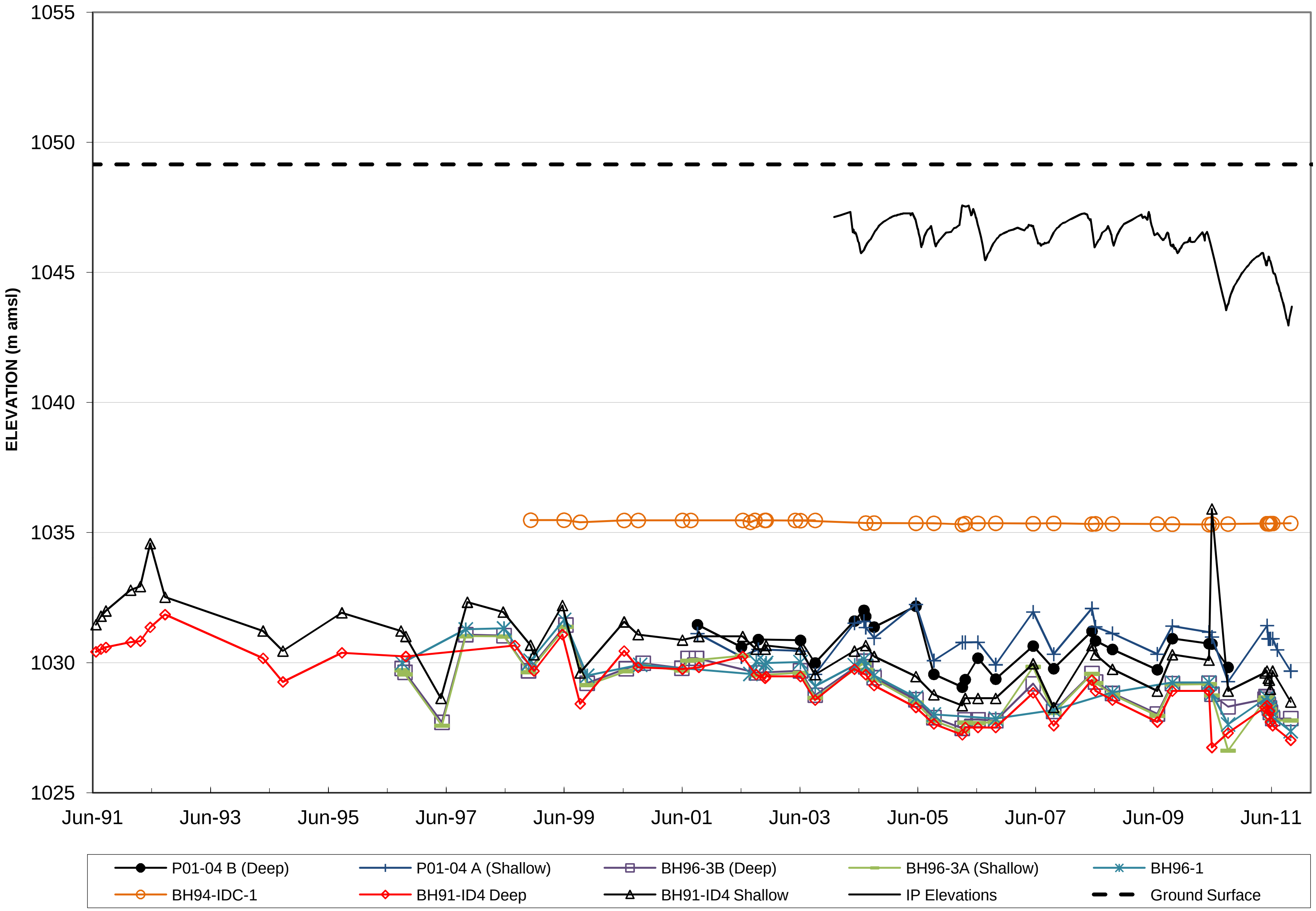


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Figure H-40: Intermediate Dam Piezometers - Cross Section 'C'

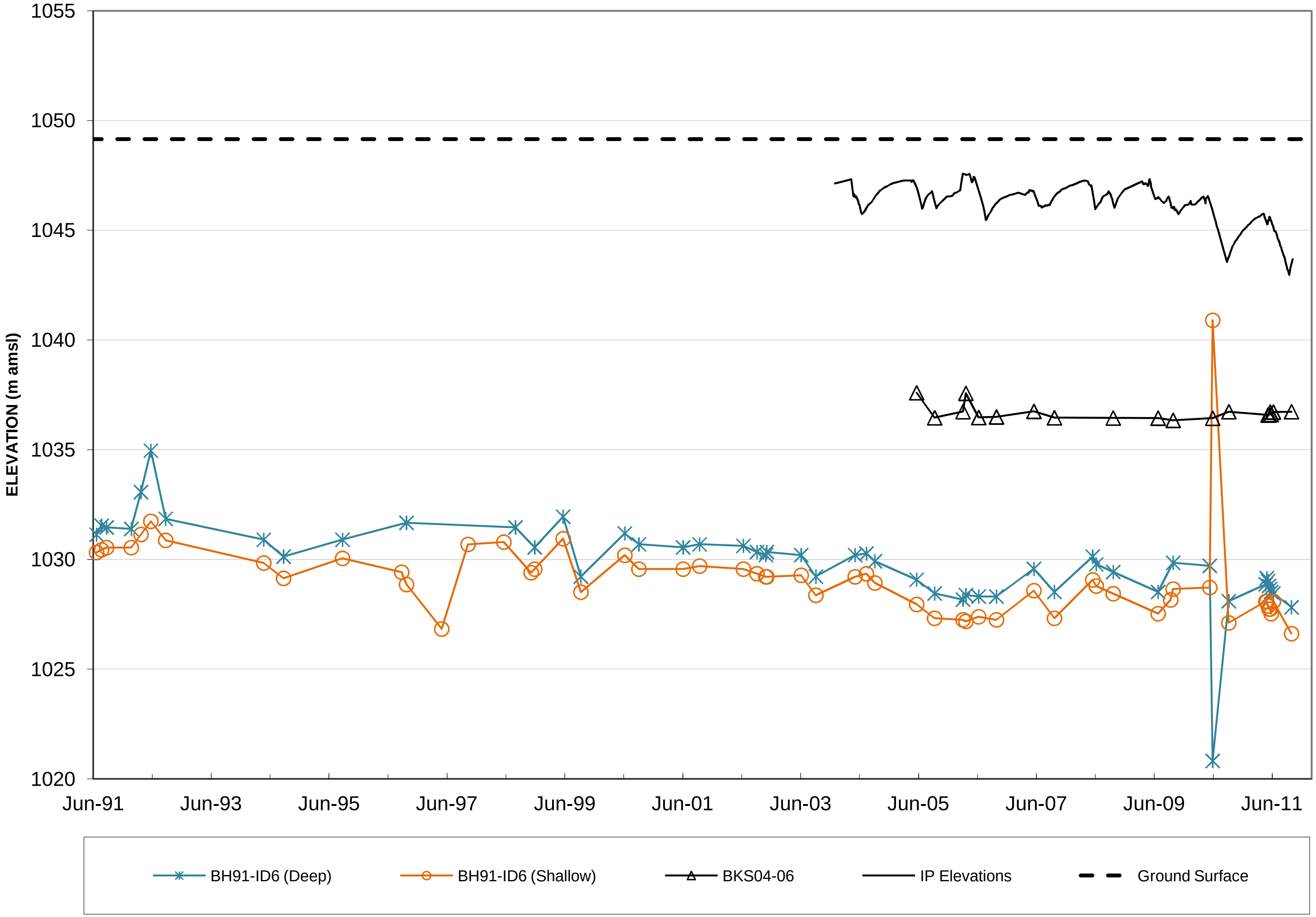

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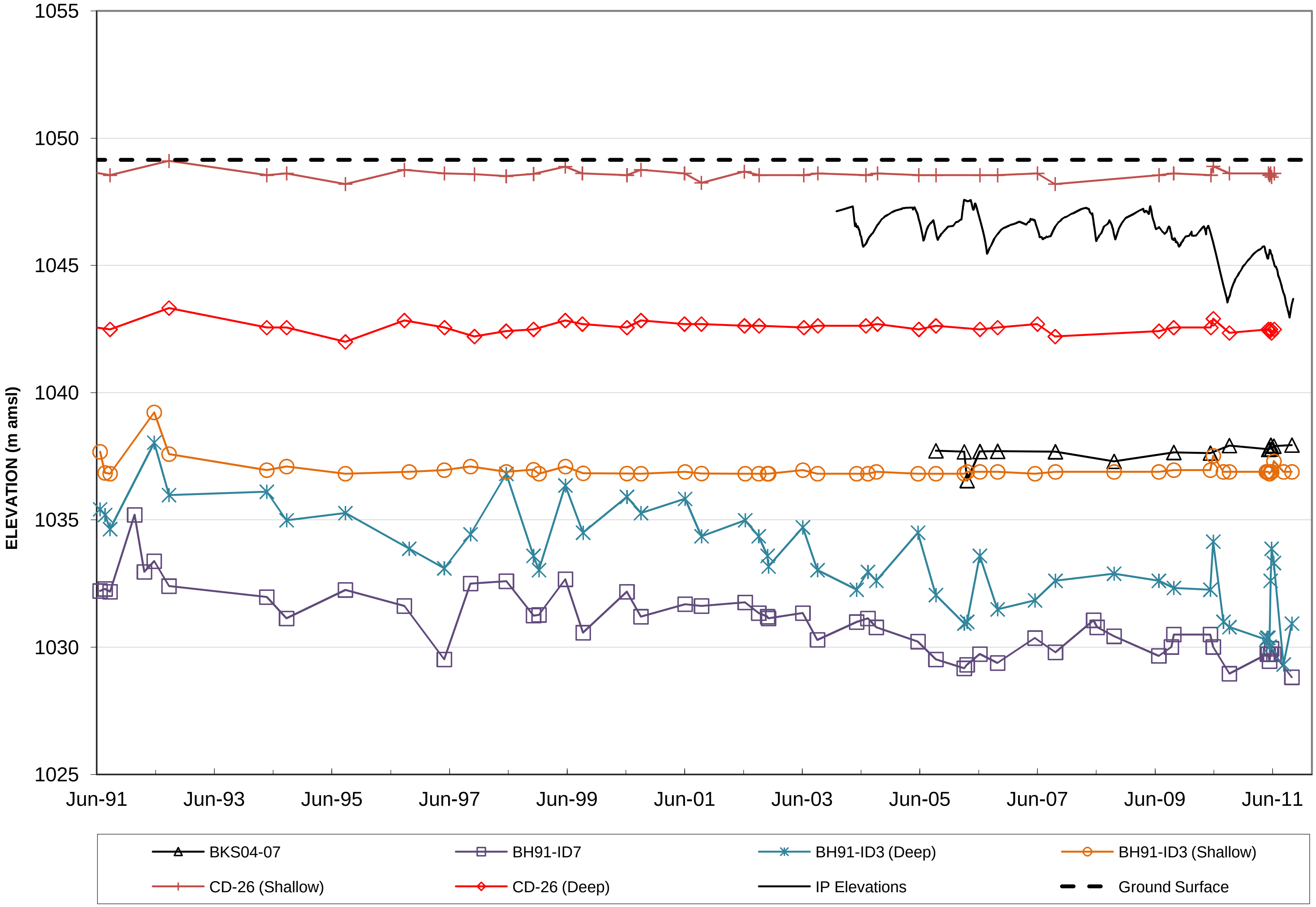
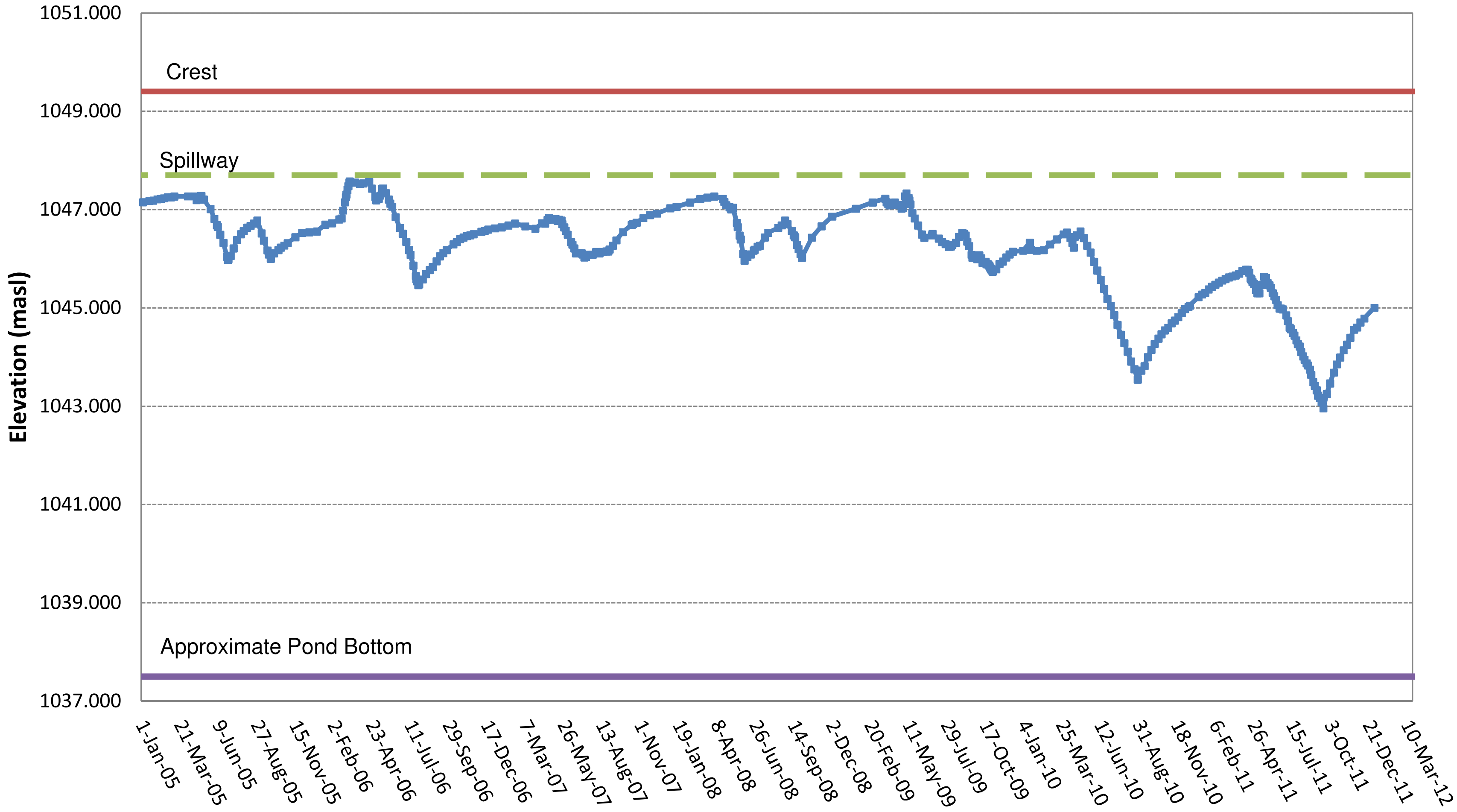
Figure H-41: Intermediate Dam
Piezometers Cross Section 'S Abut'



G.2 – Pond Level (Intermediate Pond)

Intermediate Pond Water Elevations



APPENDIX II-H

Cross Valley Dam

H.1 – Piezometers

H.2 – Thermistors

H.3 – Pond Level (Polishing Pond)

H.4 – Downstream Weir Flow Measurement

H.1 – Piezometers

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Figure H-26: Cross Valley Dam
Piezometers - Cross Section 'D'

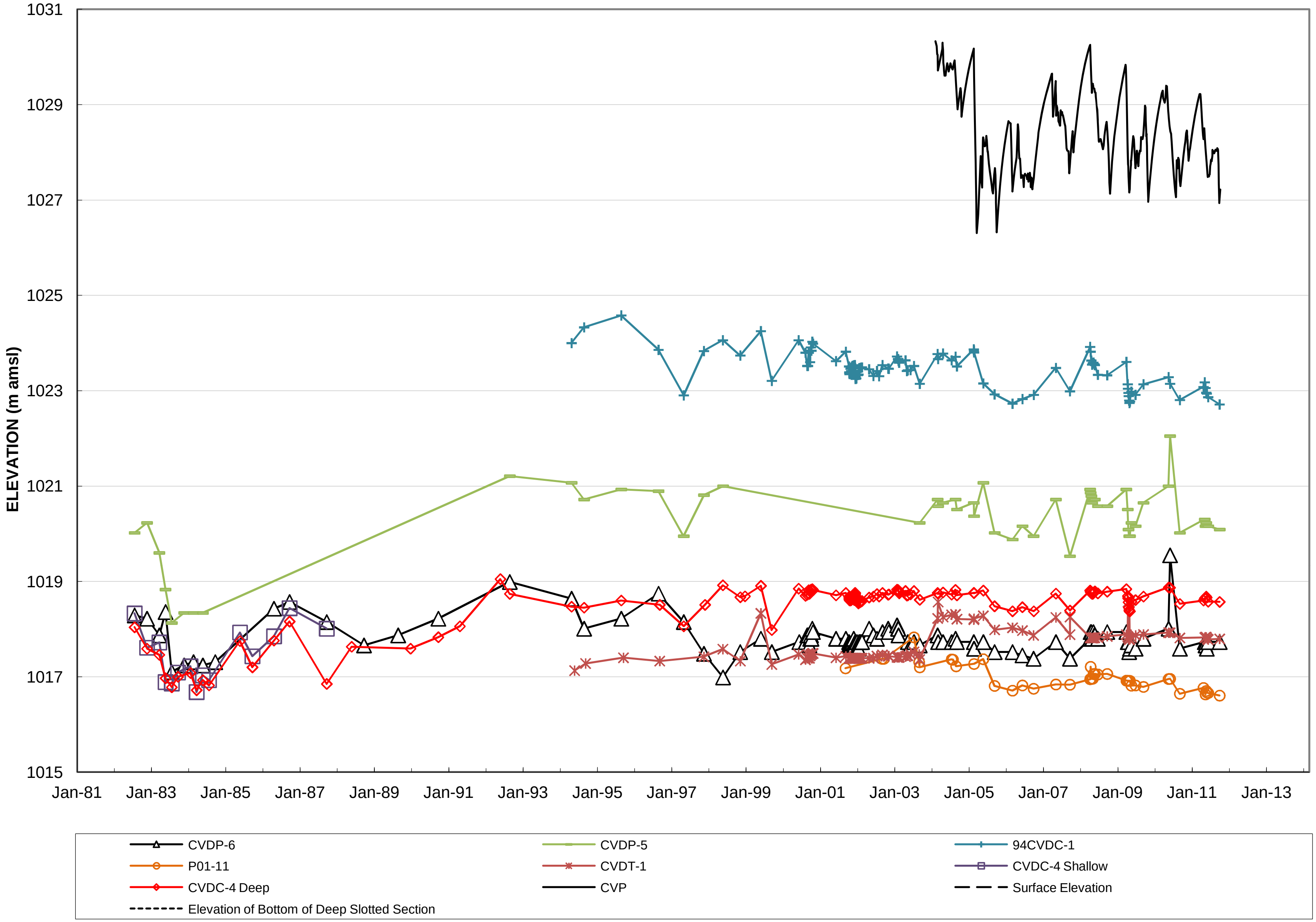


Figure H-27: Cross Valley Dam
Piezometers - Cross Section 'E'

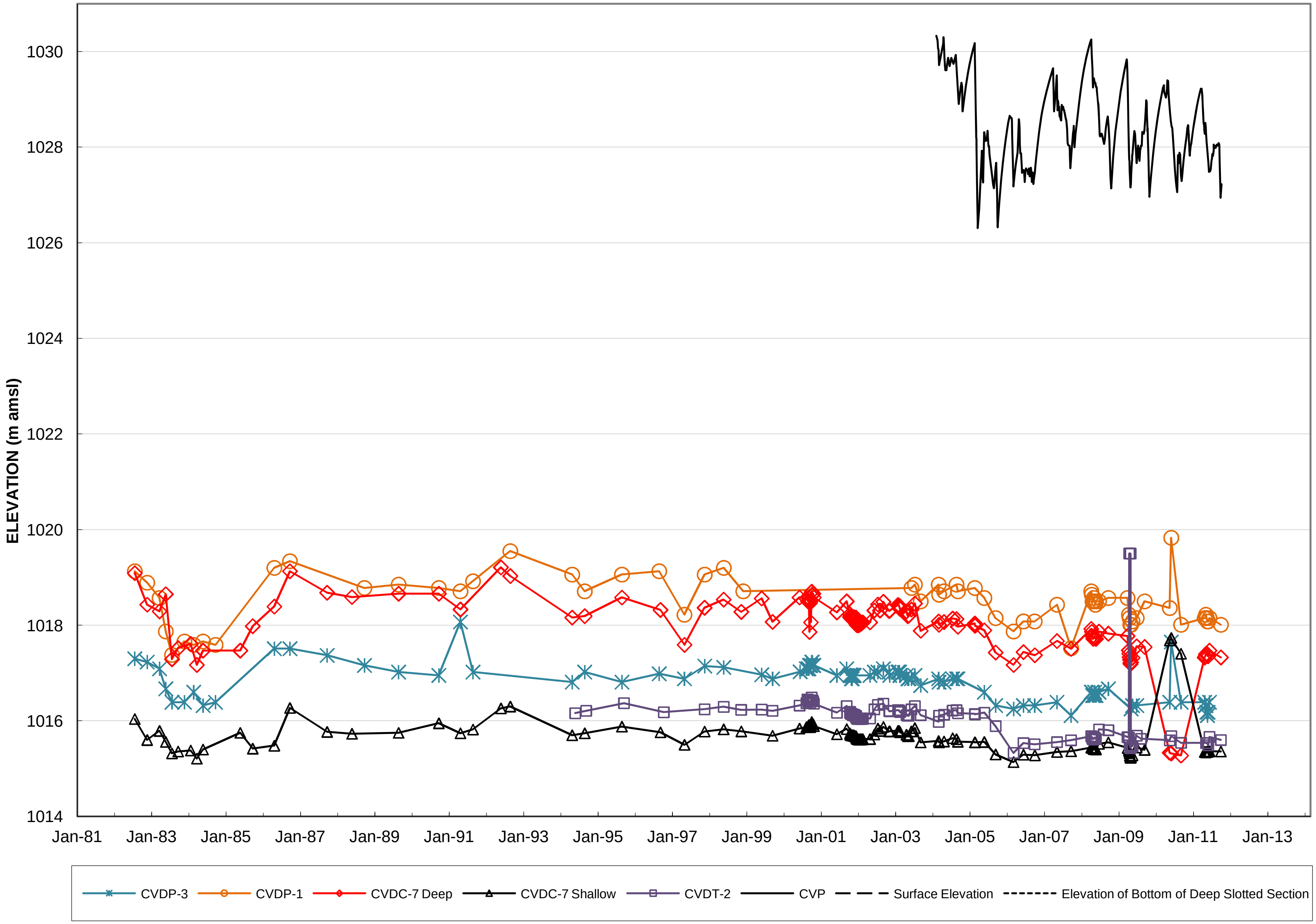
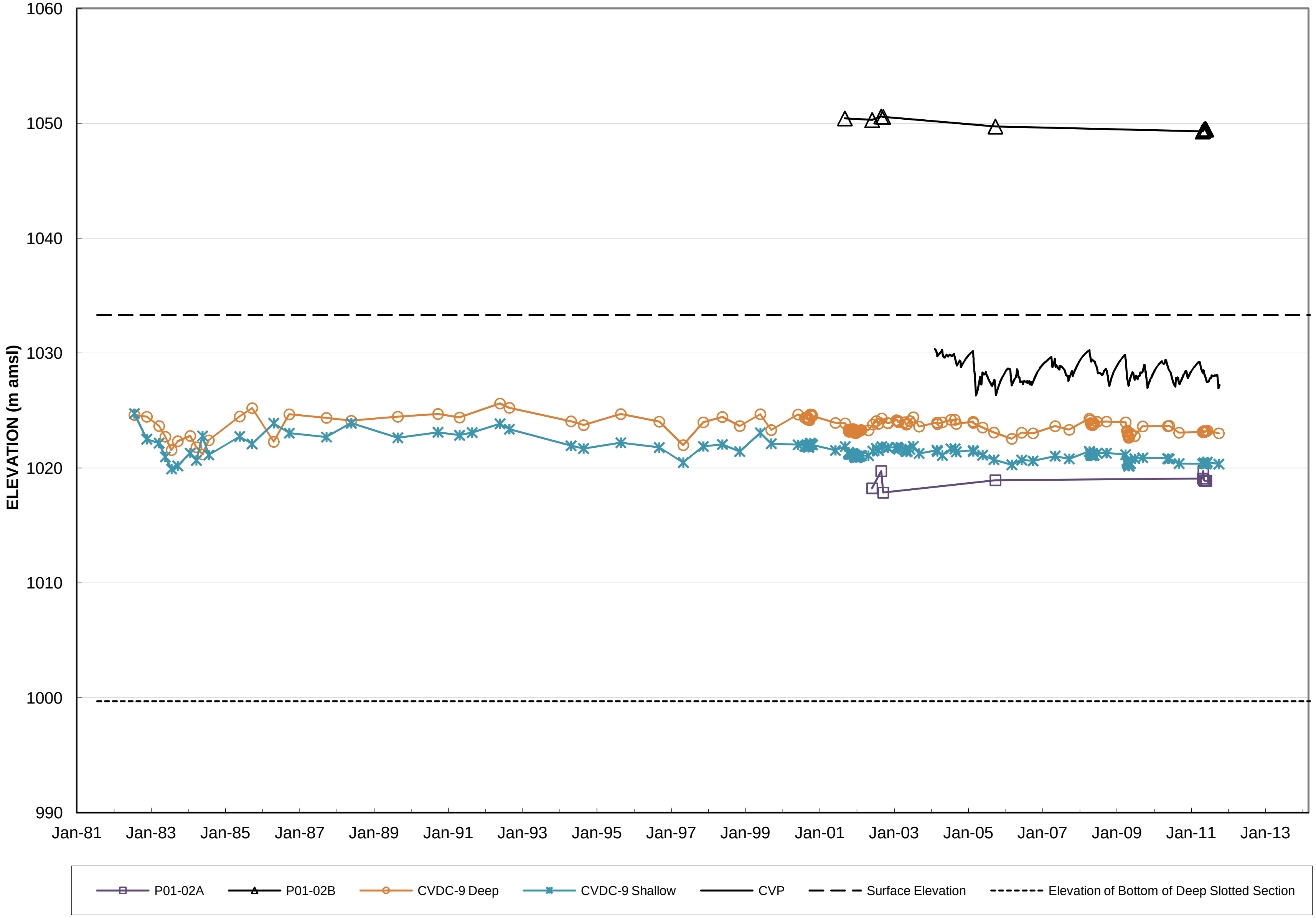
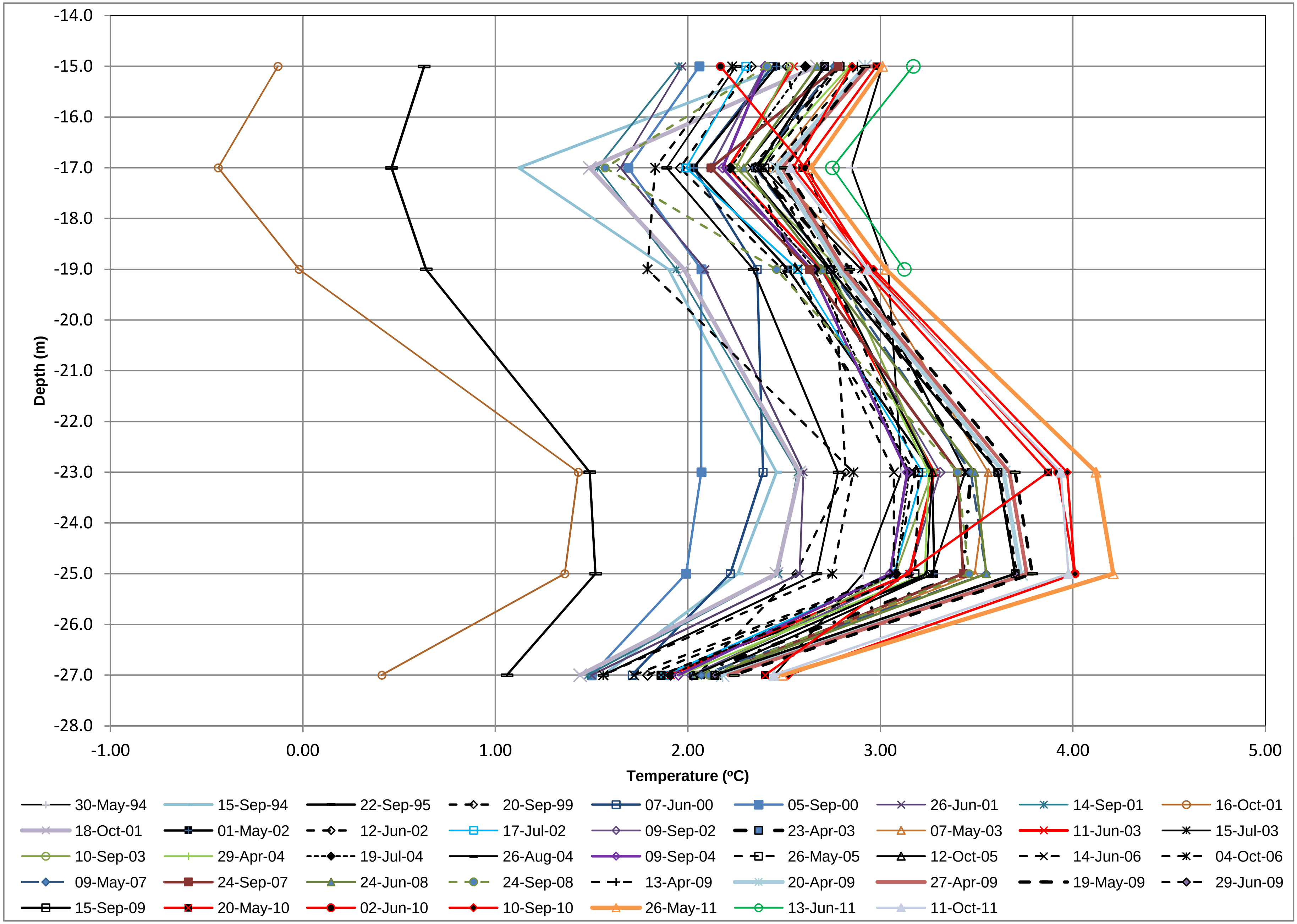


Figure H-28: Cross Valley Dam
Piezometers Cross Section 'F'



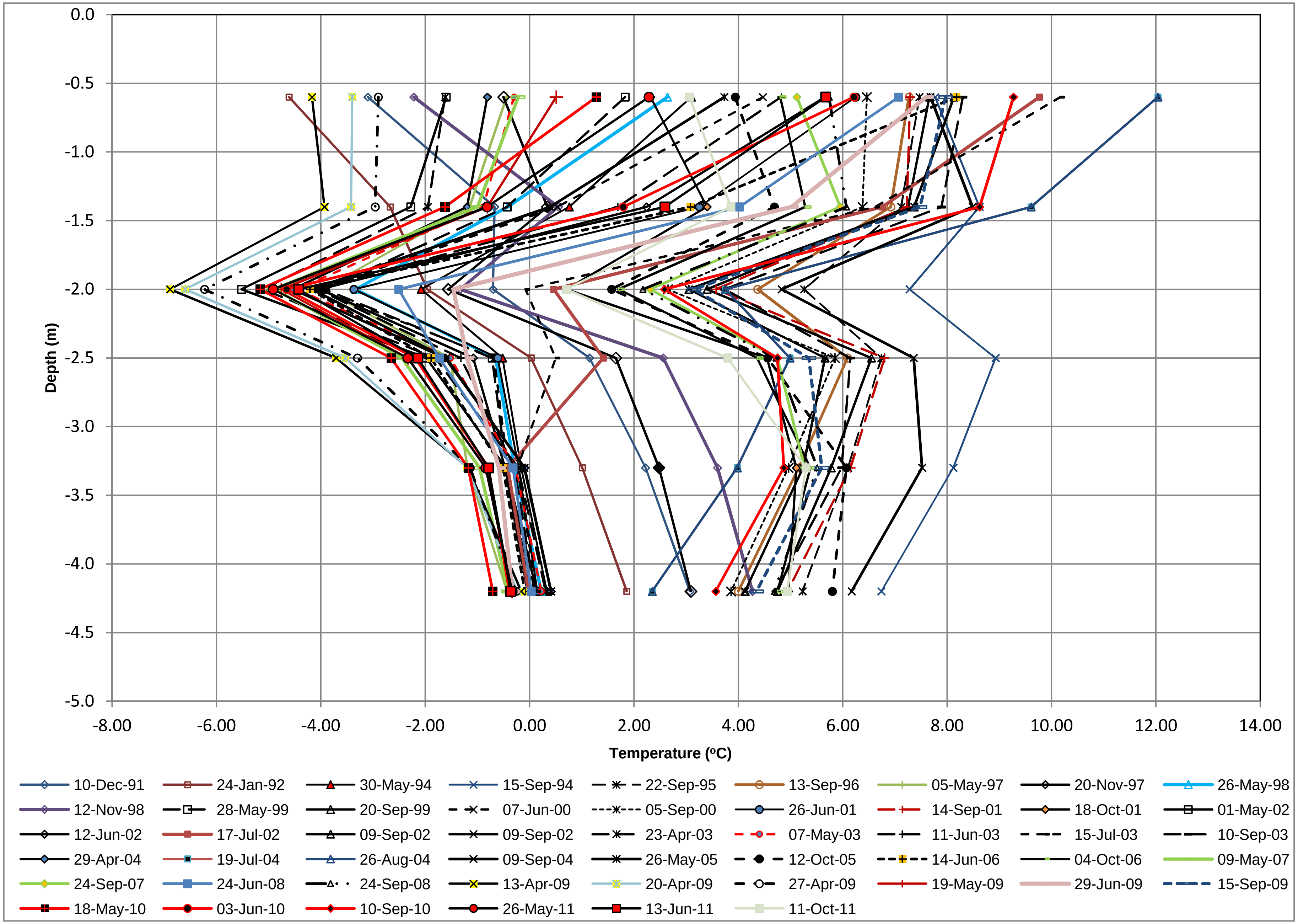
H.2 – Thermistors

Figure H-12: Cross Valley Dam
Thermistor CVDC-6



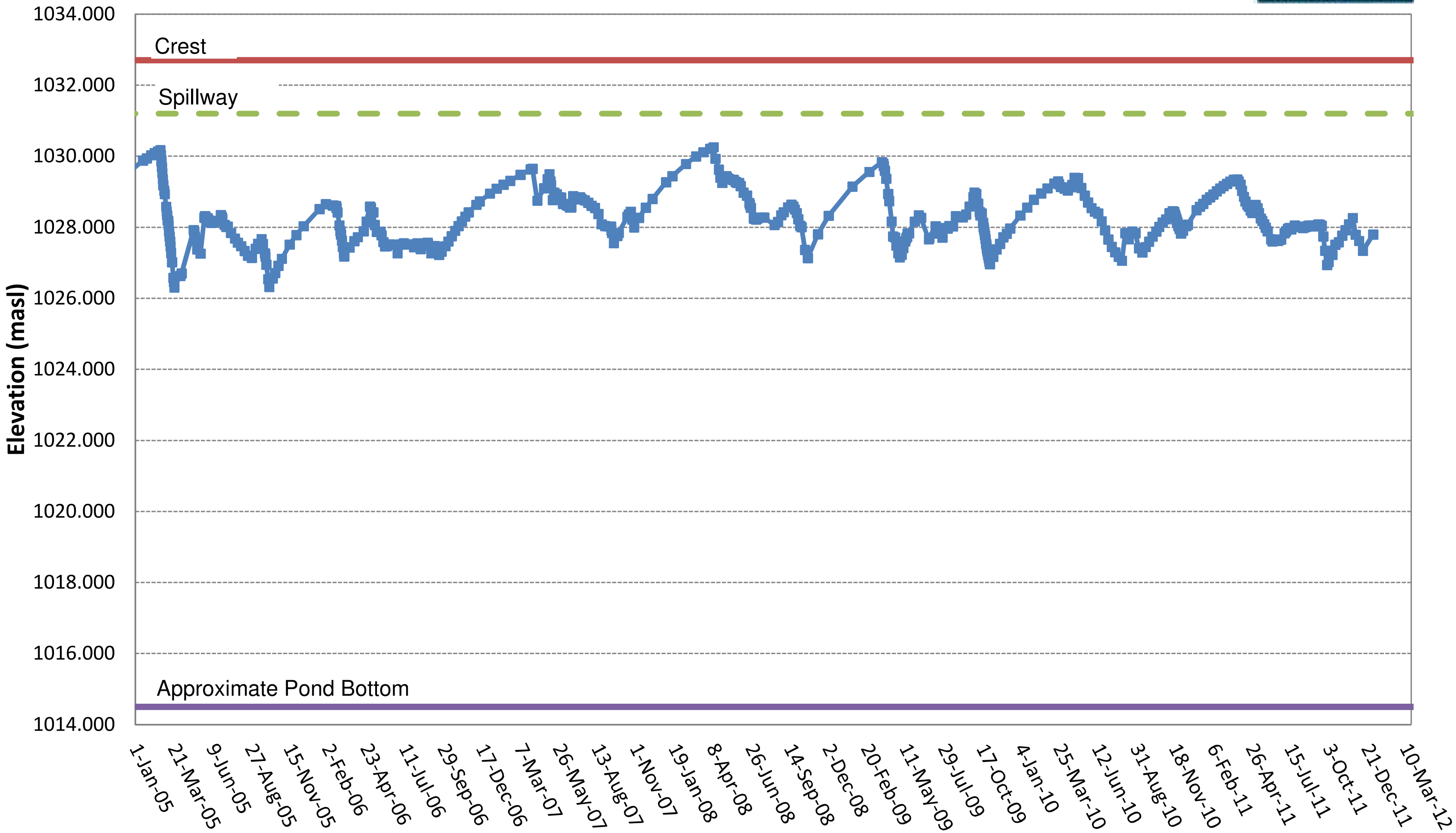
Z:\M\VCR\M09770A01 - Gov't Yukon-FaroSiteGeotech\700 Deliverables\710 Drafts\Annual Review\Draft\Appendix II\Original files\H-2-CVD Thermistors.xlsx\ChartCVDC-6(H-12)

Figure H-13: Cross Valley Dam
Thermistor BH88-4

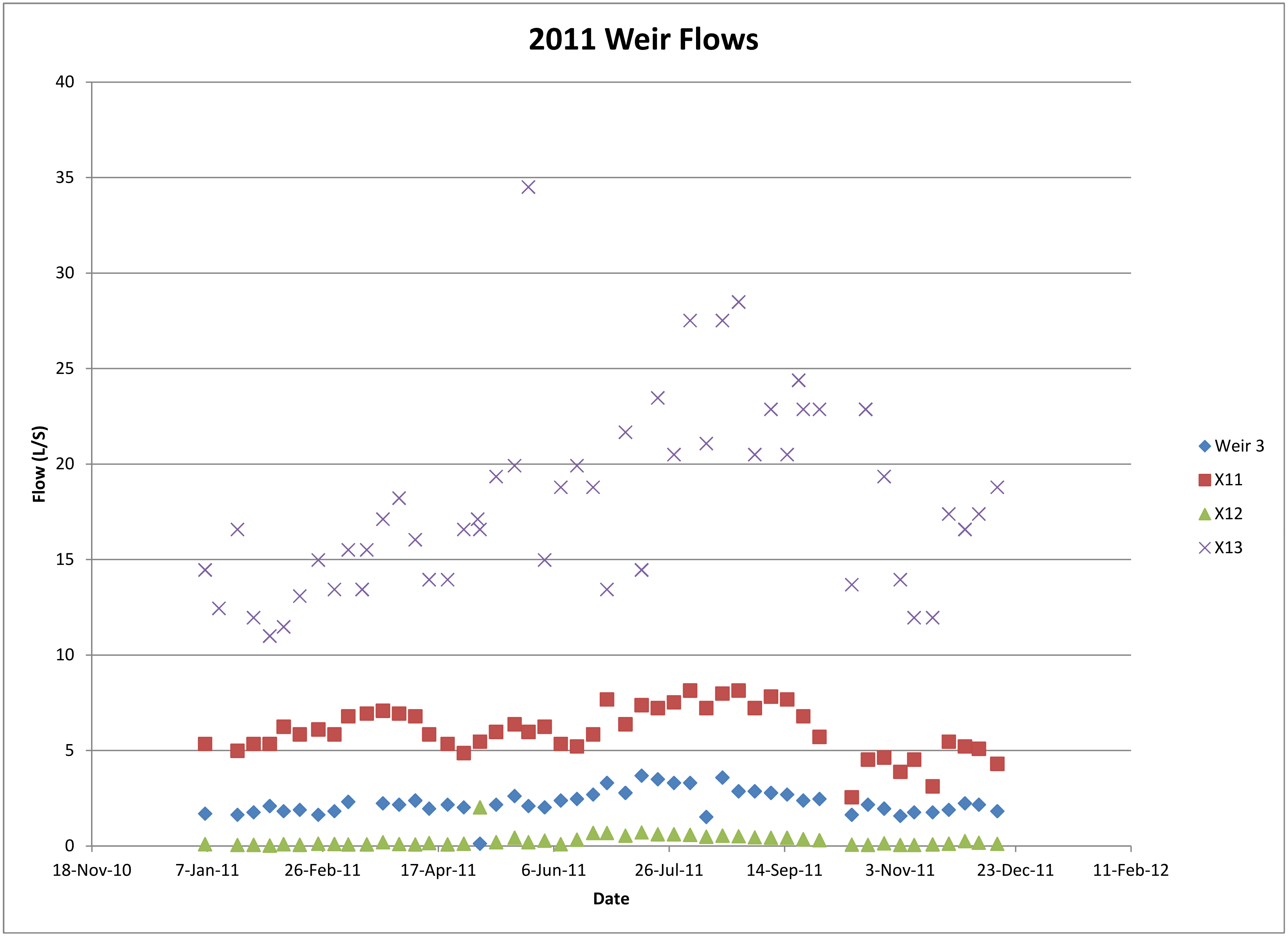


H.3 – Pond Level (Polishing Pond)

Polishing Pond Water Elevations



H.4 – Downstream Weir Flow Measurement



2011 Weir Flows
Flow (L/S)
40
35
30
25
20
15
10
5
0
18-Nov-10
7-Jan-11
26-Feb-11
17-Apr-11
6-Jun-11
26-Jul-11
14-Sep-11
3-Nov-11
23-Dec-11
11-Feb-12
Date
Weir 3
X11
X12
X13

APPENDIX II-I

Grum Pit

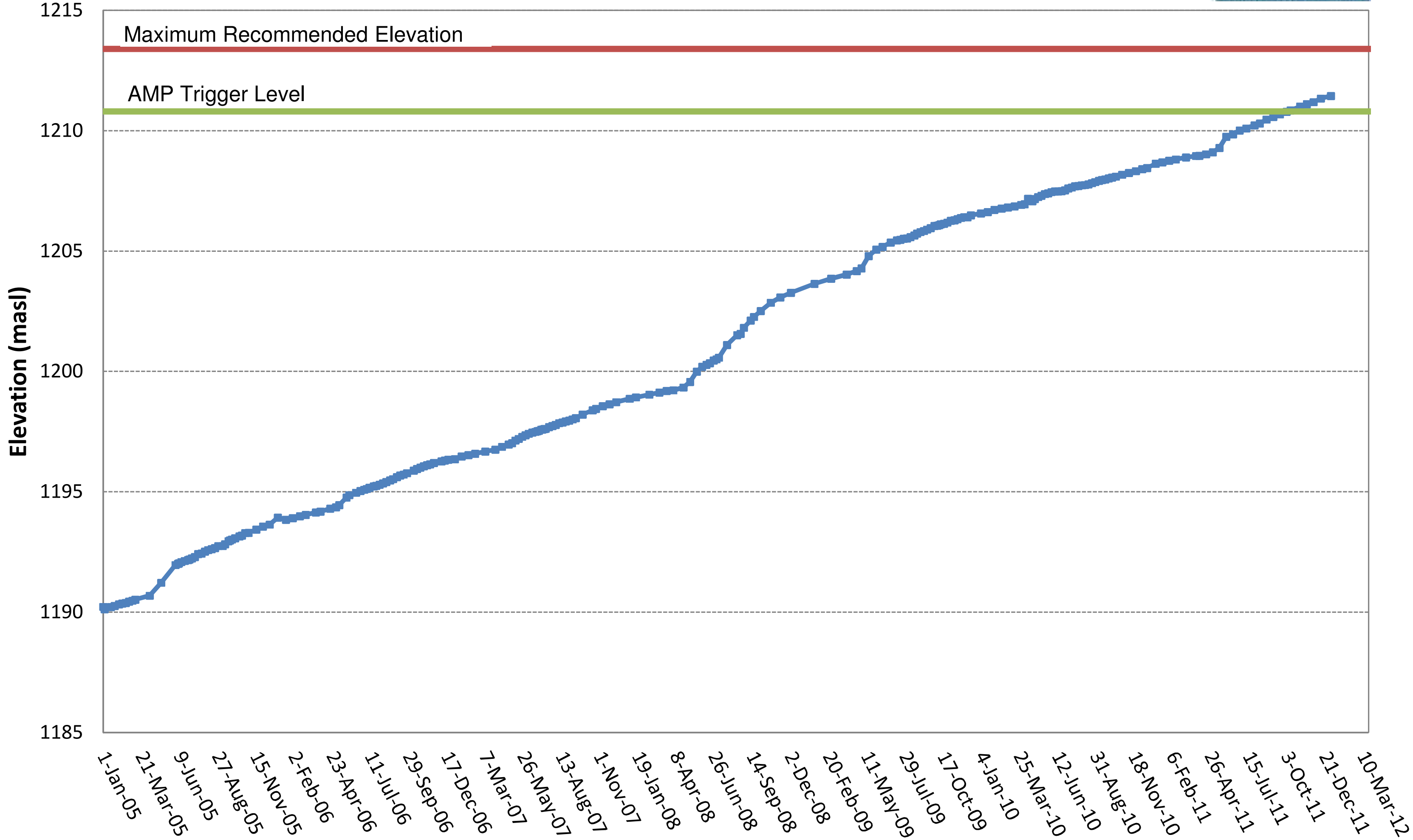
I.1 – Pond Level

I.2 – Displacement Monitoring

I.3 – Piezometers (cut slot)

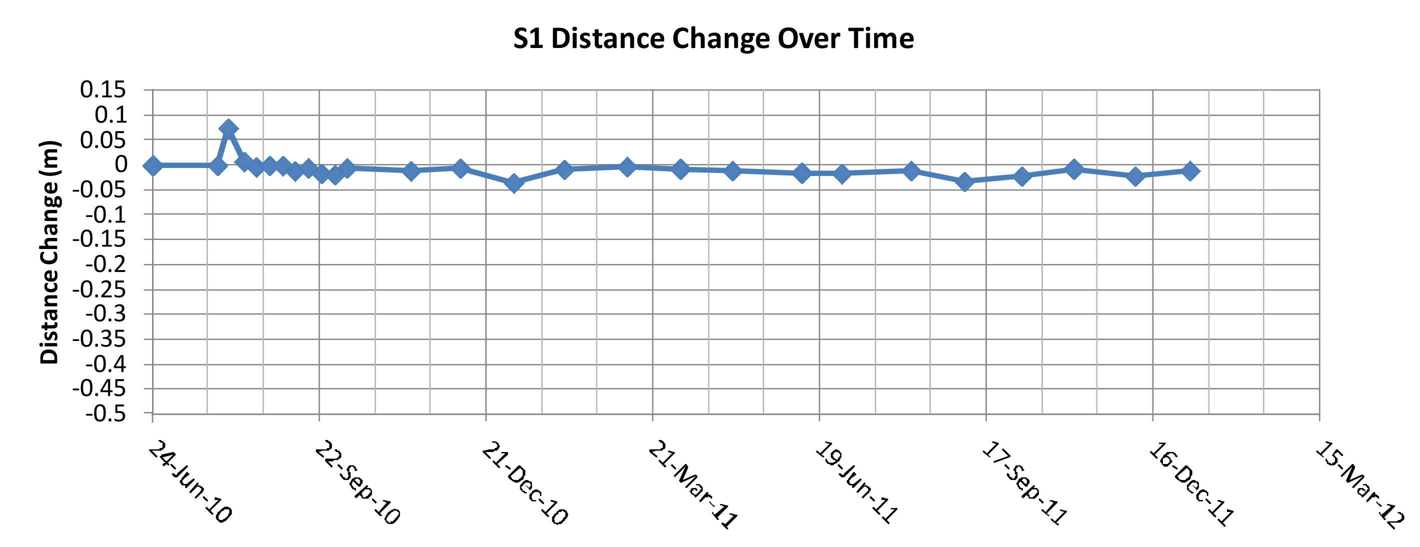
I.1 – Pond Level

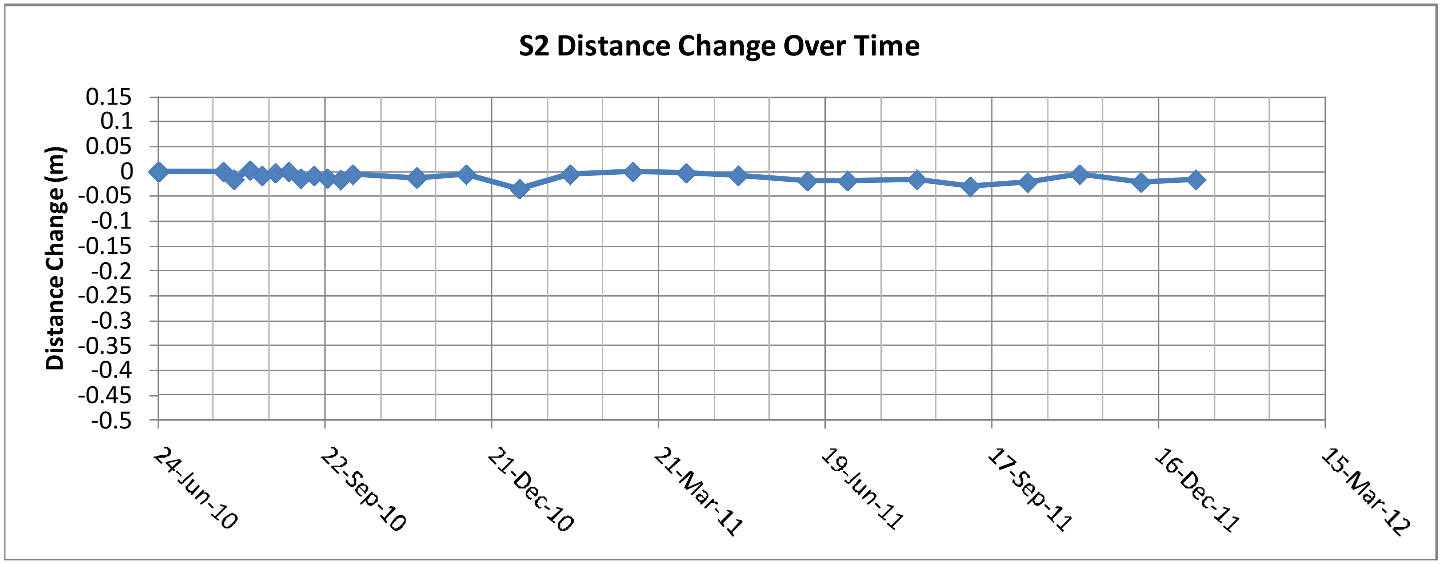
Grum Pit Water Elevations



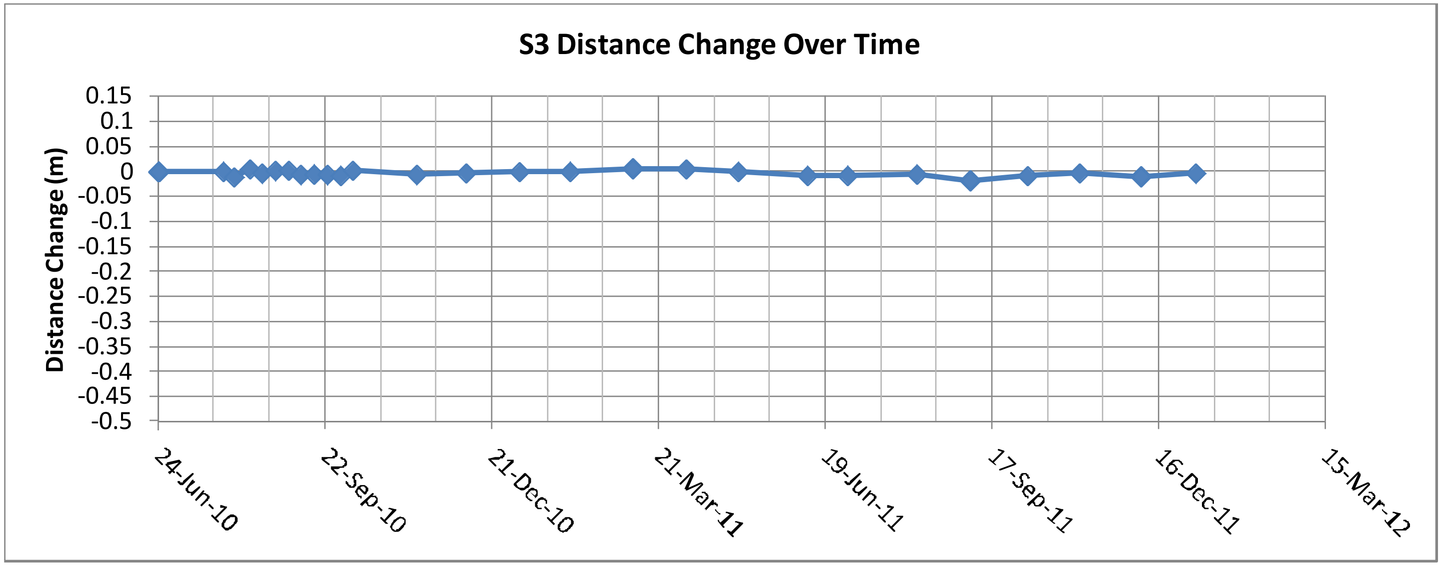
I.2 – Displacement Monitoring

Grum Pit Slope Stability Monitoring

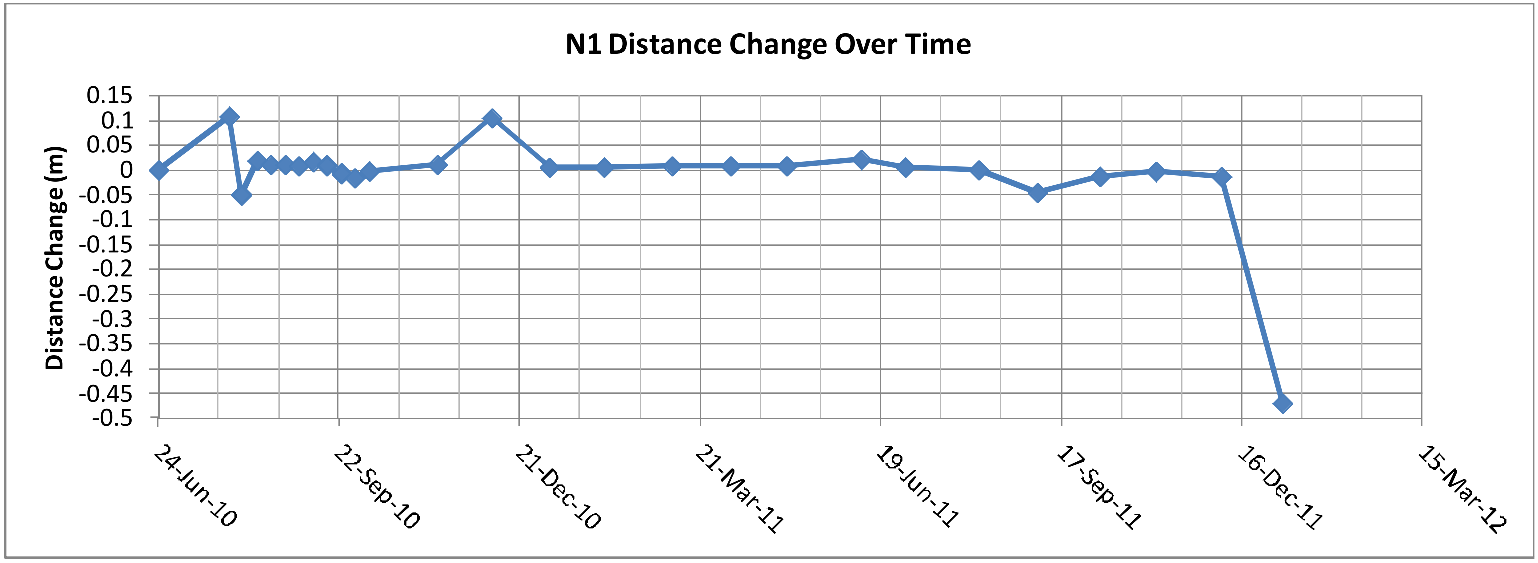


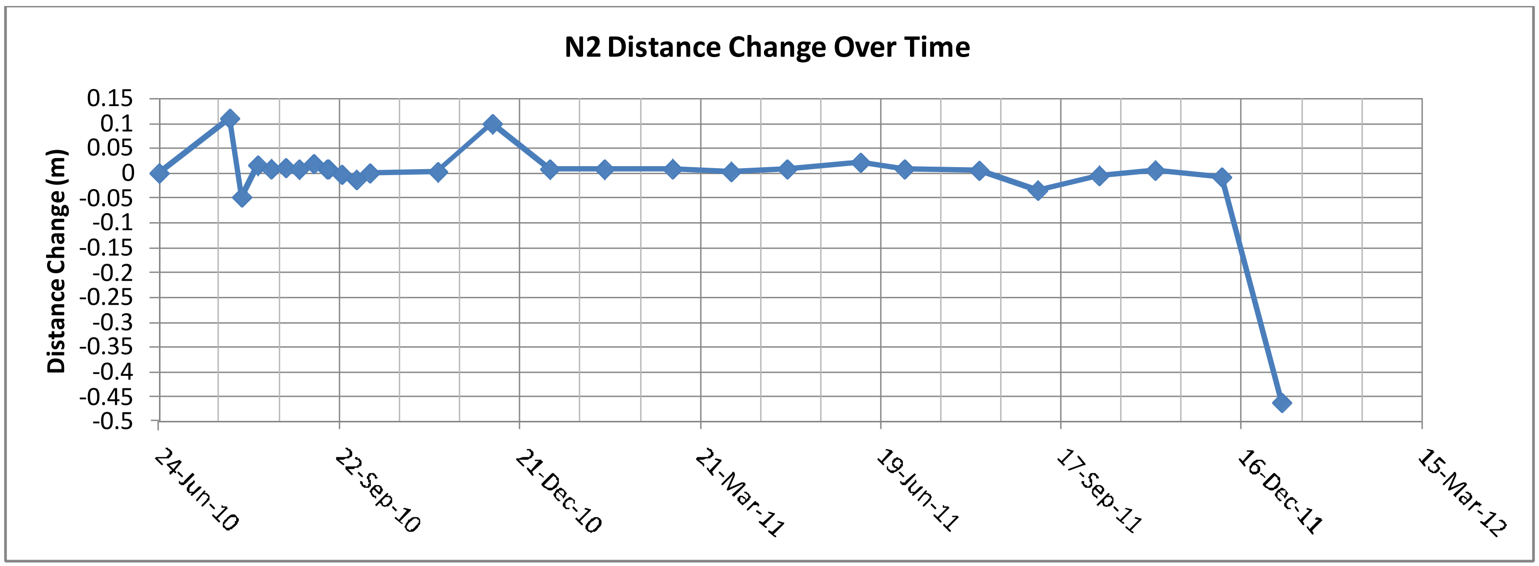


Grum Pit Slope Stability Monitoring

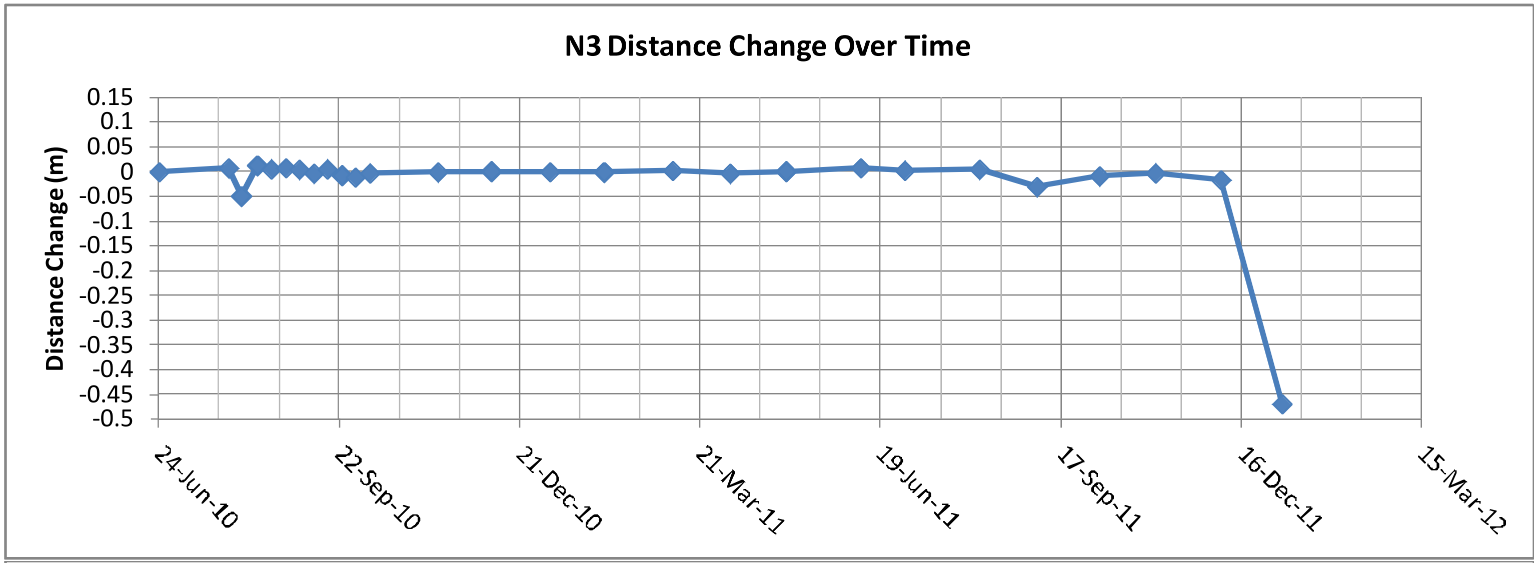


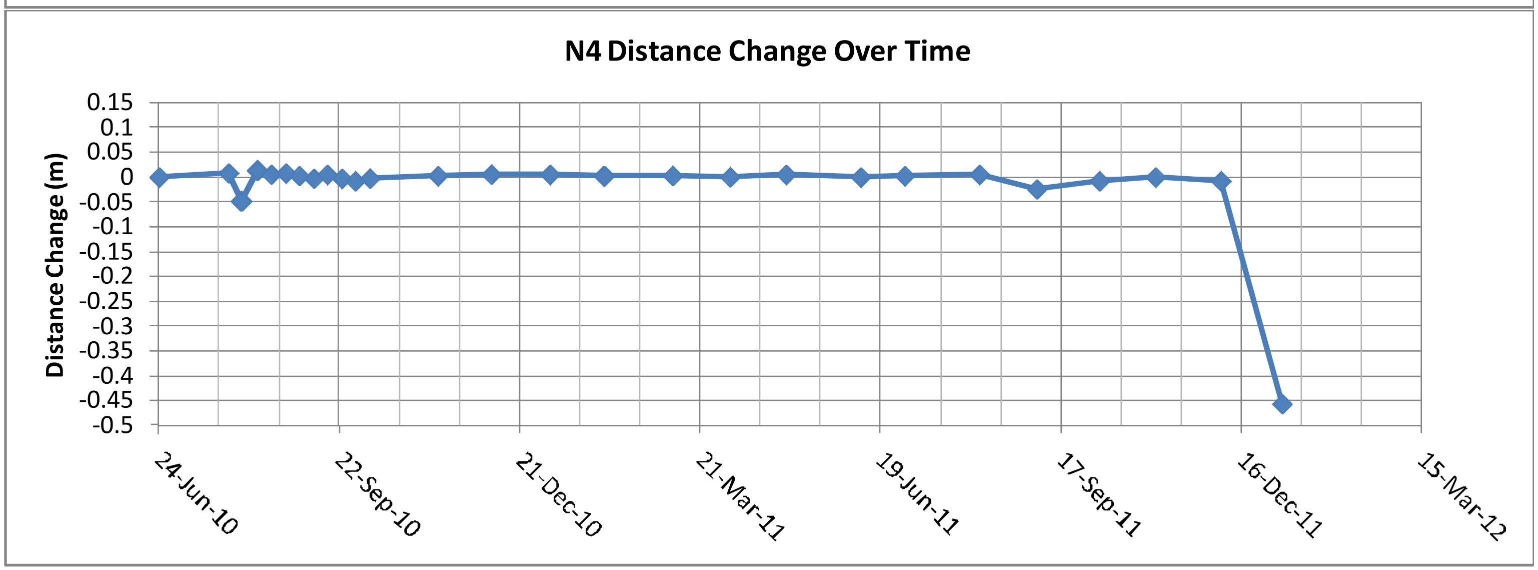
Grum Pit Slope Stability Monitoring





Grum Pit Slope Stability Monitoring





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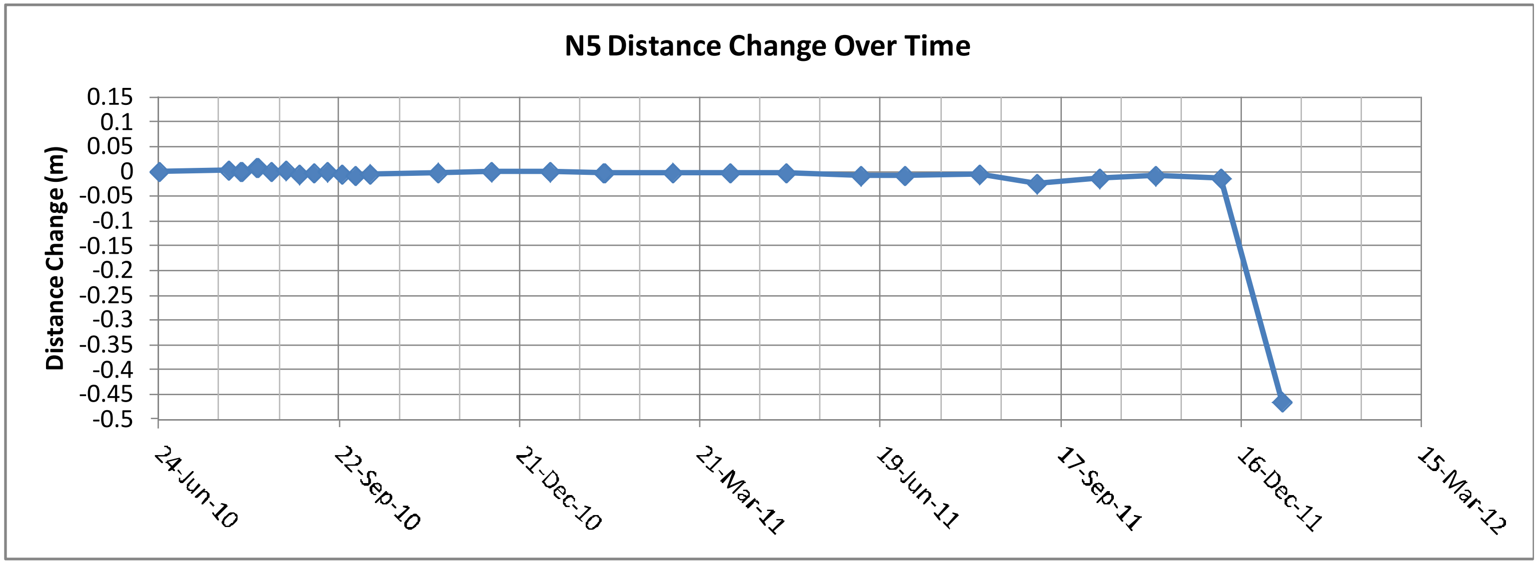
Grum Pit Slope Stability Monitoring



I.3 – Piezometers (cut slot)

Water Elevations - Grum Slot Cut Piezometers
(Aug. 2009 to Aug. 2011)

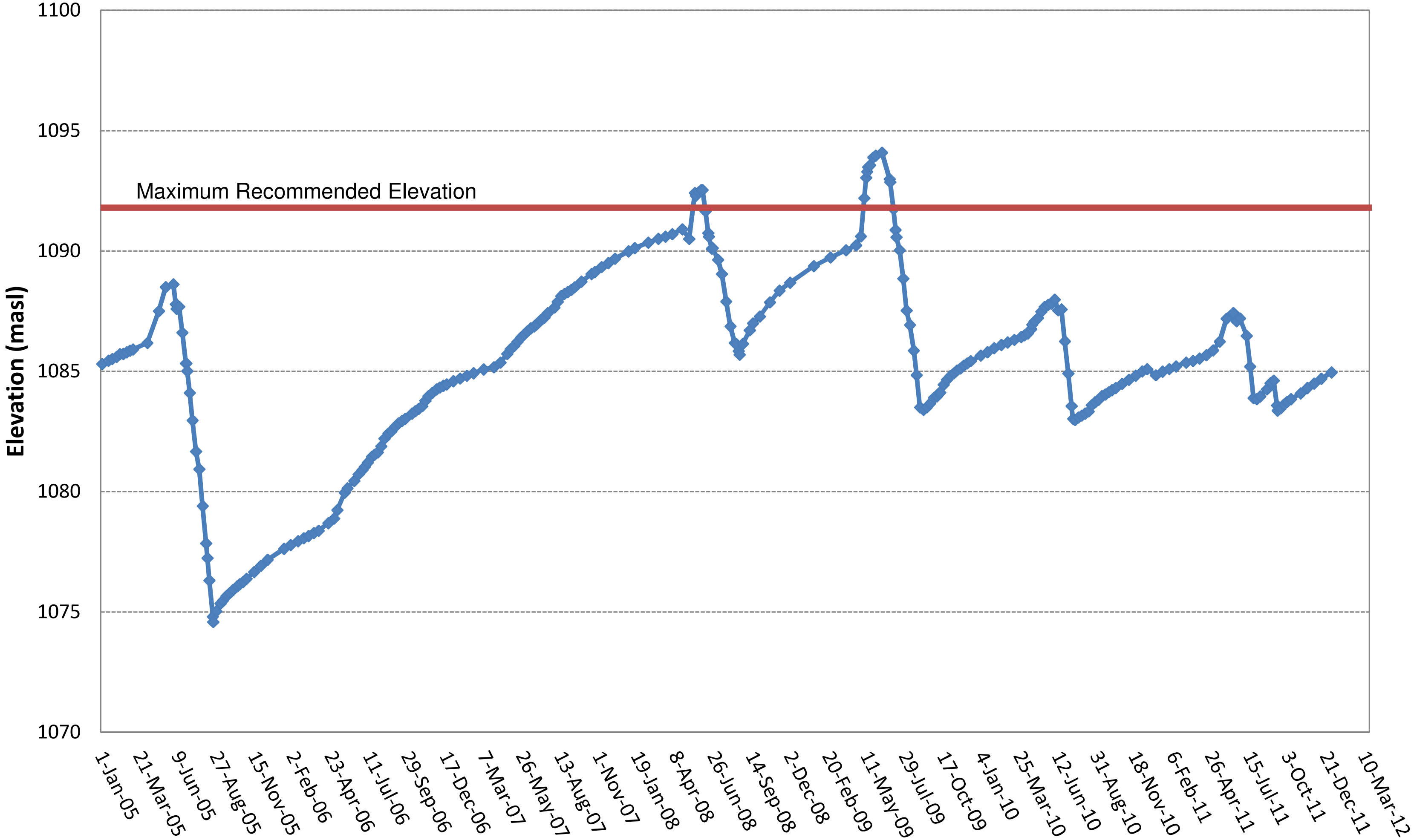
APPENDIX II-J

Vangorda Pit

J.1 – Pond Level

J.1 – Pond Level

Vangorda Pit Water Elevations



APPENDIX II-K

Vangorda Waste Rock Dump

K.1 – Weir Flow Measurements and Visual Drain Monitoring

K.2 – Piezometers

K.1 – Weir Flow Measurements and Visual Drain Monitoring

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Table H-72: Vangorda Waste Rock Dump Drains

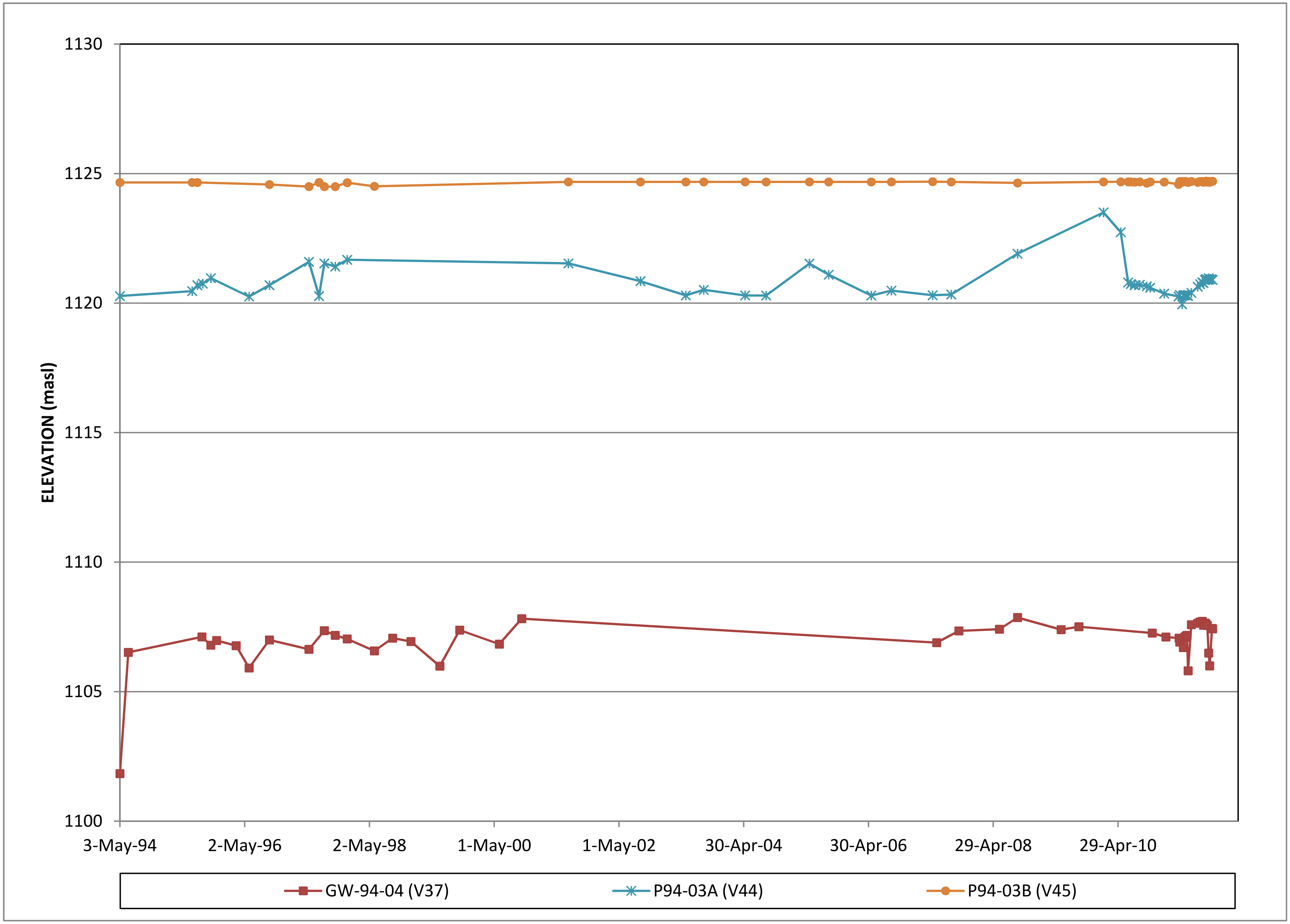
	V28		V29		V30		V31		V32		V33	
Date	Drain 1		Drain 2		Drain 3		Drain 4		Drain 5		Drain 6	
	Flow L/s	Observations	Flow L/s	Observations	Flow L/s	Observations	Flow L/s	Observations	Flow L/s	Observations	Flow L/s	Observations
16-May-11	0.18	Water flowing off dump, pooling behind drain. Estimated flow of 0.18 l/s. Photo taken.	0.03	Drain snowed in. Estimated flow of 0.03 l/s. Photo taken.	0.03	Snow and ice behind weir. Estimated flow of 0.03 l/s. Photo taken.	none	No flow. Photo taken.	none	No flow. Photo taken.	0.25	Snow and ice behind weir. Estimated flow of 0.25 l/s. Photo taken.
23-May-11	none	Dry. Photo taken.	0.04	Drain snowed in. Weir measured at 0.015m. Photo taken.	0.25	Esimated flow of 0.25 l/s. Weir tilted so not measured. Photo taken.	0.20	Partially covered with snow. Estimated flow of 0.20 l/s. Photo taken.	0.10	Weir still buried in snow. Esimated flow of 0.10 l/s downstream. Photo taken.	0.41	Still partially covered in snow but flowing at weir; Weir measured at 0.039m. Photo taken.
30-May-11	none	Dry. Photo taken.	0.05	Estimated flow of 0.05 l/s.Photo taken.	0.13	Estimated flow of 0.13 l/s. Photo taken.	0.10	Estimated flow of 0.10 l/s. Photo taken.	none	Standing water. Photo taken.	0.10	Weir measured at 0.022m. Estimated flow of 0.10 l/s. Photo taken.
7-Jun-11	none	Dry. Photo taken.	none	No flow through weir. Photo taken.	0.08	Weir measured at 0.020m. Photo taken.	0.10	Estimatd flow of 0.10 l/s. Photo taken.	0.20	Estimated flow of 0.20 l/s. Photo taken.	0.04	Weir measured at 0.016m. Photo taken.
14-Jun-11	none	Dry. Photo taken.	none	Dry. Photo taken.	0.02	Weir measured at 0.011m. Photo taken.	0.13	Estimated flow of 0.13 l/s. Photo taken.	none	Standing water. Photo taken.	0.06	Weir measured at 0.018m. Photo taken.
28-Jun-11	none	Dry. Photo taken.	none	Dry. Photo taken.	0.08	Estimated flow of 0.08 l/s. Photo taken.	0.05	Estimated flow of 0.05 l/s. Photo taken.	<0.01	Estimated flow of <0.01 l/s. Photo taken.	0.04	Weir measured at0.016m. Photo taken.
3-Jul-11	none	Dry. Photo taken.	none	Dry. Photo taken.	flow not taken.	Weir measured at0.019m. Photo taken.	0.50	Estimated flow of 0.50 l/s. Oily film. Photo taken.	0.15	Weir measured at 0.026m. Photo taken.	flow not taken.	Weir measured at 0.017m. Photo taken.
22-Jul-11	none	Dry. Photo taken.	none	Dry. Photo taken.	0.06	Estimated flow of 0.06 l/s. Photo taken.	0.05	Esimated flow of 0.05 l/s. Photo taken.	0.01	Estimated flow of 0.01 l/s. Photo taken.	0.09	Weir measured at 0.021m Photo taken.
3-Aug-11	none	Dry, Photo taken	none	Dry; Photo taken	0.08	Weir measured at 0.020m; Photo taken	0.01	Estimated flow of 0.01 l/s. Photo taken.	none	Standing water; Photo taken	0.07	Weir measured at 0.019m. Photo taken.
19-Aug-11	none	Dry.	none	Dry.	0.05	Weir measured at 0.016m. Estimated flow of 0.05 l/s.	<0.1	Estimated flow of <0.1 l/s.	none	Standing water.	0.07	Weir measured at 0.019m.
2-Sep-11	none	Dry. Photo taken.	none	Dry. Photo taken.	0.03	Weir measured at 0.013m. Photo taken.	0.02	Estimated flow of 0.02 l/s. Photo taken.	0.01	Estimated flow of 0.01 l/s. Photo taken.	0.18	Weir measured at 0.028m. Photo taken.
9-Sep-11	none	Dry. Photo taken	none	Dry; Photo taken	0.11	Weir measured at 0.013m. Estimated flow of 0.11 l/s. Photo taken.	<0.1	Estimated flow of <0.1 l/s. Photo taken.	none	Standing water; Photo taken	0.04	Weir measured at 0.016m. Photo taken.
16-Sep-11	none	Dry.	none	Dry.	0.08	Weir measured at 0.019m. Estimated flow of 0.08 l/s.	<0.1	Estimated flow of 0.001 l/s.	none	Standing water.	0.12	Weir measured at 0.024m.
26-Sep-11	none	Dry. Photo taken.	none	Dry. Photo taken.	0.04	Weir measured at 0.015m. Photo taken.	0.02	Estimated flow of 0.02 l/s. Photo taken.	0.01	Estimated flow of 0.01 l/s. Photo taken.	0.01	Weir measured at 0.010m. Photo taken.
4-Oct-11	none	Dry, Photo taken	none	Dry; Photo taken	0.03	Weir measured at 0.014m. Estimated flow of 0.03 l/s. Photo taken.	<0.1	Estimated flow of <0.1 l/s. Photo taken.	none	Standing water; Photo taken	0.07	Weir measured at 0.019m. Photo taken.
11-Oct-11	none	Dry.	none	Dry.	0.05	Weir measured at 0.018m. Estimated flow of 0.05 l/s.	<0.1	Estimated flow of <0.1 l/s.	none	Standing water.	0.15	Weir measured at 0.026m.
17-Oct-11	none	Dry.	none	Dry.	0.0002	Weir measured at 0.002m.	none	No Flow	0.0002	Weir measured at 0.002m.	0.01	weir measured at 0.01m.
31-Oct-11	none	Dry, Photo taken	none	Dry, Photo taken	0.03	Weir measured at 0.013m. Estimated flow of 0.03 l/s. Photo taken.	none	No flow. Photo taken.	0.0024	Weir measured at 0.005m. Photo taken.	0.12	Weir measured at 0.024m. Photo taken.
3-Nov-11	none	Dry, Photo taken	none	Dry, Photo taken	0.03	Weir measured at 0.012m. Estimated flow of 0.03 l/s. Photo taken.	none	No flow. Photo taken.	none	No flow. Photo taken.	0.044	Weir measured at 0.016m. Photo taken.

K.2 – Piezometers

Denison Environmental Services

Figure H-54: Vangorda Waste Rock Dump
Piezometric Elevations - Cross Section 'A'

Faro Mine Closure



Denison Environmental Services

Figure H-55: Vangorda Waste Rock Dump
Piezometric Elevations - Cross Section 'B'

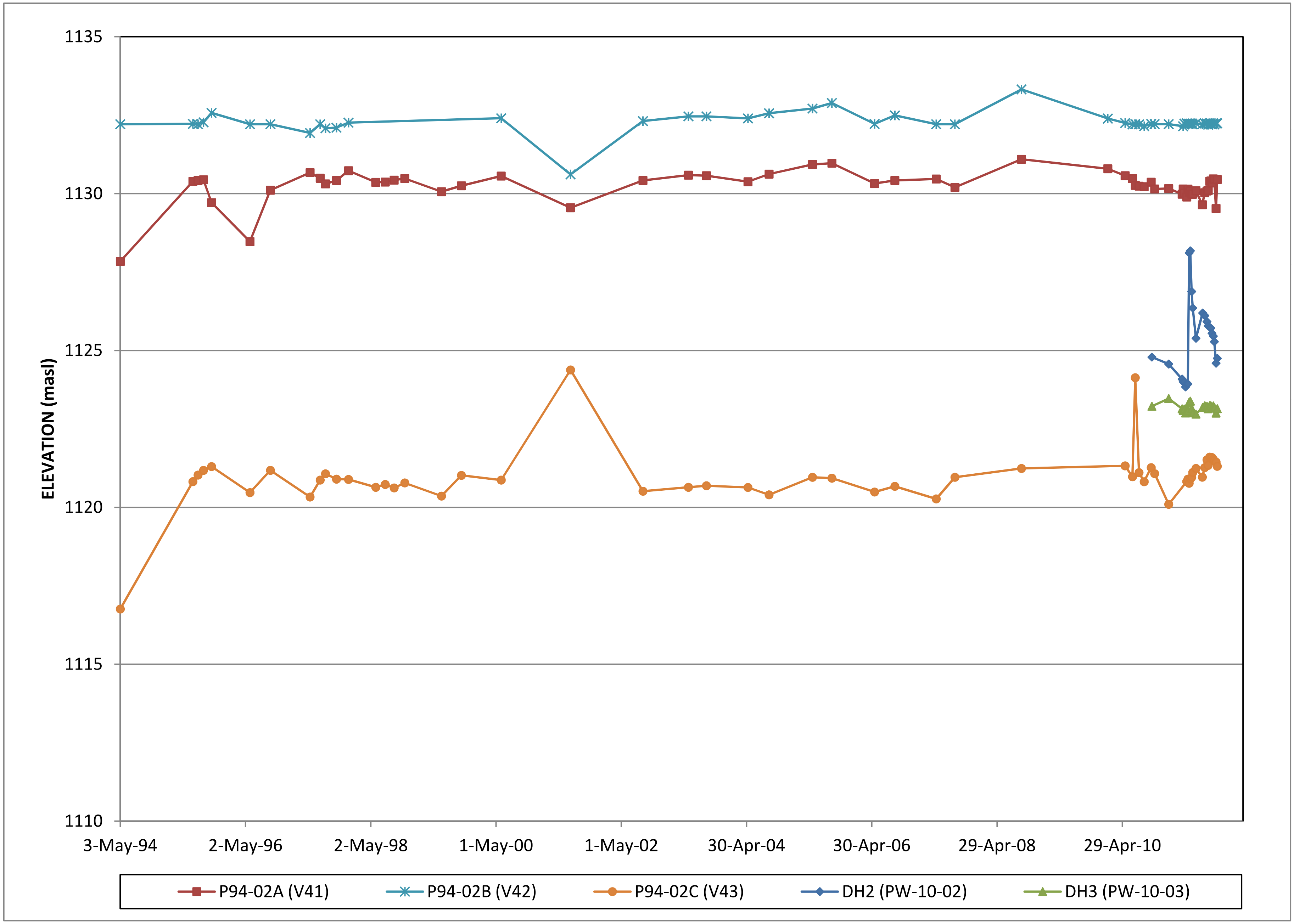
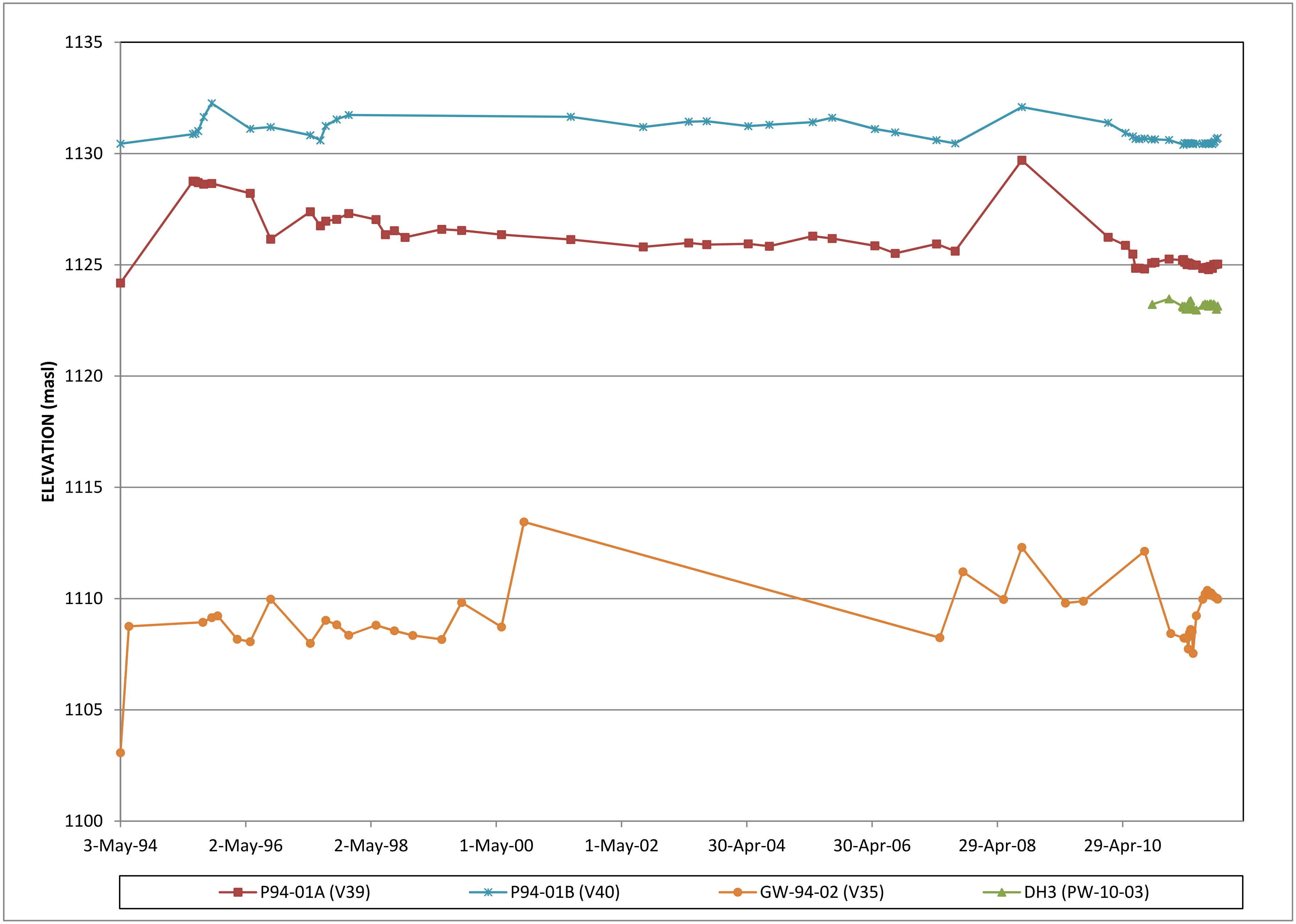


Figure H-56: Vangorda Waste Rock Dump
Piezometric Elevations - Cross Section 'C'



Denison Environmental Services

Figure H-57: Vangorda Waste Rock Dump
Piezometric Elevations - Cross Section 'D'

Faro Mine Closure

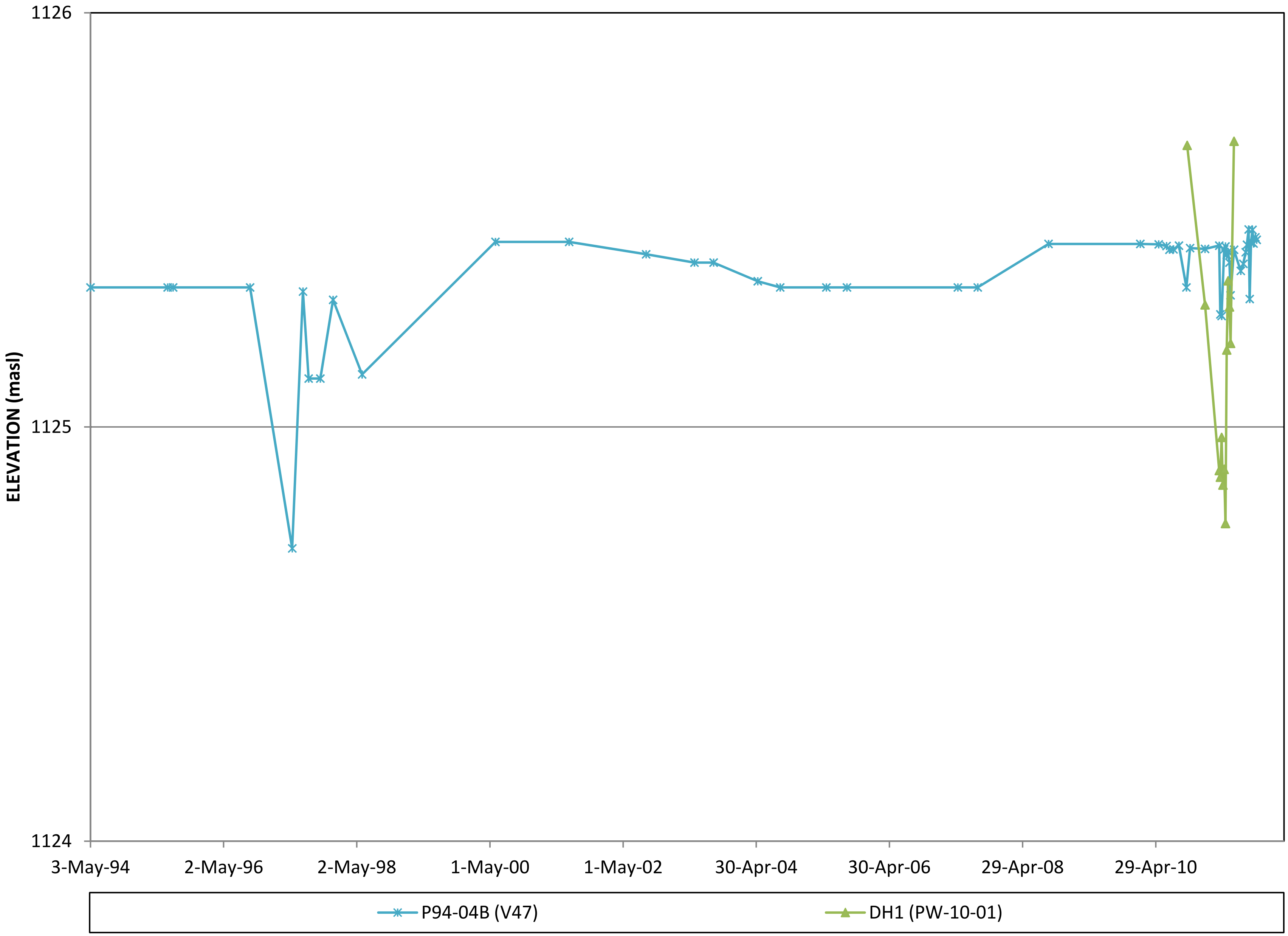
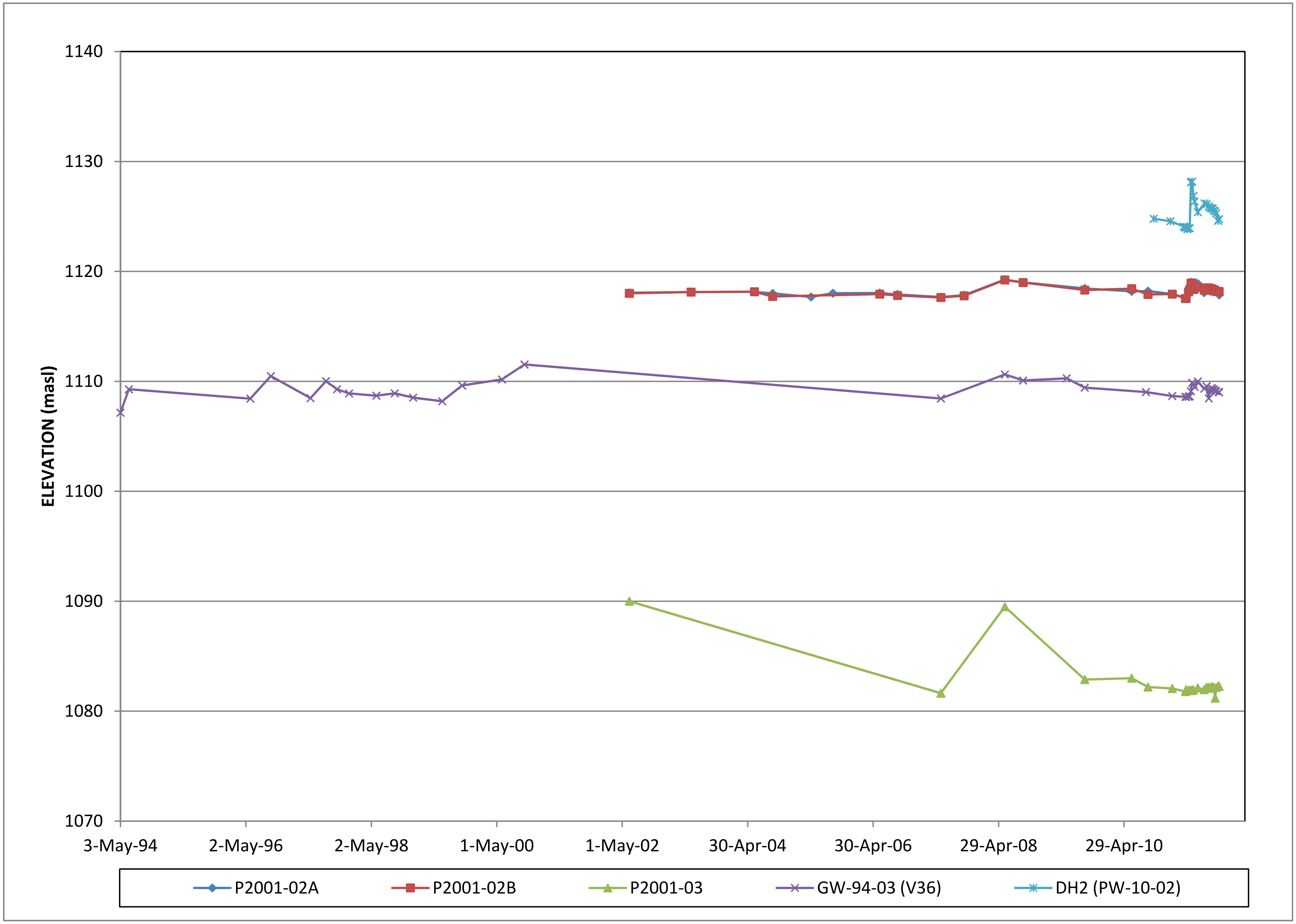
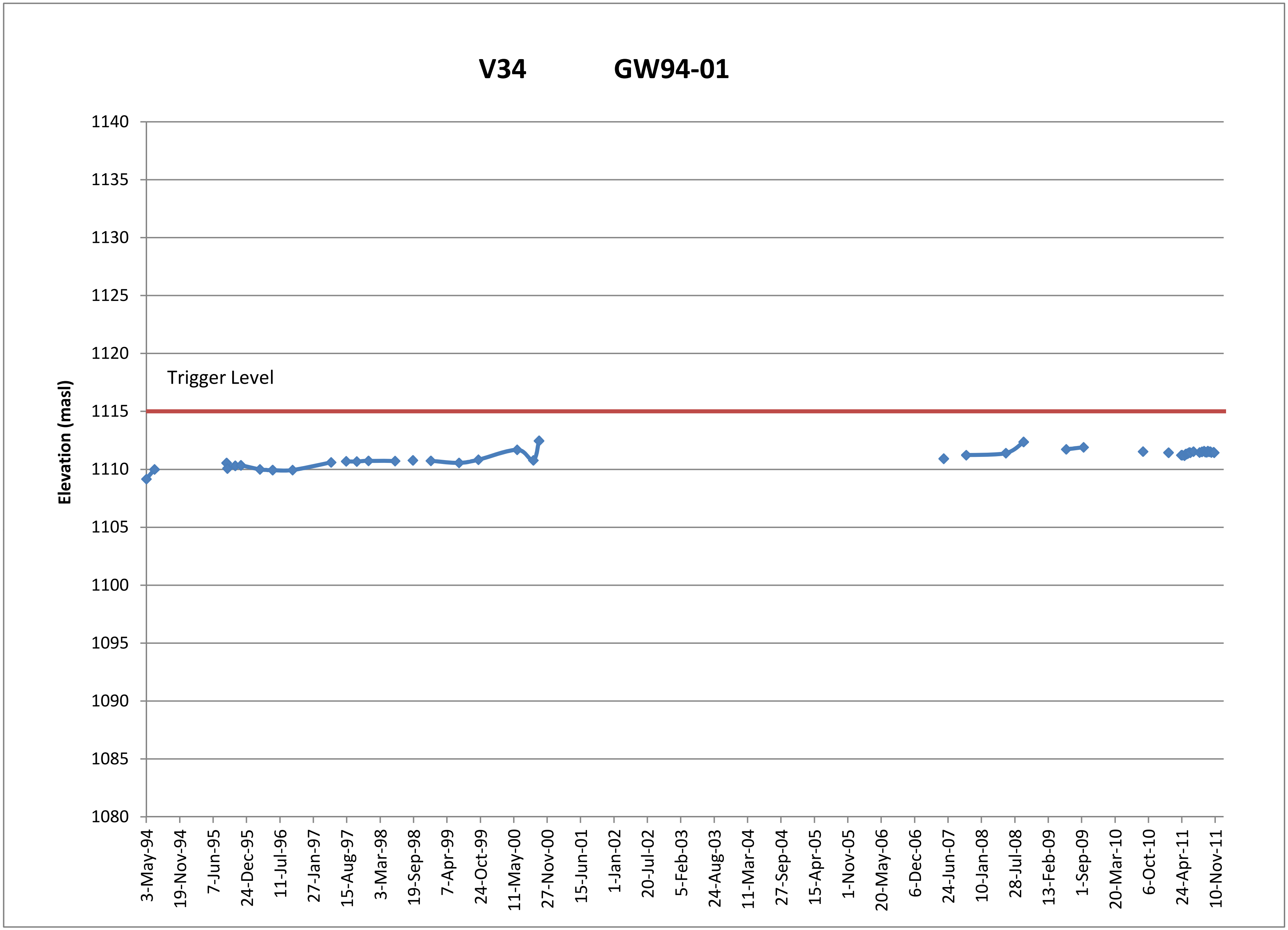


Figure H-58: Vangorda Waste Rock Dump Piezometric Elevations - Cross Section 'E'

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Elevation (masl)
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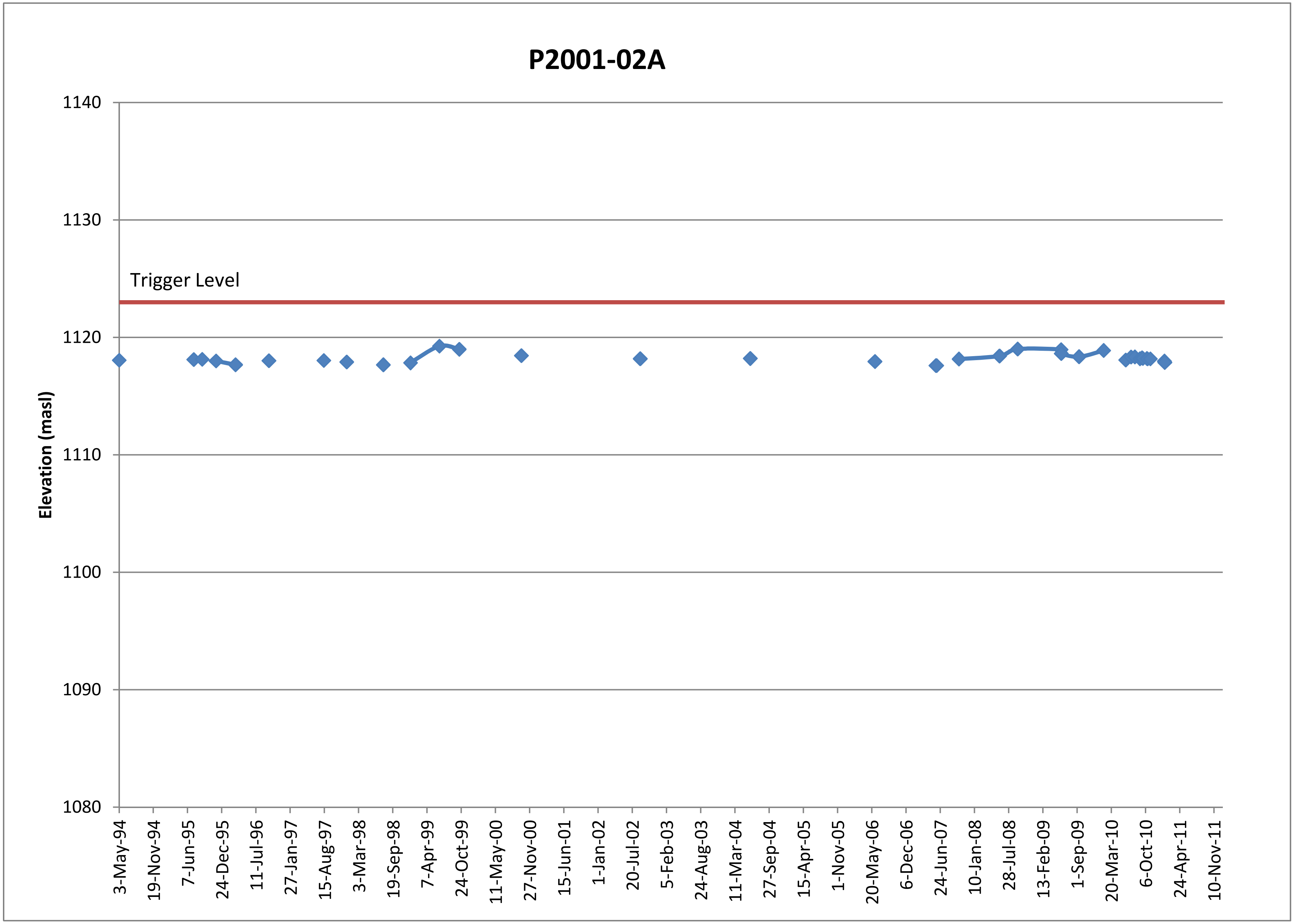
1135
1130
1125
1120
1115
1110
1105
1100
1095
1090
1085
1080
Trigger Level
3-May-94
19-Nov-94
7-Jun-95
24-Dec-95
11-Jul-96
27-Jan-97
15-Aug-97
3-Mar-98
19-Sep-98
7-Apr-99
24-Oct-99
11-May-00
27-Nov-00
15-Jun-01
1-Jan-02
20-Jul-02
5-Feb-03
24-Aug-03
11-Mar-04
27-Sep-04
15-Apr-05
1-Nov-05
20-May-06
6-Dec-06
24-Jun-07
10-Jan-08
28-Jul-08
13-Feb-09
1-Sep-09
20-Mar-10
6-Oct-10
24-Apr-11
10-Nov-11



P2001-02A
Elevation (masl)
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1130
1120
1110
1100
1090
1080
Trigger Level
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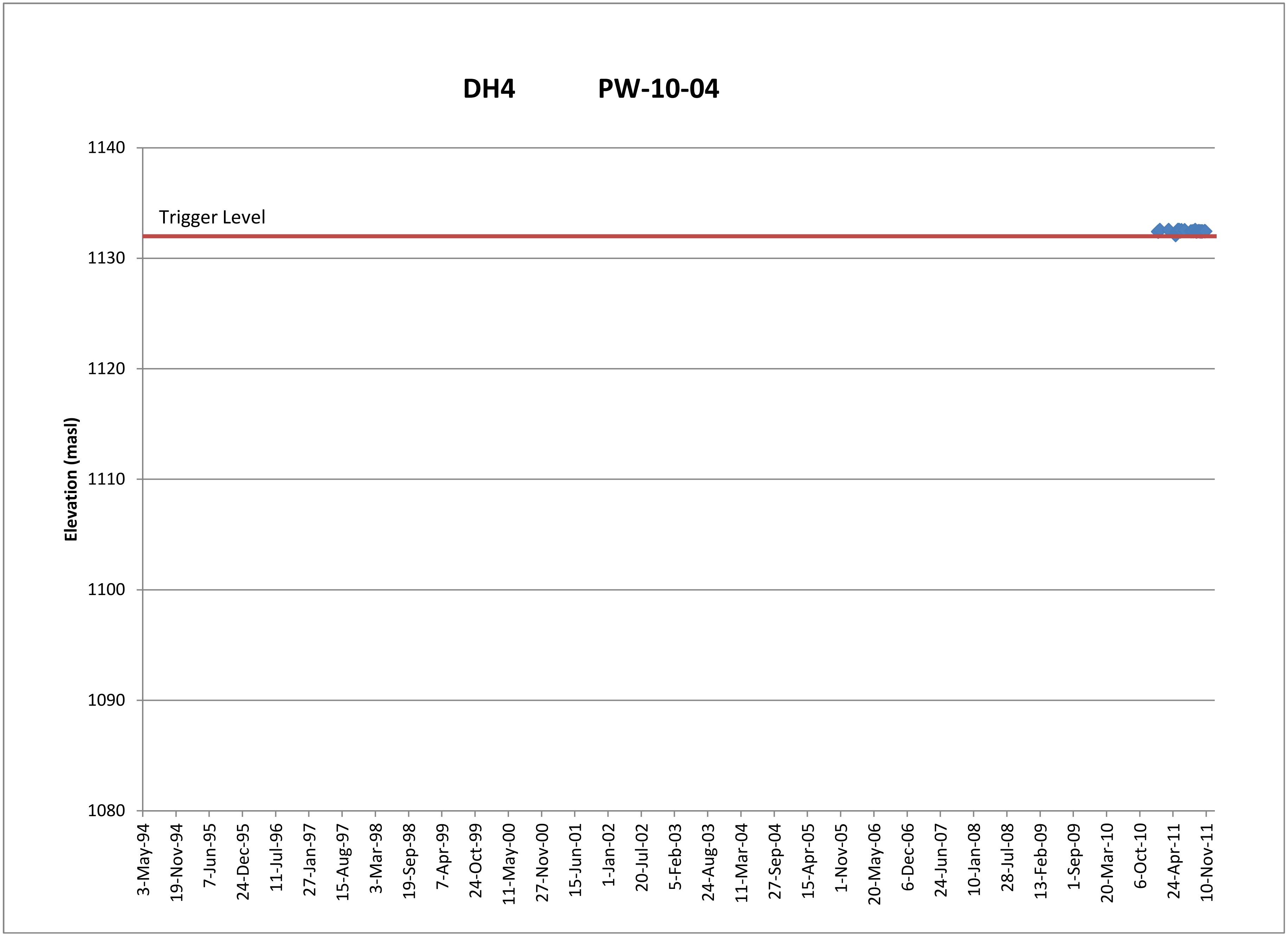
19-Nov-94
7-Jun-95
24-Dec-95
11-Jul-96
27-Jan-97
15-Aug-97
3-Mar-98
19-Sep-98
7-Apr-99
24-Oct-99
11-May-00
27-Nov-00
15-Jun-01
1-Jan-02
20-Jul-02
5-Feb-03
24-Aug-03
11-Mar-04
27-Sep-04
15-Apr-05
1-Nov-05
20-May-06
6-Dec-06
24-Jun-07
10-Jan-08
28-Jul-08
13-Feb-09
1-Sep-09
20-Mar-10
6-Oct-10
24-Apr-11
10-Nov-11


DH4 PW-10-04
Elevation (masl)
1140
1130
1120
1110
1100
1090
1080
Trigger Level
3-May-94
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7-Jun-95
24-Dec-95
11-Jul-96
27-Jan-97
15-Aug-97
3-Mar-98
19-Sep-98
7-Apr-99
24-Oct-99
11-May-00
27-Nov-00
15-Jun-01
1-Jan-02
20-Jul-02
5-Feb-03
24-Aug-03
11-Mar-04
27-Sep-04
15-Apr-05
1-Nov-05
20-May-06
6-Dec-06
24-Jun-07
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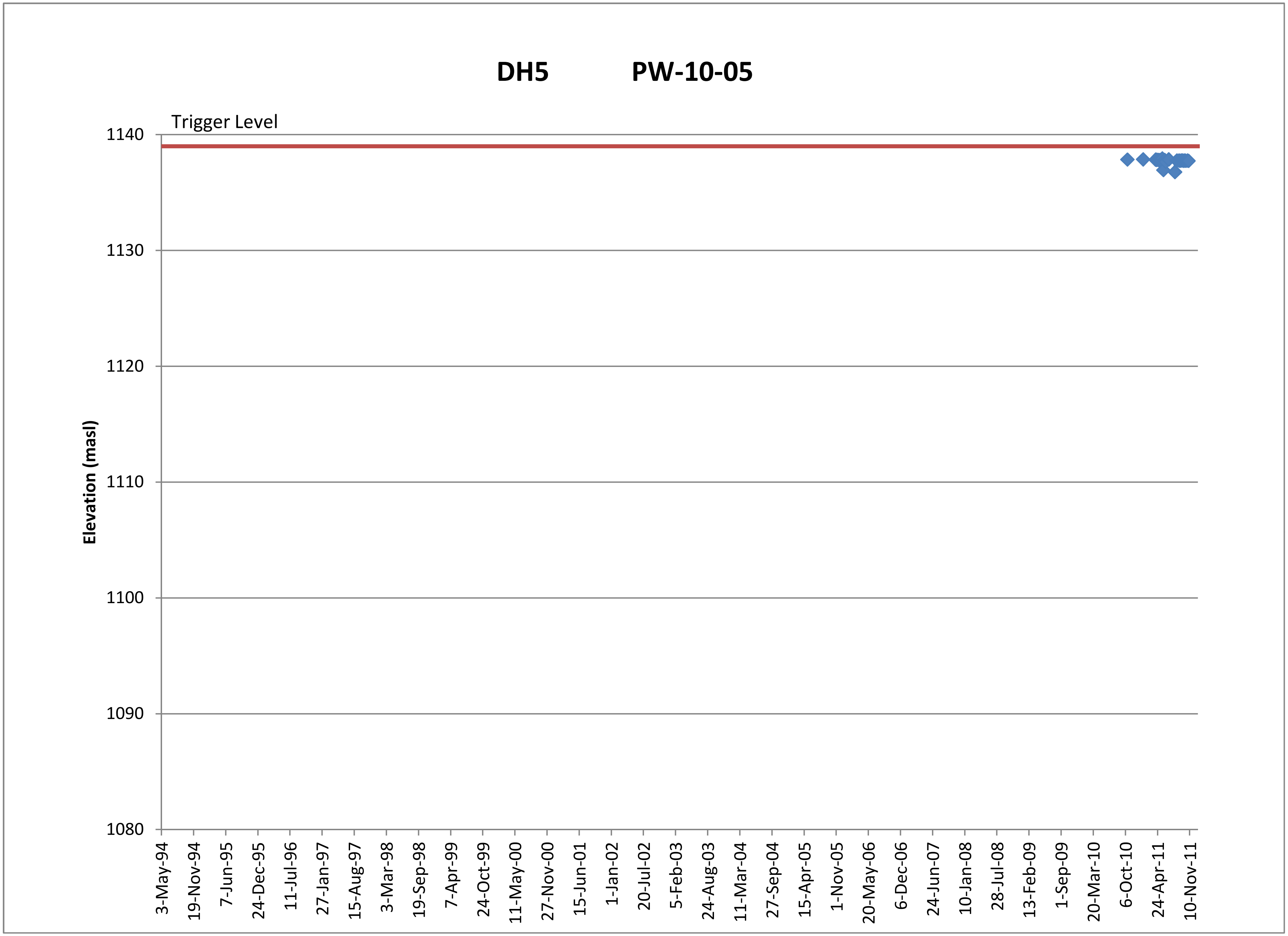
28-Jul-08
13-Feb-09
1-Sep-09
20-Mar-10
6-Oct-10
24-Apr-11
10-Nov-11


DH5 PW-10-05
Trigger Level
Elevation (masl)
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1130
1120
1110
1100
1090
1080
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7-Jun-95
24-Dec-95
11-Jul-96
27-Jan-97
15-Aug-97
3-Mar-98
19-Sep-98
7-Apr-99
24-Oct-99
11-May-00
27-Nov-00
15-Jun-01
1-Jan-02
20-Jul-02
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27-Sep-04
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1-Nov-05
20-May-06
6-Dec-06
24-Jun-07
10-Jan-08
28-Jul-08
13-Feb-09
1-Sep-09
20-Mar-10
6-Oct-10
24-Apr-11
10-Nov-11

APPENDIX II-L

Little Creek Dam

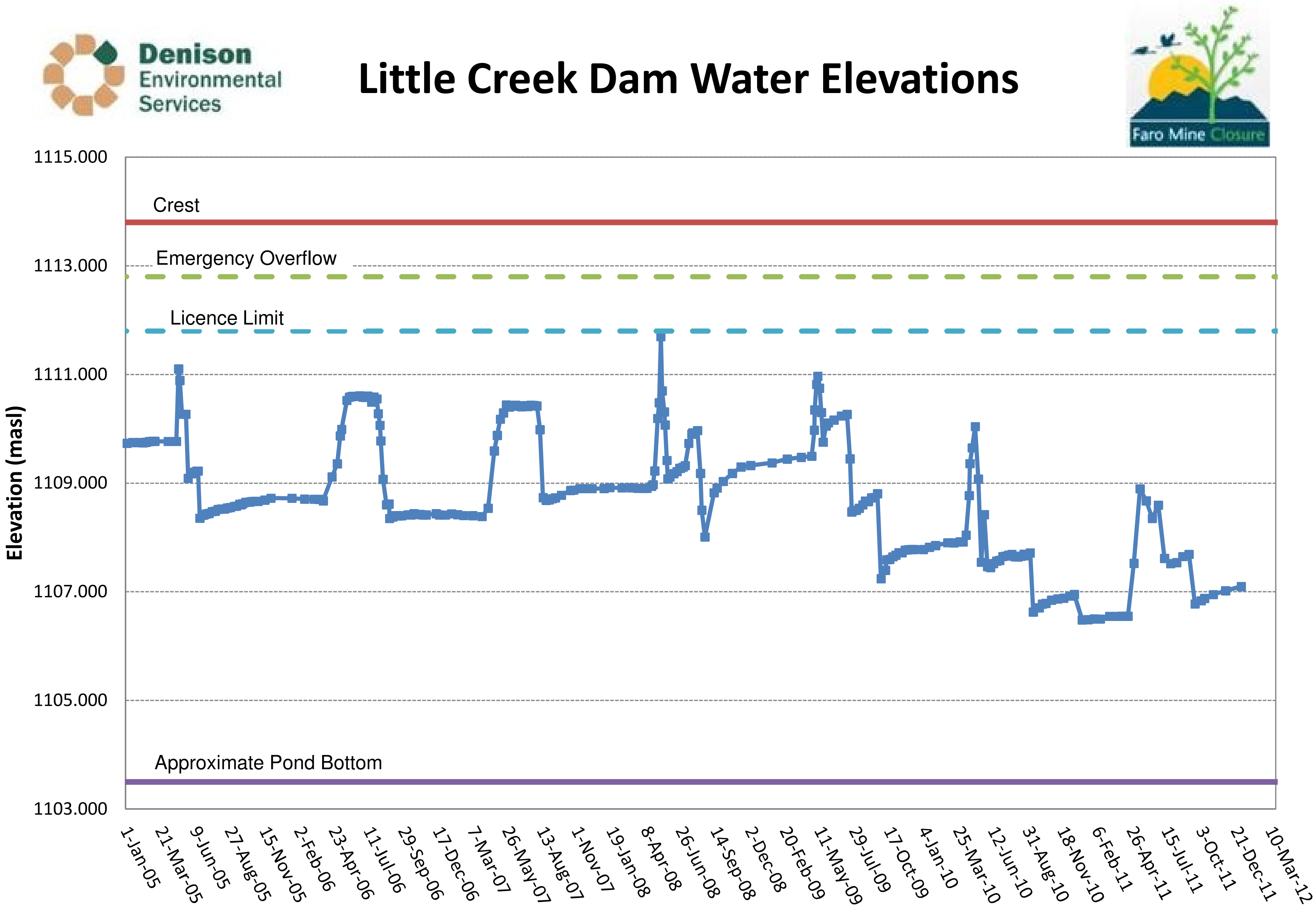
L.1 – Pond Level

L.2 – Piezometers

L.3 – Thermistors

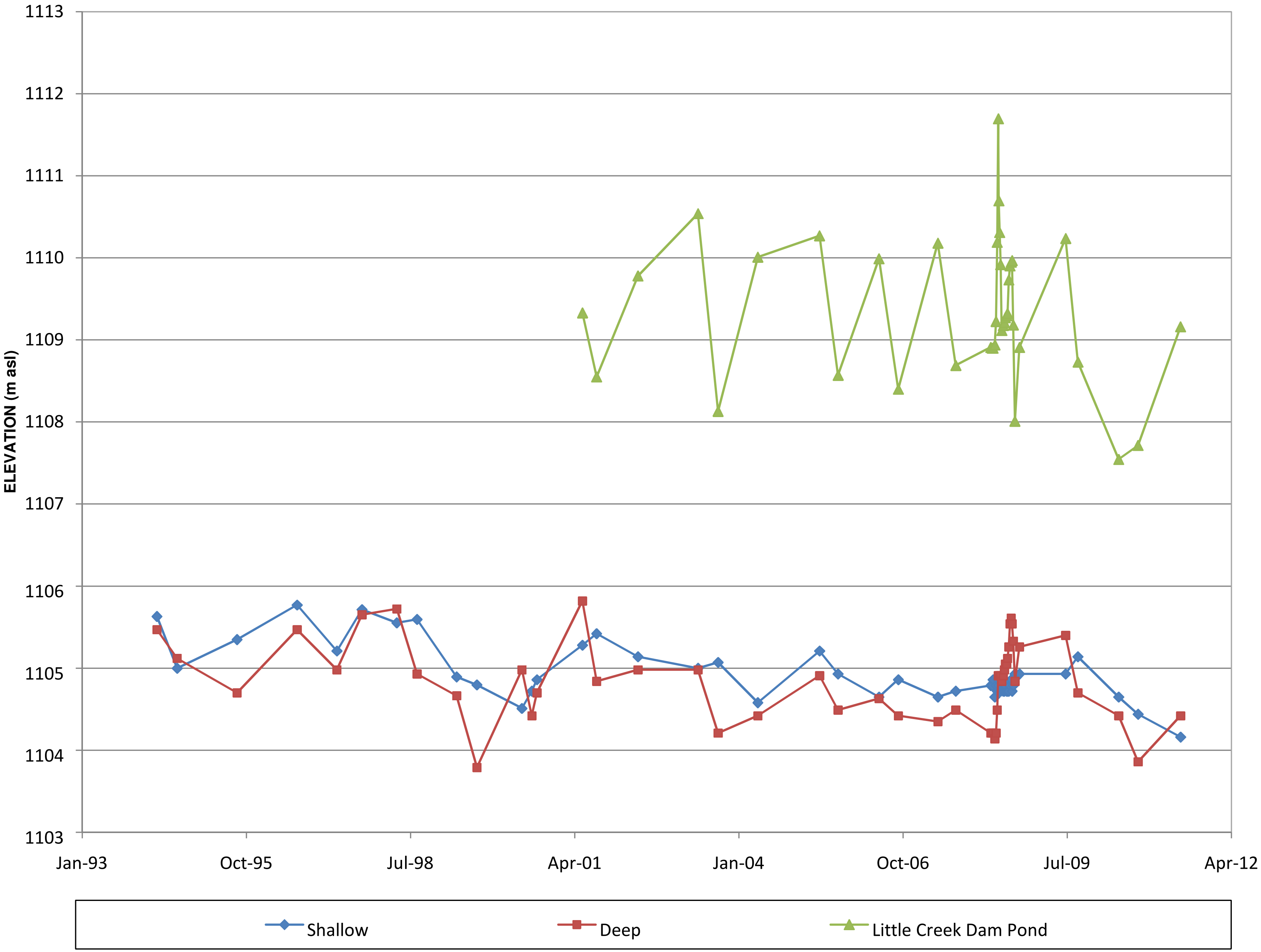
L.1 – Pond Level

Little Creek Dam Water Elevations



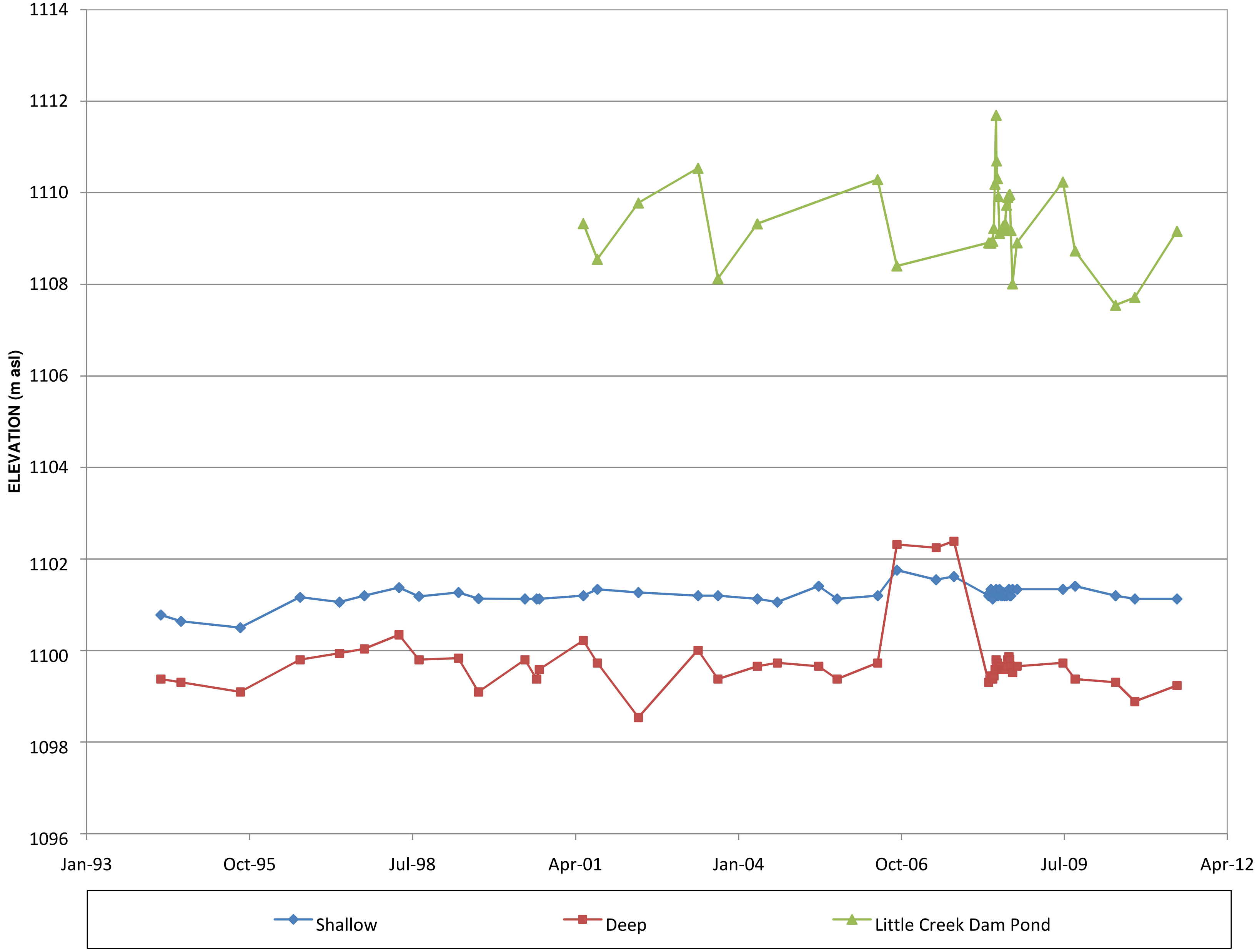
L.2 – Piezometers

Figure H-51: Little Creek Dam
Piezometer BH94 LCD1



Denison Environmental Services

Figure H-52: Little Creek Dam
Piezometer BH94 LCD2



C:\Documents and Settings\bolsen\Local Settings\Temp\wzead2\Fall Geotech\(14) 2011 LCD Piezometers.xlsx\BH94 LCD2 Figure(H-52)

Denison Environmental Services

Figure H-53: Little Creek Dam
Piezometer BH94 LCD3

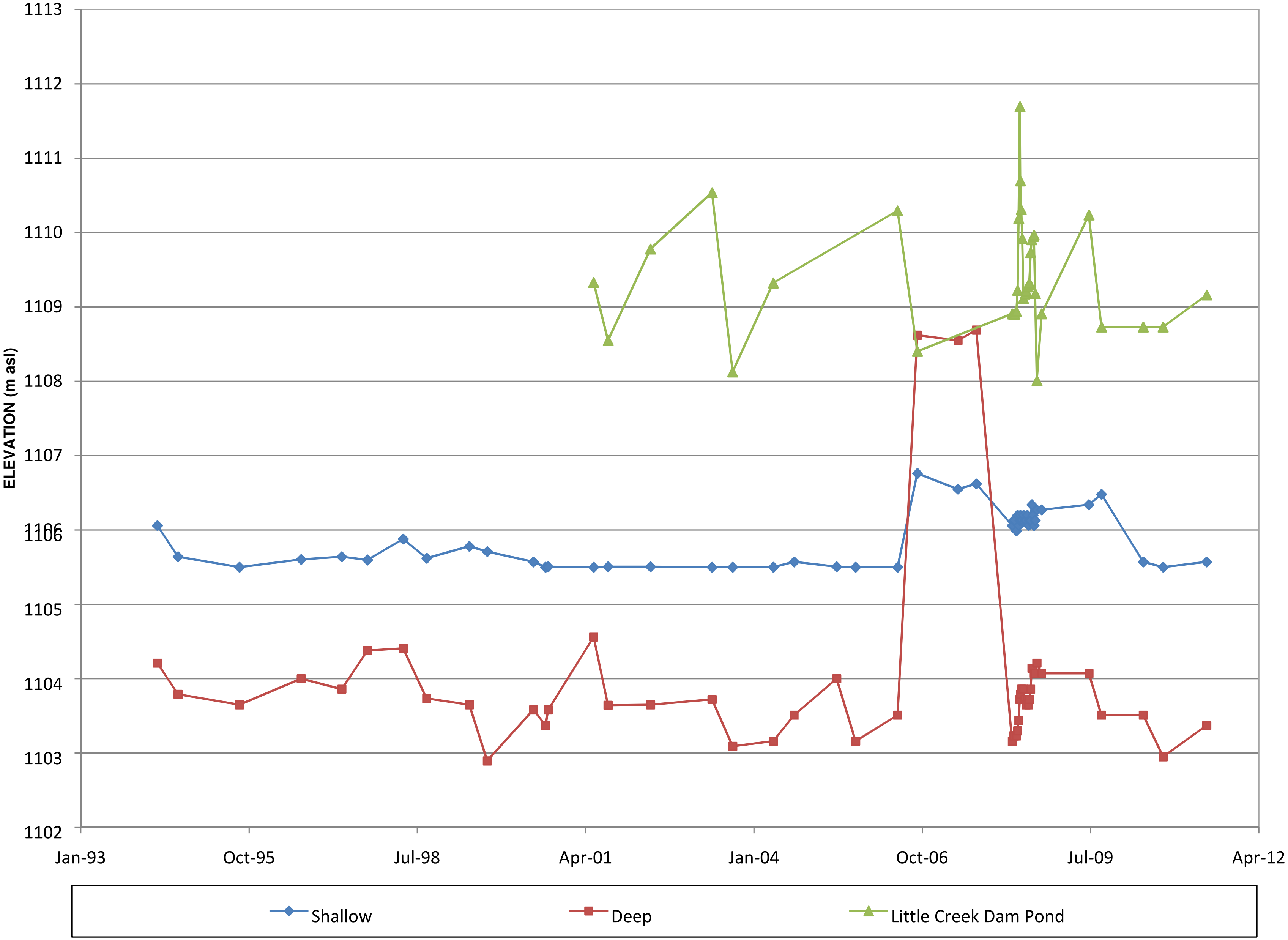


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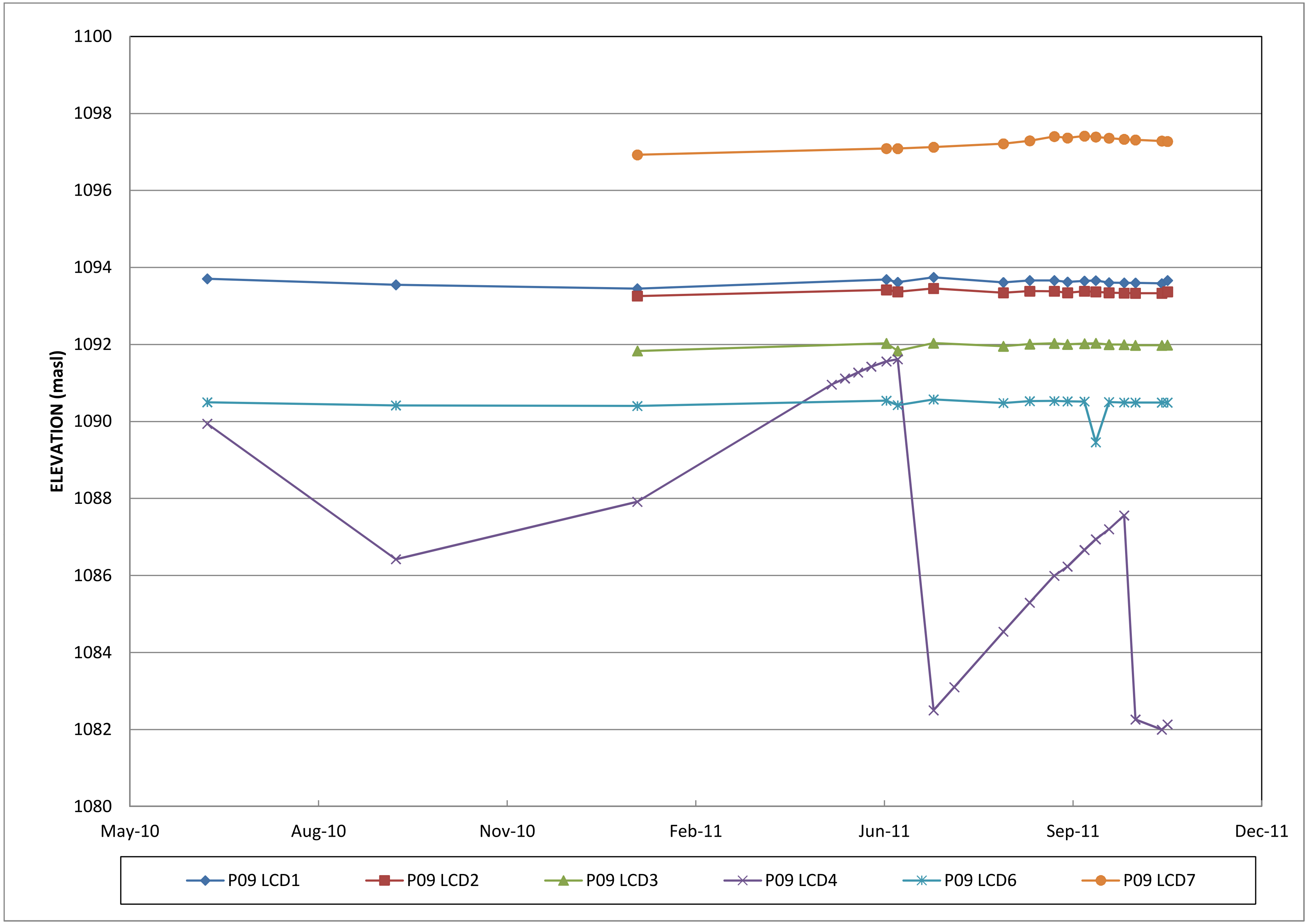
Figure H-54: Little Creek Dam
Piezometric Elevations

Faro Mine Closure



L.3 – Thermistors

Denison Environmental Services

Figure H-48: Little Creek Dam
Thermistor BH94 LCD4

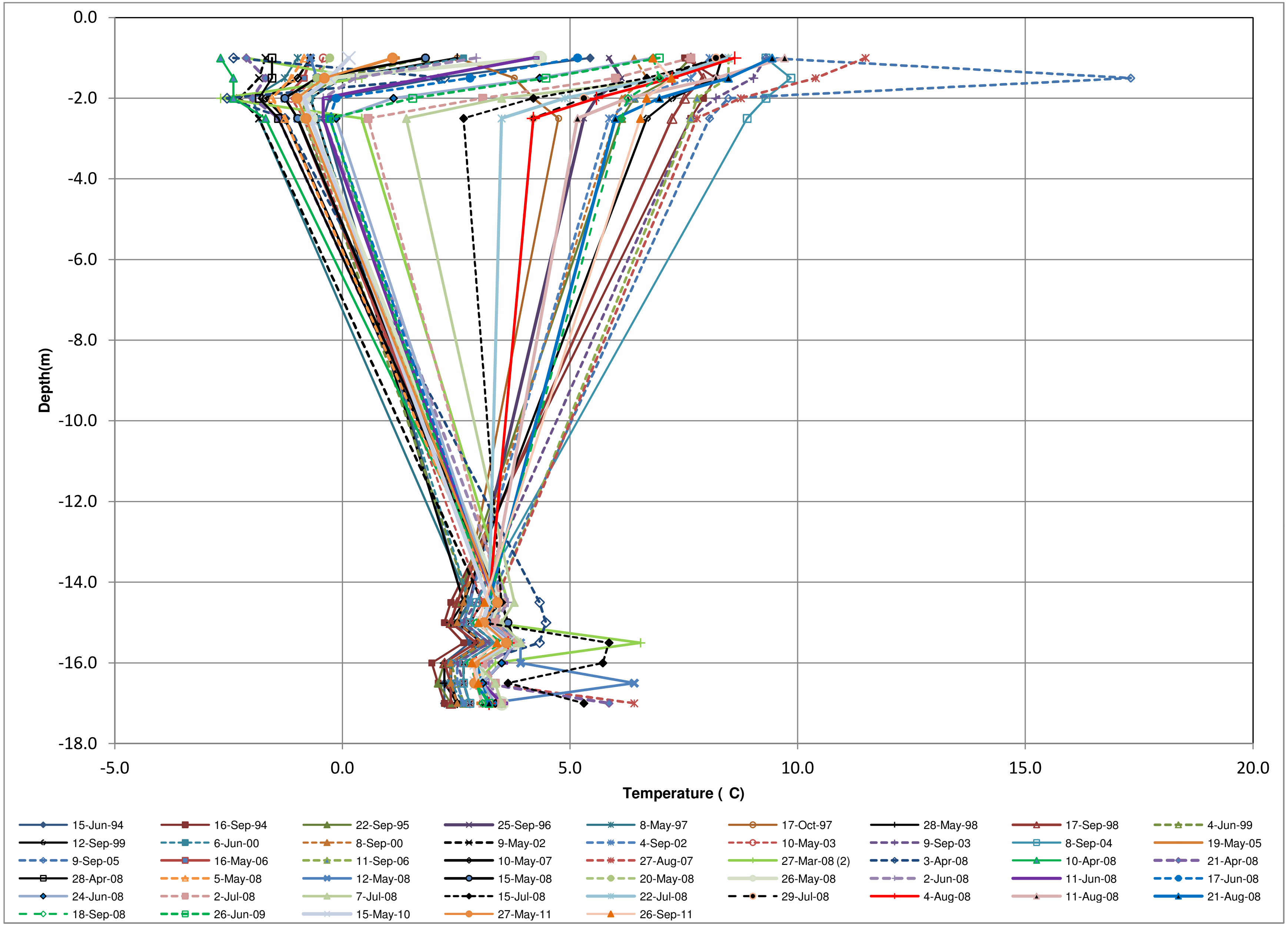


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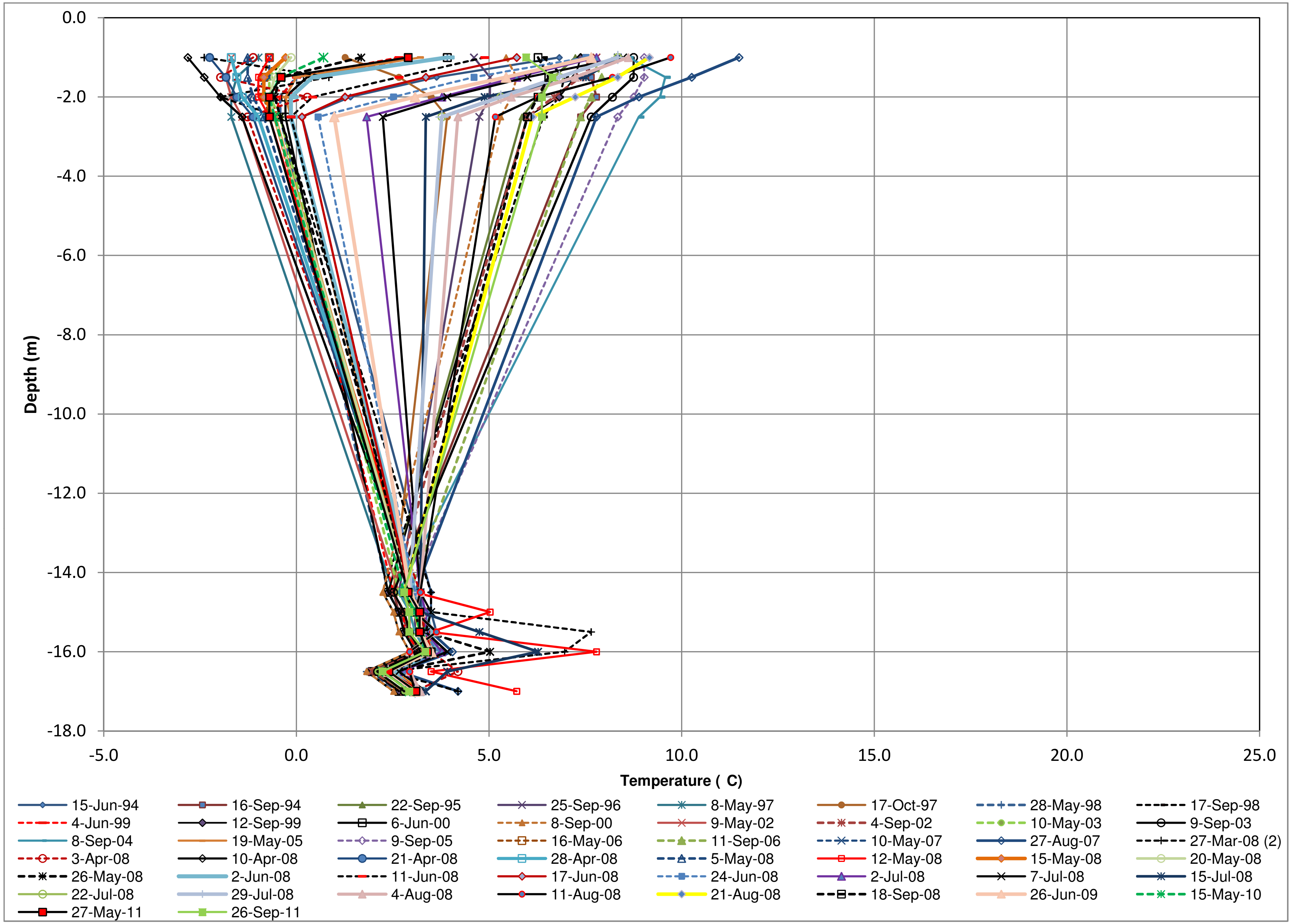
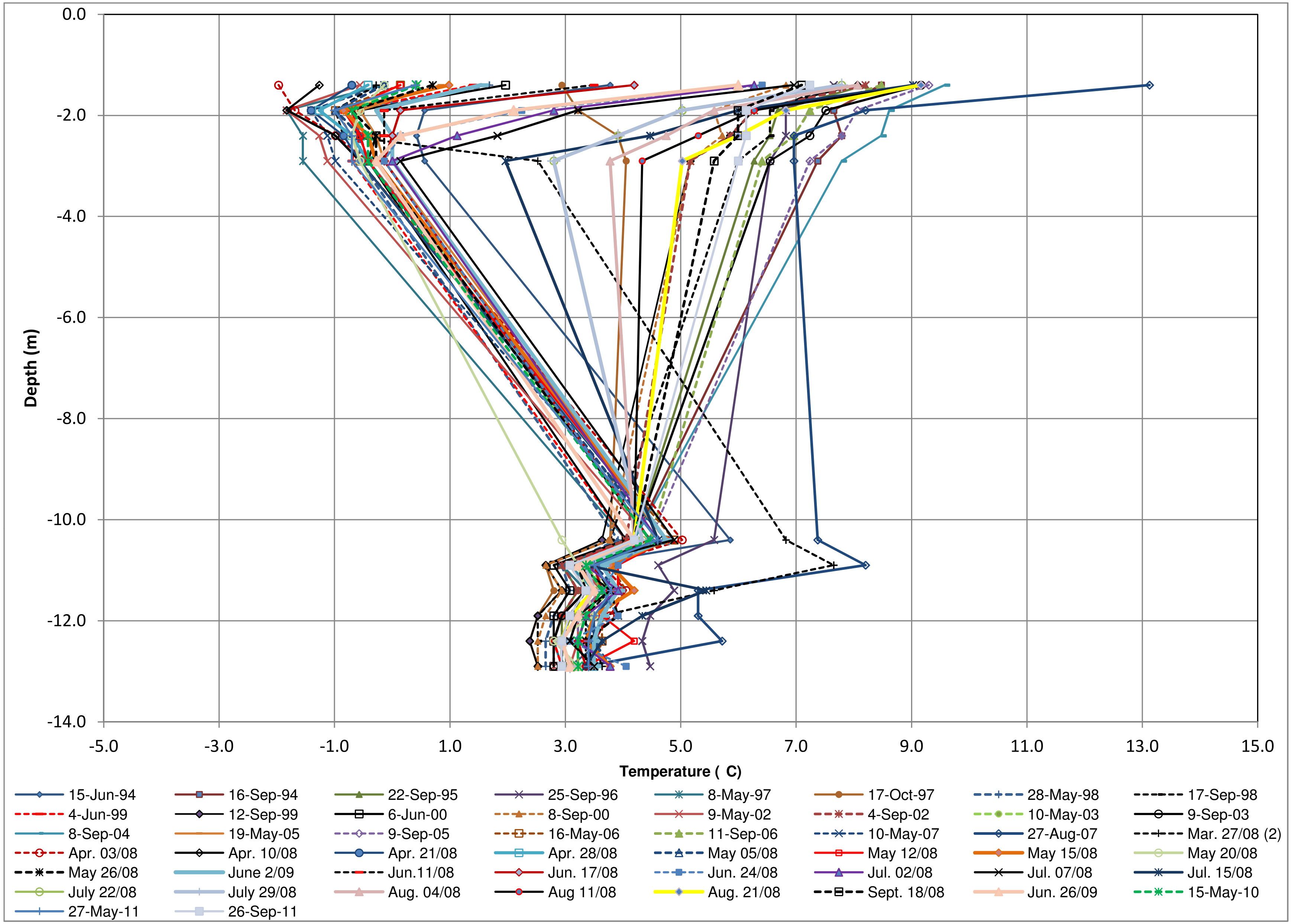
Figure H-49: Little Creek Dam
Thermistor BH94 LCD5



Denison Environmental Services

Figure H-50: Little Creek Dam
Thermistor BH94 LCD6



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APPENDIX III

PowerPoint Presentation Slides for Dennison Environmental Services Staff Training

APPENDIX III

PowerPoint Presentation Slides for Dennison Environmental Services Staff Training

FARO MINE COMPLEX – STAFF TRAINING

Robert C. Lo, P.Eng. August 23, 2011

OUTLINES OF PRESENTATION

- Tailings Dam General Background (Klohn Crippen 1996)
- Inspection & Maintenance of Dams (B.C. Ministry of Environment 2011)
- Faro Mine Complex Key Structures
- Instrumentation Used on Site
- Failure Mechanisms and Inspection for Problems

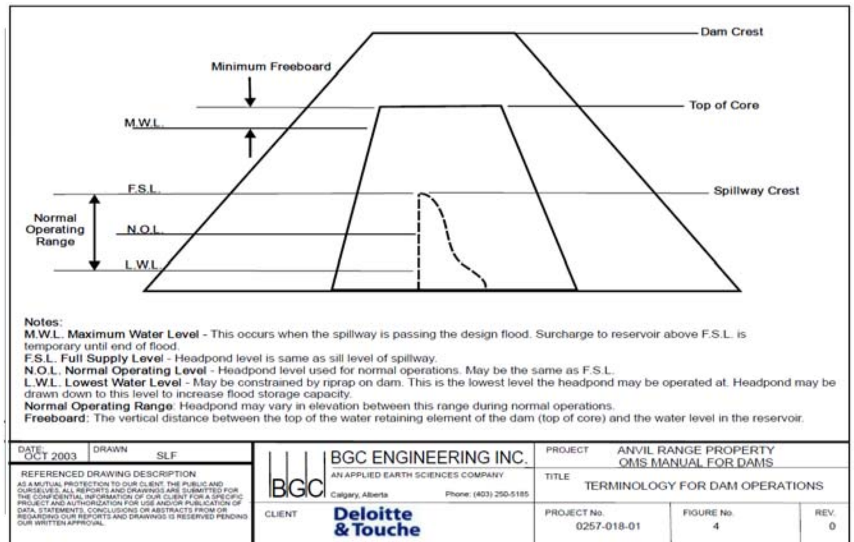
Klohn Crippen Berger 60 YEARS

Tailings Dam

General Background

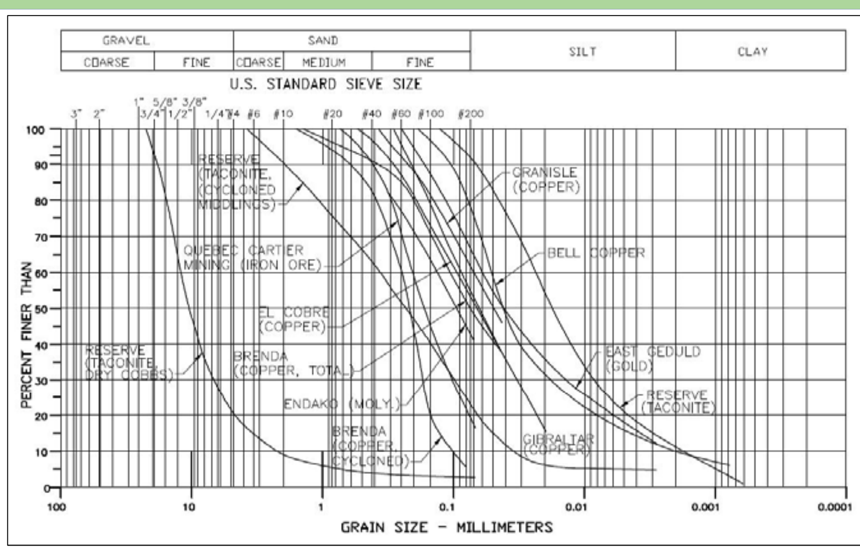
Klohn Crippen Berger 60 YEARS

Terminology for Dam Operation



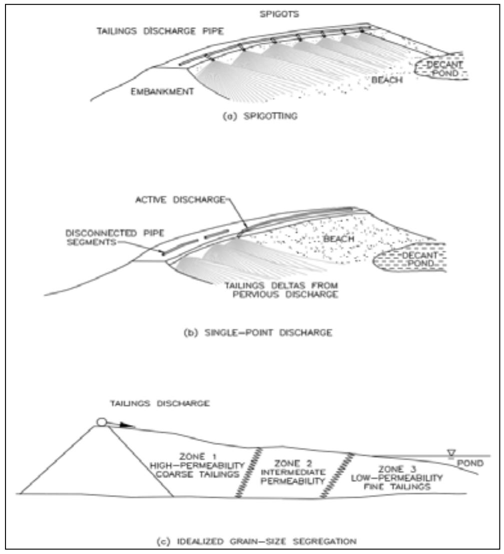
Klohn Crippen Berger 60 YEARS

Figure 1 - Typical Tailings Grain Size Curves



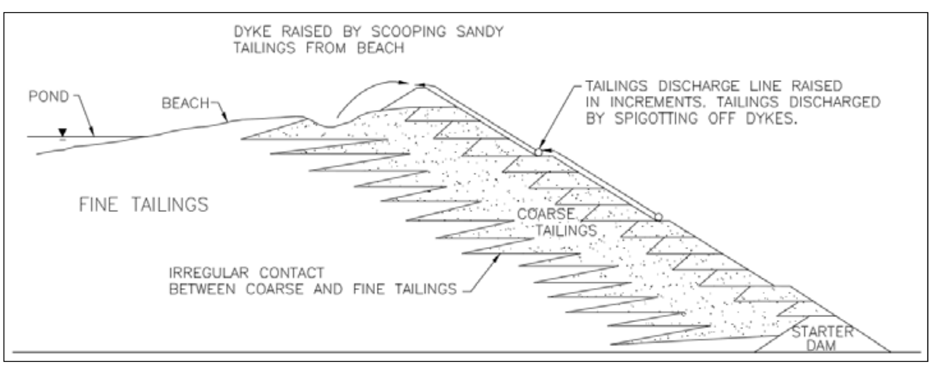
Klohn Crippen Berger 60 YEARS

Figure 2 – Tailings Discharge Methods (after Vick, 1990)



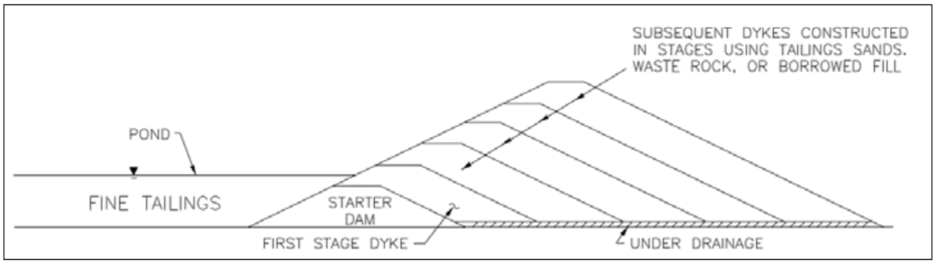
Klohn Crippen Berger 60 YEARS

Figure 3 – Upstream Method of Tailings Dam Construction



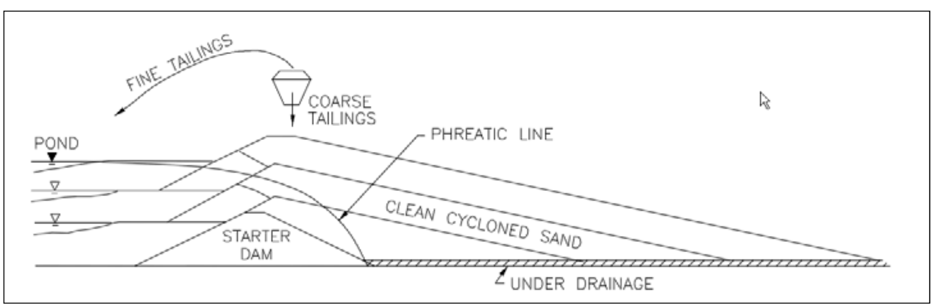
Klohn Crippen Berger 60 YEARS

Figure 4 – Downstream Method of Tailings Dam Construction



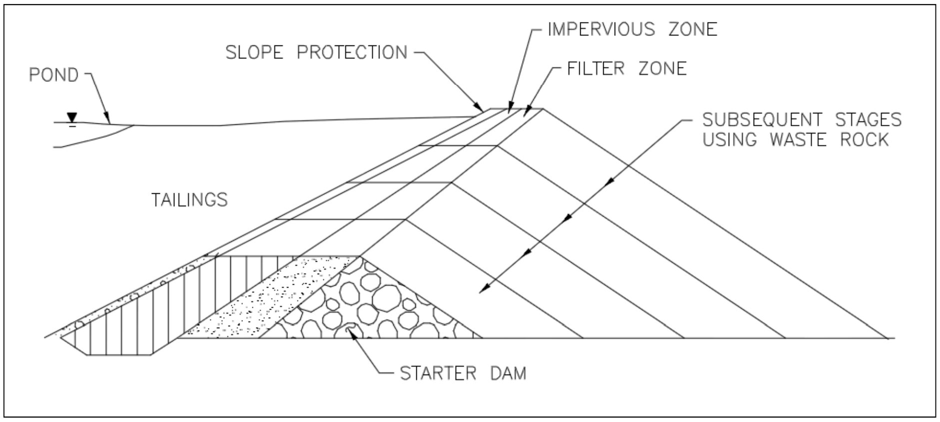
Klohn Crippen Berger 60 YEARS

Figure 5 – Centreline Method of Construction Using Cycloned Sand



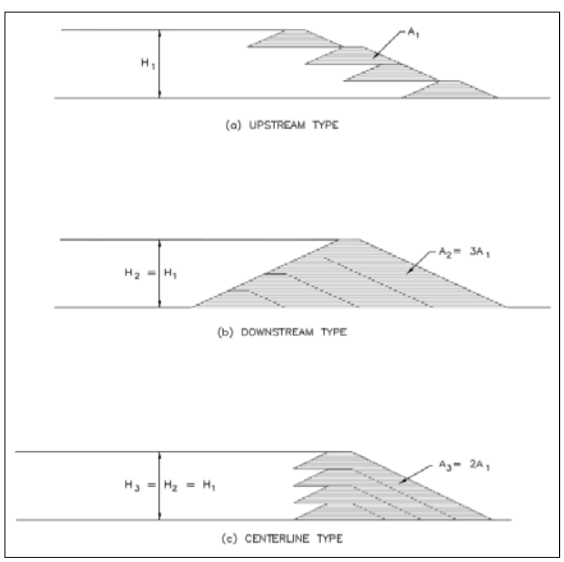
Klohn Crippen Berger 60 YEARS

Figure 6 – Impervious Tailings Dam Constructed Using Waste Rock



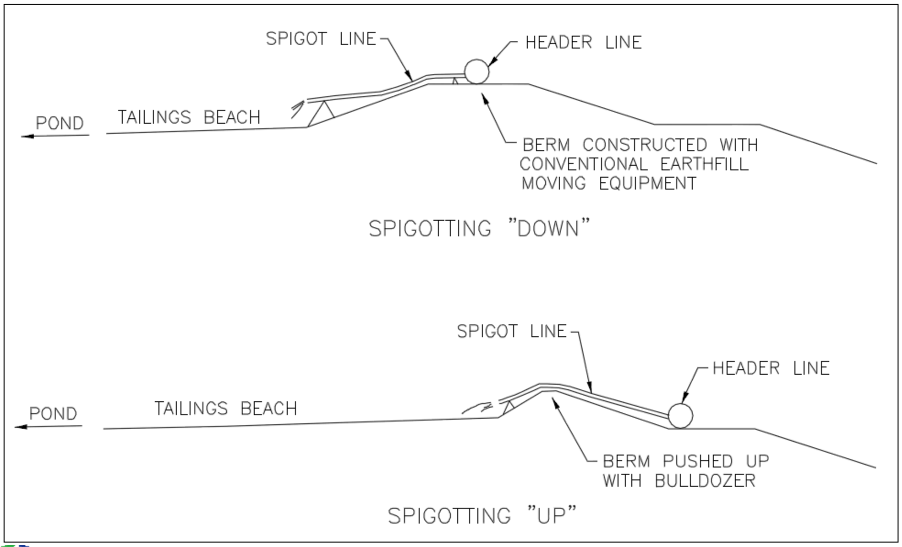
Klohn Crippen Berger 60 YEARS

Figure 7 – Comparison of Fill Volumes for Various Tailings Dam Types (after Vick, 1990)



Klohn Crippen Berger 60 YEARS

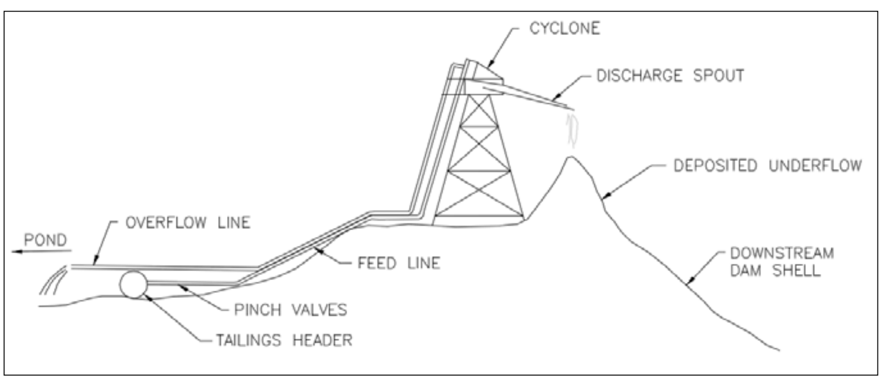
Figure 8 – Typical Spotting Configurations



Klohn Crippen Berger 60 YEARS

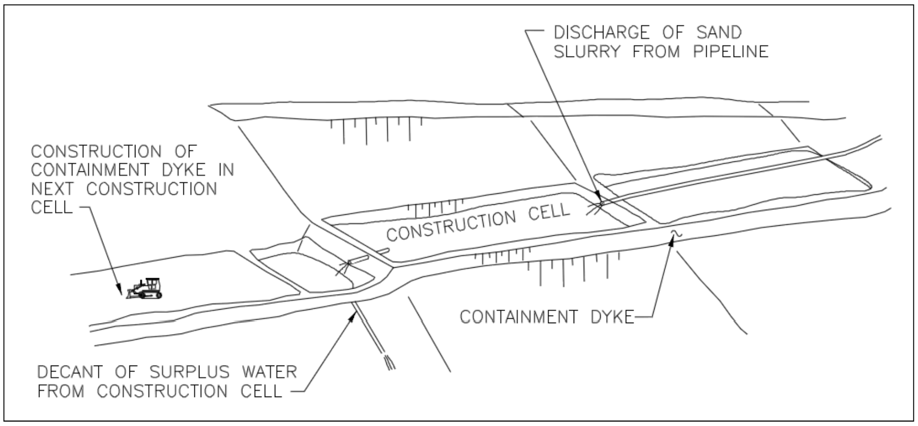
Figure 9 – Typical On-Dam Cyclone Arrangement

(after Lighthall et al., 1989)



Klohn Crippen Berger 60 YEARS

Figure 10a – Cell Construction by Sluicing



Klohn Crippen Berger 60 YEARS

Main Tailings Dam and Upstream Beach

14

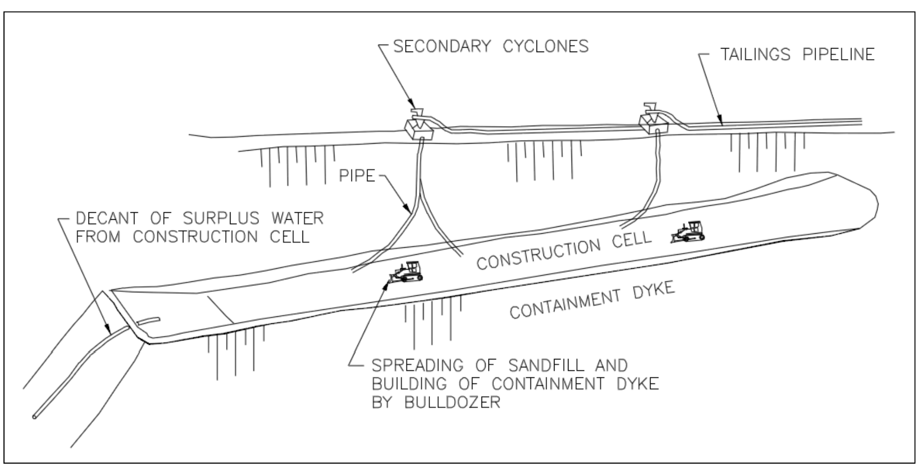
Klohn Crippen Berger 60 YEARS

Brenda Mine Tailings Impoundment

15

Klohn Crippen Berger 60 YEARS

Figure 10b – Cell Construction by Bulldozer Spreading



Klohn Crippen Berger 60 YEARS

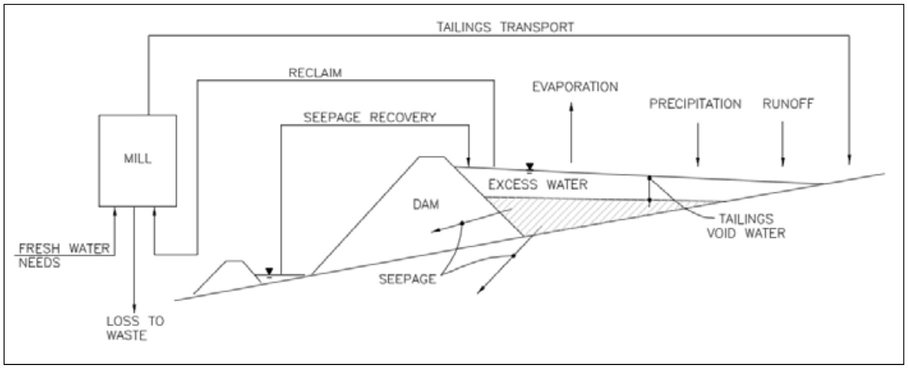
L-L TAILINGS DAM

Klohn Crippen Berger 60 YEARS

18

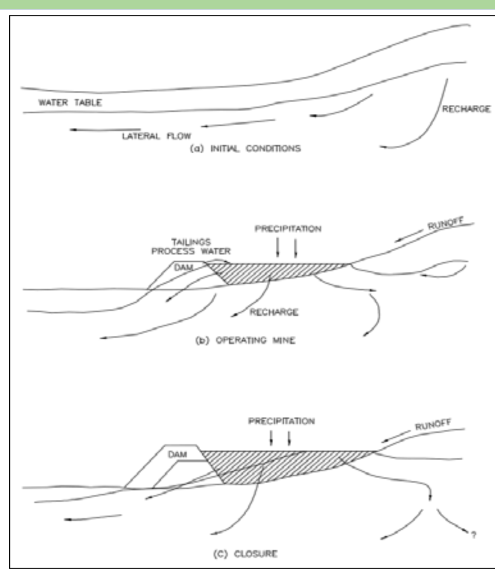
Klohn Crippen Berger 60 YEARS

Figure 11 – Tailings Pond Water Balance



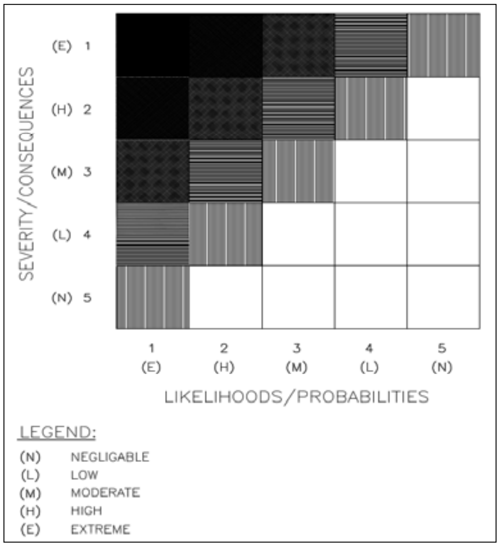
Klohn Crippen Berger 60 YEARS

Figure 12 – Schematic Groundwater Flow System around a Tailings Pond Impounded Behind a Dam



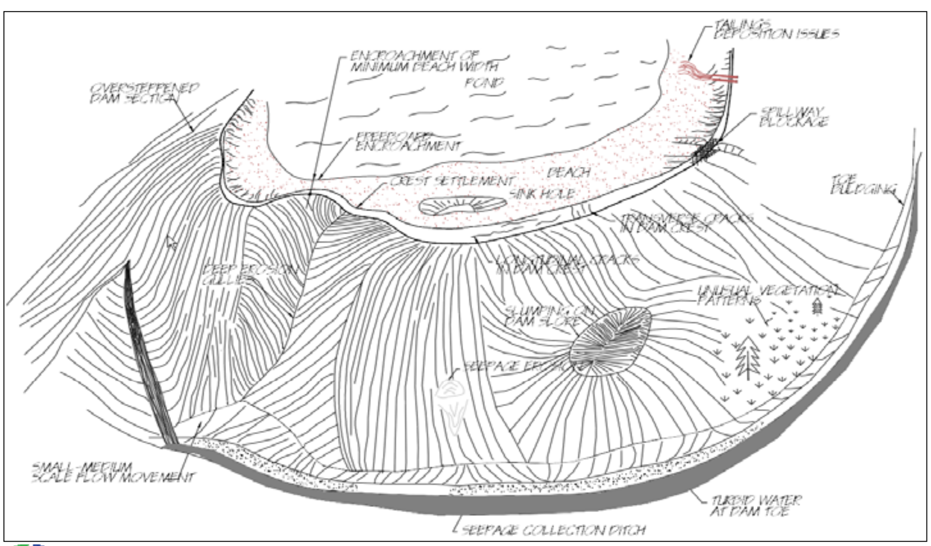
Klohn Crippen Berger 60 YEARS

Figure 13 – Simplified Risk Classification Scheme



Klohn Crippen Berger 60 YEARS

Figure 14 – Inspection of Tailings Dams, Examples of Visually Identifiable Issues

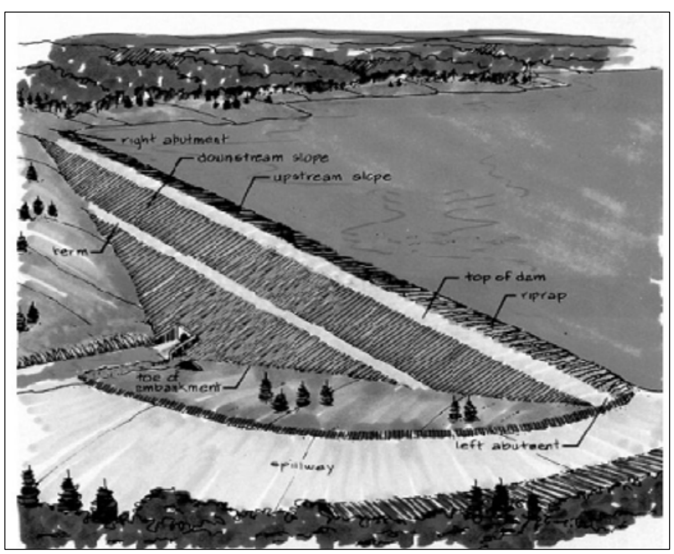


Klohn Crippen Berger 60 YEARS

Inspection & Maintenance of Dams

Klohn Crippen Berger 60 YEARS

Figure 1 – Principal Parts of an Embankment Dam



Klohn Crippen Berger 60 YEARS

Figure 2 – Typical Cross Section of an Embankment Dam

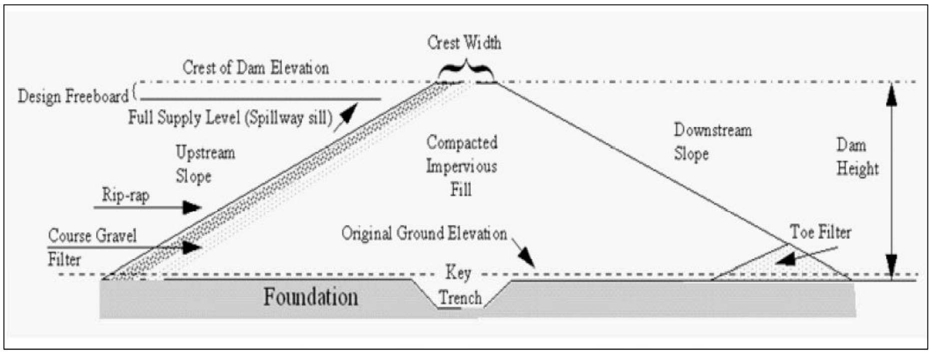


Figure 3 – Typical Catchment Area

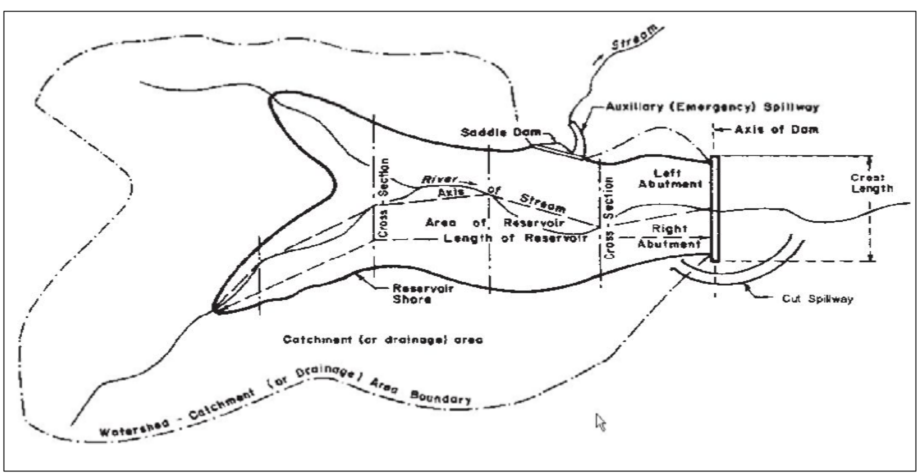


Figure 4 – Dam Breach caused by Slope Instability

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Figure 5 – Testalinden Dam Failure (near Oliver) June 13, 2010

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60 YEARS

Figure 6 – Ellis Creek Dam Failure (near Penticton) 1941

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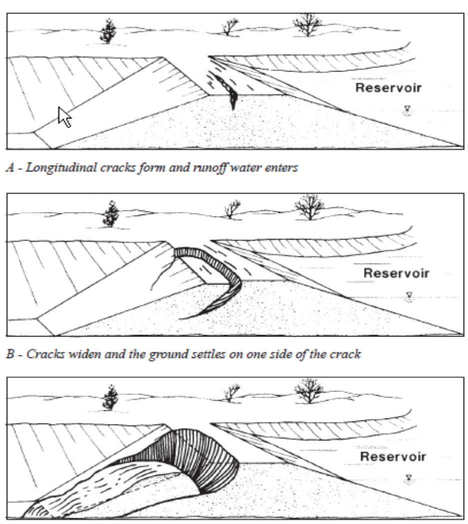
Figure 7 – Development of a Slope Failure from Longitudinal Cracking



A - Longitudinal cracks form and runoff water enters

B - Cracks widen and the ground settles on one side of the crack

C - The slope fails

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Figure 8 – Development of a Failure from Transverse Cracking

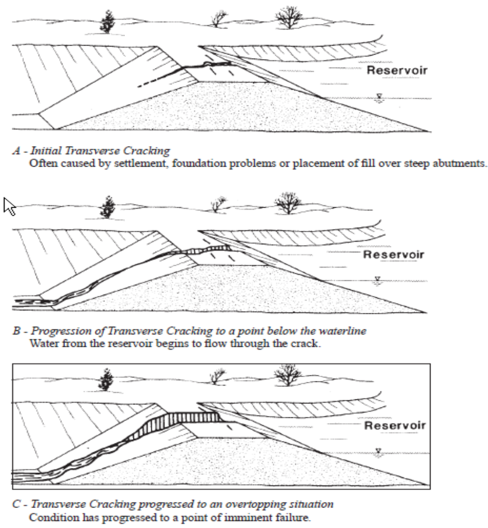

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Figure 9 – Dam Inspection in Northern B.C.

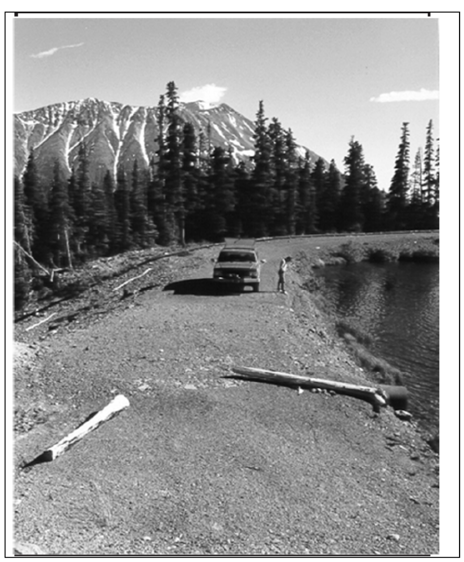

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Figure 10 – Potential Problem Indicators

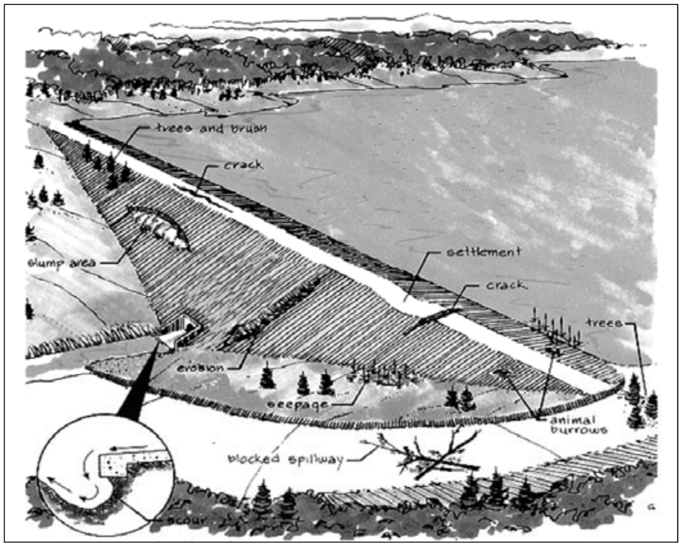

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Figure 11 – Transverse Cracking

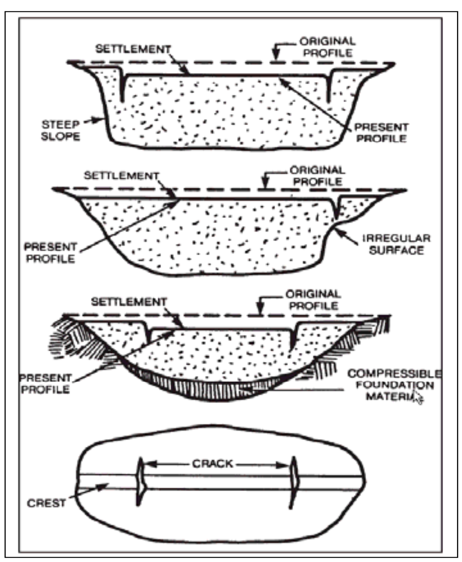

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Figure 12 – Longitudinal Cracking

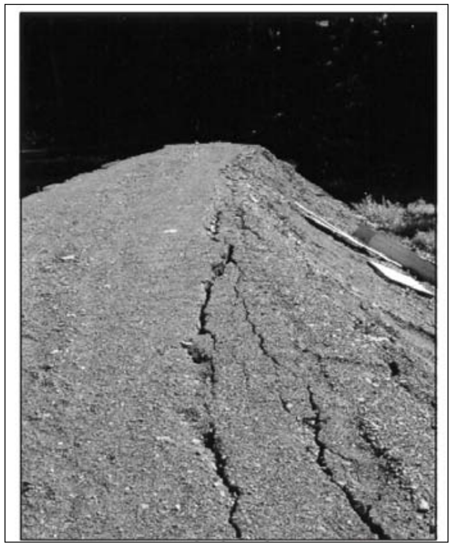

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Figure 13 – Obstructed spillway channel

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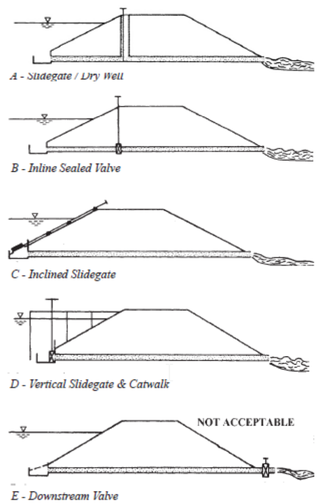
60 YEARS

Figure 14 – Most Common Types of Low Level Outlet Controls



A: Best protection from ice and water damage. The downstream side of the gate can be inspected in the dry. By blocking the inlet, the well and conduit can be drained for maintenance and repairs.

B: May be difficult to service unless it is installed in a dry well. Conduit upstream of valve is under constant pressure from reservoir head.

C: Slidegate and control may be damaged by ice, leaving system inoperable.

D: Slidegate, control and catwalk may be damaged by ice, leaving system inoperable. Catwalk requires additional maintence to remain in a safe usable condtion.

E: Entire conduit is under constant pressure from reservoir head. This design would not be allowed on new or replacement outlets. See potential failure scenario Figure No. 16, page 31.

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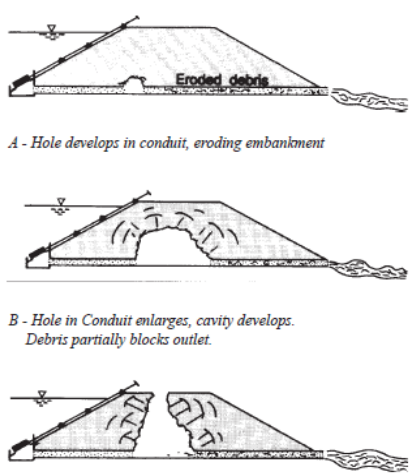
Figure 15 – Development of a Sinkhole and Failure Resulting from a Hole or Joint Separation in the Conduit



A - Hole develops in conduit, eroding embankment

B - Hole in Conduit enlarges, cavity develops. Debris partially blocks outlet.

C - Sinkhole develops, complete failure is probable.

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Figure 16 – Development of a Piping Failure Resulting from a Hole in a Conduit with a Downstream Valve

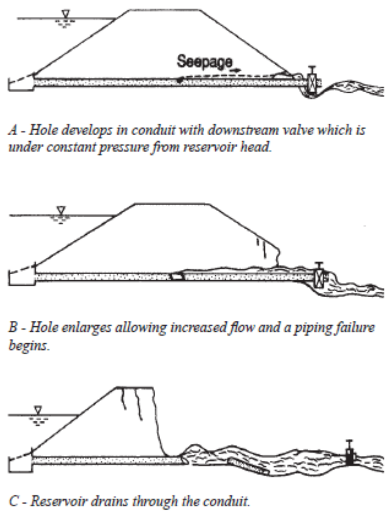

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Figure 17 – Excess growth, broken log boom

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Figure 18 – Properly maintained

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Figure 19 – Intake Control Access Structure Failure

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Figure 20 – Outlet discharge weir

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60 YEARS

Figure 21 – Inspecting a spillway training wall

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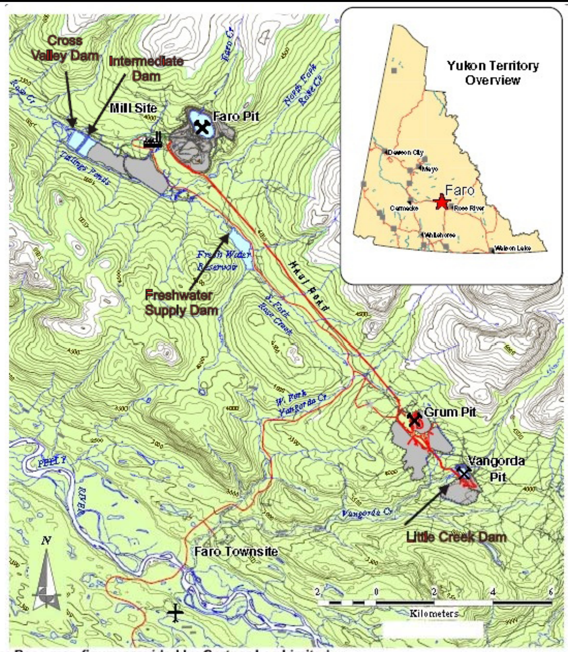
60 YEARS

Faro Mine Complex Key Structures

Key Structures

- Cross Valley Dam
- Intermediate Dam
- Secondary Tailings Dam
- Little Creek Dam
- North Valley Wall Interceptor Ditch
- Rose Creek Diversion Channel
- Faro Creek Diversion
- Vangorda Creek Diversion Channel
- Moose Pond
- Vangorda Waste Rock Pile
- Faro Pit
- Grum Pit



Note: Base map figure provided by Gartner Lee Limited.

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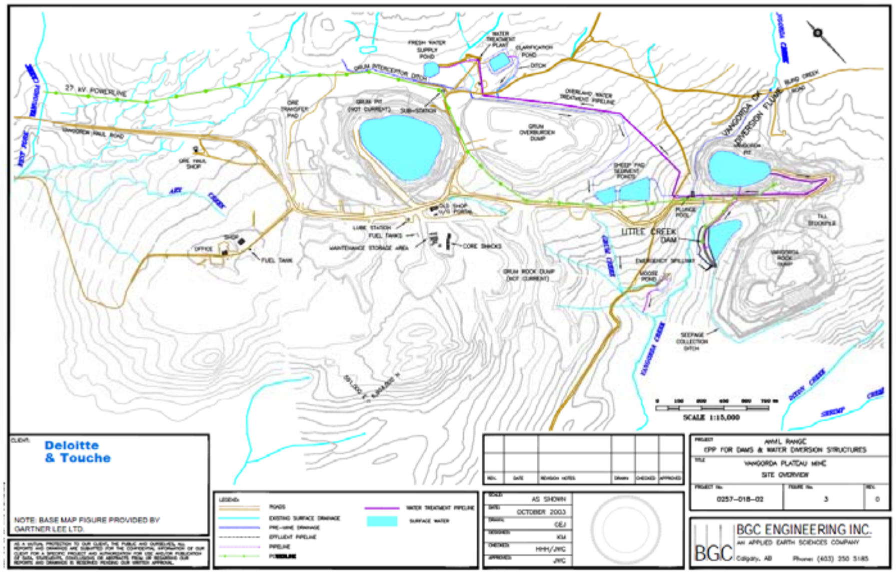

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ANVIL RANGE PROPERTY, FARO, YT

OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL FOR SELECTED DAMS

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EMERGENCY PREPAREDNESS PLAN FOR SELECTED DAMS AND WATER DIVERSION STRUCTURES

FINAL
COPY #7

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Instrumentation Used on Site

- Thermistor
- Piezometer (Pneumatic and Standpipe)
- Inclinometer
- Survey
- Flow Measurement (To be reviewed by Arvind Dalpatram in September)

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Faro Mine Complex Dams

Failure Mechanisms
Inspection for Problems

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Failure Mechanisms

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Summary of RWC Failure Modes for Dams

Dam	Reasonably Worst Case Failure Modes
Intermediate Dam	• Overtopping due to floods (spillway designed for 1:500 year event), blockages and failure of the Second Tailings Embankment. • Static instability including surface sloughing, pore pressure changes and frost effects. • Seismic instability including overall stability and liquefaction. • Piping.
Cross Valley Dam	• Overtopping due to floods (spillway designed for 1:500 year event), blockages and failure of the Intermediate Dam. • Static instability including surface sloughing, pore pressure changes and frost effects. • Seismic instability including overall stability and liquefaction. • Piping.
Little Creek Dam	• Overtopping due to floods (emergency spillway designed for 1:200 year event) or pumping system failure (meant to keep pond down). • Static instability including surface sloughing, pore pressure changes and frost effects. • Seismic instability including overall stability and liquefaction. • Piping.

Summary of RWC Failure Modes for Channels

Dam	Reasonably Worst Case Failure Modes
Faro Creek Diversion Channel	• Overtopping due to floods or ice/snow blockage. • Slope instability above the channel leading to deformation and/or blockage of the channel. • Instability (including complete failure) of proximal pit wall leading to leakage and/or blockage of the channel. • Leakage from the channel to nearby pit wall, possibly lending to piping in the dike.
Vangorda Creek Diversion Flume	• Overtopping due to floods (designed for 1:100 year event) or ice/snow blockage. • Blockage of the upstream headworks collection dam leading to dam breach. • Slope instability above the channel leading to deformation and/or blockage of the channel. • Instability (including complete failure) of proximal pit wall leading to leakage and/or blockage of the channel. • Leakage from the channel to nearby pit wall, possibly lending to piping in the dike. • Failure of the piping system and drop box below the channel.

Intermediate Dam Alert Levels

Incident	Alert Level
Dam Overtopping	Reservoir level is at normal operating level and starts to rise to maximum operating level.
Dam Embankment Instability	Appearance of new cracks or the opening of existing cracks in crest or faces of dam. Significant warming trend in thermistors, increasing pore pressures in piezometers or high one-time reading from a single piezometer.
Piping	Small quantities of clear seepage water flowing from the toe or abutment of a dam may be considered normal, but should be recorded as part of the regular visual inspections being carried out. The location and seepage quantity, preferably measured by a weir or by the time required to fill a container of known volume should be monitored. Changes in the location, rate of flow may be related to reservoir levels, precipitation, snowmelt or thawing of ground ice. May be associated with warming trend in thermistors.
Seismic Instability and Large Earthquake Events	Site staff should inspect all dams after a seismic event has been felt at the site, regardless of the size of the event. Pore pressure readings should be taken on all piezometers. Information may be obtained from the PGC website given in the EPP regarding recent seismic events in western and northern Canada and Alaska.

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Cross Valley Dam Alert Levels

Incident	Alert Level
Dam Overtopping	Reservoir level is at normal operating level (See OMS Manual for dam specific reservoir data) and starts to rise to maximum operating level.
Dam Embankment Instability	Appearance of new cracks or the opening of existing cracks in crest or faces of dam. Significant warming trend in thermistors, increasing pore pressures in piezometers or high one-time reading from a single piezometer.
Piping	Small quantities of clear seepage water flowing from the toe or abutment of a dam may be considered normal, but should be recorded as part of the regular visual inspections being carried out. The location and seepage quantities, preferably measured by a weir or by the time required to fill a container of known volume should be monitored. Changes in the location, rate of flow may be related to reservoir levels, precipitation, snowmelt or thawing of ground ice. May be associated with warming trend in thermistors.
Seismic Instability and Large Earthquake Events	Site staff should inspect all dams after a seismic event has been felt at the site, regardless of the size of the event. Pore pressure readings should be taken on all piezometers. Information may be obtained from the PGC website given in the EPP regarding recent seismic events in western and northern Canada and Alaska.

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Little Creek Dam Alert Levels

Incident	Alert Level
Dam Overtopping	Reservoir level is at normal operating level and starts to rise to maximum operating level.
Dam Embankment Instability	Appearance of new cracks or the opening of existing cracks in crest or faces of dam. Significant warming trend in thermistors, increasing pore pressures in piezometers or high one-time reading from a single piezometer.
Piping	Small quantities of clear seepage water flowing from the toe or abutment of a dam may be considered normal, but should be recorded as part of the regular visual inspections being carried out. The location and seepage quantities, preferably measured by a weir or by the time required to fill a container of known volume should be monitored. Changes in the location, rate of flow may be related to reservoir levels, precipitation, snowmelt or thawing of ground ice. May be associated with warming trend in thermistors.
Seismic Instability and Large Earthquake Events	Site staff should inspect all dams after a seismic event has been felt at the site, regardless of the size of the event. Pore pressure readings should be taken on all piezometers. Information may be obtained from the PGC website given in the EPP regarding recent seismic events in western and northern Canada and Alaska.

Diversion Channels and Pond

North Valley Wall Interceptor Ditch

Rose Creek Diversion Channel

Faro Creek Diversion

Vangorda Creek Diversion Channel

Moose Pond

Waste Dumps

Vangorda Rock Waste Dump

Other Waste Dumps

Pit Lakes

Grum Pit – East Wall Instability Zone

Faro Pit – East Wall Instability Zones:
North Instability Zone
South Instability Zone

Vangorda Pit

Inspection for Problems

Inspection for Problems

Reservoir Problems

Crest Problems

Upstream Slope Problems

Downstream Slope Problems

Downstream Toe Problems

Downstream Abutment Problems

Low-Level Outlet Problems

Spillway Problems

Minimum Checklist for Tailings Dam Inspections

GENERAL

- ☐ Ensure tailings discharge to pond in accordance with design and good practice - is tailings management plan being followed?
- ☐ Inspect condition of tailings lines, return water line for support, sagging, leaks
- ☐ If staged construction in progress, check for improper construction or operating techniques
- ☐ Inspect for evidence of animals burrowing in slopes of the dam and/or beaver activity near water control facilities
- ☐ Trees should not be allowed to grow on dam slopes as piping failure are possible along the root system - brush and grasses should be encouraged to reduce wind and water erosion and excessive freeze-thaw
- ☐ Check for wet areas on downstream face of dam and other signs of seepage
- ☐ Check the minimum beach width

GEOTECHNICAL

- ☐ Examine tailing impoundment area for potential slope instability that could enter impoundment and result in overtopping of dam
- ☐ Check for longitudinal and transverse cracking of dam
- ☐ Check for sinkholes in dam on the exposed beach and on the dam faces
- ☐ Check for sloughing on the upstream and downstream faces
- ☐ Question large changes in piezometer readings if dam is so equipped
- ☐ Check for heaving at toe of dam
- ☐ Check for horizontal and vertical movement of the dam crest. For larger dams, surface reference markers and/or slope indicators may be present and their data available
- ☐ Check integrity of any membrane or clay liners where exposed above the pond elevation
- ☐ If the dam has a decant culvert, carefully inspect for seepage along the outer walls. Check for collapse of decant structure indicated by increase of volume of discharged water compared with water that enters decant line, or by sinkholes along decant

WATER/ENVIRONMENT

- ☐ Check tailings pond elevation and location relative to design stipulations; adequate freeboard required year-round
- ☐ Is there water against the dam?
- ☐ Inspect diversion ditches for clogging and erosion
- ☐ Check decant system and spillways for proper operation, or readiness for operation
- ☐ Check decant and spillway for appropriate discharge away from toe of dam
- ☐ Check emergency and/or operational spillway for settlement and/or differential movement and integrity of structure
- ☐ If the dam is equipped with underdrains, they must be checked for flow volume and turbidity. Any seepage should be clear. Any flow that becomes turbid indicates a potentially serious condition
- ☐ Clear water or springs that develop on dam downstream face must be corrected. If springs develop turbidity, emergency action must be taken
- ☐ Stream flow or run-off must not be allowed to erode abutments

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APPENDIX IV

Memo on 2012 Spring Site Visit

MEMORANDUM

TO:	Karen Furlong, EIT Project Manager Yukon Government	**DATE:**	June 15, 2012
CC:	Boyd Barstad, Tlicho Engineering and Environmental Services		
FROM:	Robert C. Lo, P.Eng.	**FILE NO:**	M09770A01.730
SUBJECT:	Faro Mine Complex–2012 Spring Site Visit		

The 2012 spring site visit of both the Faro and Vangorda Plateau minesite facilities was carried out by Klohn Crippen Berger's (KCB's) Robert C. Lo accompanied by Ms. Karen Furlong of Yukon Government on May 29 and 30, 2012.

In the morning of May 29, a brief meeting was held with the attendance of Ms. Furlong, Messrs. Boyd Barstad, Site Manager of Tlicho Environmental Engineering Services (TEES), and Lo, reviewing the concerns of TEES regarding site monitoring activities and the update of Operation, Maintenance and Surveillance (OMS) Manual and Emergency Response Plan (ERP). Possible engagement of Golder to review the Vangorda Pit slope stability as well as to update their review of the Faro and Grum Pits was discussed in the meeting. Other discussed items include:

- Update and improvement of site facility figures.
- Update of site OMS manual and ERP making use of existing documents by BGC Engineering and TEES Emergency Management Plan. The update would be a joint effort by the Yukon Government and its site representative, TEES, and geotechnical consultant.

After the meeting, Ms. Elleni Mouriki of TEES participated in the site visit in the morning of May 29, while Ms. Furlong and Mr. Lo conducted the entire visit on both May 29 and 30. All site flow-diversion facilities besides other key structures were visited, as the spring freshet approaching its end phase.

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Select site-visit photos of Faro and Vangorda facilities taken on May 29 and 30 are presented in Appendix A, while our site observations, comments and recommendations following the visit are summarized in Table 1.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Robert C. Lo, P.Eng.
Project Manager

RL:dl

Enclosures:

Table 1	Faro Mine Site Complex - 2012 Spring Site Visit Summary
Appendix A	Select Site-Visit Photos

APPENDIX A
Select Site Visit Photos

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Faro Pit	• An inactive open pit, roughly elliptical shaped, with major axis along northwest-southeast direction. • The east wall is about 375 m high, containing two, North and South, Instability Zones, separated by a calc-silicate rock slope. • Minimum distances between the pit wall and the Faro Creek Diversion Channel are 18.5 m and 93 m, respectively in the North and South Instability Zone.	• No obvious changes on the east pit wall North and South Instability Zones were observed. • Seepage observed on pit wall similar to that in Sept. 2011.	• Continue visual monitoring of pit wall conditions with photos taken at “Eye in the Sky” vantage points. • Continue monitoring distances between the pit wall and Faro Creek Diversion Channel at existing strategic locations. • Continue to have pit slope stability reviewed periodically.
Faro Creek Diversion Channel (FCDC)	• Diverts creek flow from head waters north of the Faro Pit around the east side of the mine site, and discharges into North Fork Rose Creek.	• Flow condition was similar to that in Aug. 2011. • Portions of the channel are lined with rock and geotextile or tarp. Rock armour has moved in some areas, and geotextile and tarp are exposed in some areas. • Stable channel and side slopes, satisfactory rock armour and lined channel.	• Continue visual monitoring of diversion channel and any seepage from the channel to the Faro Pit wall with photos taken at strategic points. • Cover exposed geotextile and tarp with rock armour. • Convert monitored staff gauge readings to flow rates.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Faro Site Facilities

STRUCTURE	DESCRIPTION	OBSERVATIONS	COMMENTS AND RECOMMENDATIONS
North Valley Wall Interceptor Ditch (NVWID)	• Diverts creek flow from north valley wall around tailings impoundment area. • Approximately 3,000 m long, consisting of constructed and natural stream channel sections. Constructed channel sections include: 920 m long upper reach; 430 m long middle reach; and 500 m long lower reach. • Relatively flat channel gradients along constructed sections and steep stream gradients along natural channel sections.	• Similar flow condition as that in Aug. 2011. • Stable channel and side slopes. • Sedimentation developing both up and down gradient from the well access road crossing. • Moderate to heavy vegetation growth in upper and middle constructed channel reaches (no foliages during visit). • Visited natural reaches both upstream and downstream of the middle constructed channel reach.	• Monitor channel sedimentation condition at the well access road crossing, and remove sediments if additional sediment is deposited in the channel. • Clear vegetation along upper and middle constructed channel reaches. Clearing should also include the access road and berm along the channel to facilitate future inspection.
Rose Creek Diversion Channel (RCDC) and Canal Dyke (CD)	• Diverts creek channel flow around south side of tailings impoundment area. • Approximately 3,800 m long with relatively flat to moderate stream channel gradients along upper reaches and steep gradients along lower reaches.	• Flow condition was similar to that in Aug. 2011. • Stable channel and side slopes, satisfactory rock armour conditions. • Saturated base of spoil piles along CVD Polishing Pond shore.	• Continue to monitor instrumentation. • Note seepage locations from RCDC into tailings impoundment area after fresh snow fall condition. • Check vegetation growth on the downstream slope of Canal Dyke and clear vegetation as required.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
North Fork Rock Drain (NFRD)	• Mine haul road stream crossing constructed from coarse waste rock fill and drain rock. • Road embankment approximately 55 m high, with 25 m crest width.	• Flow condition was lower than that observed during Aug. 2011. Wood debris was observed on haul road embankment slope above head pond. • Stable crest and side slope of mine haul road.	• Continue to monitor head pond level and downstream flow conditions.
K8 Creek Rock Drain (K8CRD)	• Mine haul road stream crossing constructed from coarse waste rock fill and rock drain. • Road embankment approximately 55 m high, with 25 m crest width.	• Stable crest and side slopes of mine haul road. • Downstream drainage condition acceptable.	• Continue to monitor head pond level and downstream flow conditions.
Secondary Tailings Impoundment (STI)	• Perimeter tailings dam, retains tailings, supernatant and run-off water. • Encloses original tailings impoundment. • Dam Crest approximately 1120 m long, 6 m wide and, varies from El. 1060.2 m to El. 1063.3 m. • Dam height: 28 m.	• Stable crest, upstream and downstream slopes • Lower road conditions are satisfactory. • A row of tailings is located on the upstream shoulder of the crest along the southwest portion of the dam, forming the source of tailings on the dam crest due to runoff erosion. • Cracks observed previously in the springs along the downstream road reappeared this spring, and extended northeast from the beginning of the Rose Creek Diversion Channel to near the Main Access Road to the mine.	• Continue to monitor dam performance. • Continue to monitor instrumentation. • Seal off the cracks by grading along the downstream road between the beginning of the Rose Creek Diversion Channel and Main Access Road to minimize water ingress into the road embankment. • Continue to observe any crack development, especially during spring.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Intermediate Dam (ID)	• Intermediate tailings/water dam, retains tailings, supernatant and run-off water on upstream side, and polishing pond water on downstream side. • Dam height: 32m. • Crest approximately 650 m long, 7 m wide at El. 1049.2 m and spillway channel invert at El. 1047.7 m	• Pond level was relatively high at 1045.79 m, covering lower portion of the discontinuous riprap protection zone. • Monitoring posts installed in 2010 were not found. • Pond water was being drawn down by the pump barge for water treatment. • Stable crest, upstream above-water slope and spillway channel, in general. • Near south abutment, upstream slope fill adjustment was noted. • Downstream slope was experiencing extensive rill erosions, with longitudinal cracks and minor slope slumps developing, and eroded materials were forming small deltas on the downstream berm. • Most of wooden stakes placed by DES on the downstream slope in 2011 remained on the slope, indicating the rill erosion did not propagate further up slope. • Shoulder erosion of the downstream berm was much subdued as compared with that observed in Aug. 2011. • Eroded debris from the downstream slope could potentially cover drainage measures originally daylighting on the	• Continue to monitor instrumentation. • Continue to monitor Piezometers BH94-IDC-1, BKS04-06 and BKS04-07 to confirm continual function of the upstream impervious core. • Continue to monitor wave/ice erosion of the upstream slope, especially in those intervals with no riprap protection zone. Remedial measures, such as replacement of riprap, may be required if excessive erosion is observed. However, remedial measures must take into consideration the works required for permanent closure of the pond. • Continue to monitor damfill adjustment of upstream slope near the south abutment. • Repair shoulder erosion of the downstream berm, if required. • Ongoing monitor downstream slope rill erosion, longitudinal cracks and slope slumps. • Consider experimenting with potential remedial measures to reduce rill erosion of the downstream slope, such as grass planting, and addition of coarse rockfill or gabions, etc. • Monitor sediment deposition over drains on downstream berm, and consider to replace the deposited material on the deltas to infill the eroded gullies using backhoe travelling along the downstream berm. • Check piezometric data to ascertain potential blockage of drains. • Review and update, if required, geotechnical

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
		downstream berm.	stability analysis based on current dam conditions, including new operating water levels implemented recently.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Faro Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Cross Valley Dam (CVD)	• Polishing Pond dam is designed for 60-day retention capacity of seepage and discharge water from tailings storage facility and water treatment plant. • Dam height: 17 m. • Crest approximately 500 m long, 7 m wide at El. 1033.1 m and spillway channel at El. 1031.7 m.	• Stable crest, upstream and downstream slopes and spillway channel. • Tension cracks previously observed on the dam crest reappeared as fine longitudinal cracks near the middle of the crest along the southwest segment of the dam. • The surfaces of both the upstream and downstream slopes were observed being rougher than those at the Intermediate Dam, probably because of coarser damfill and construction method used at this dam.	• Continue to monitor instrumentation. • Seal off the crest cracks by grading to minimize water ingress into the dam embankment. • Ongoing monitor tension cracks development on the dam crest, especially during spring.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities			
STRUCTURE	**DESCRIPTION**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Grum Pit	• An inactive pit, elliptical in shape, extending 850 m in north/south direction and 600 m in east/west direction. • The east pit wall is about 160 m high. • East wall instability appears to be continually evolving.	• Pit-brim monitoring points survey since 2010 indicates nominal changes, which could be attributed to random measuring errors.	• Continue visual monitoring of pit wall conditions with photos taken from same vantage points. • Continue monitoring distances between survey pins located on the pit brim, perhaps with reduced frequency, if no significant movements are measured. • Continue to have pit slope stability reviewed periodically.
Vangorda Pit	• An elongated, inactive pit, with the long axis oriented in the northwest-southeast direction. • A pump barge pumps water to the treatment plant.	• Initiate taking photos along northwest wall to document pit wall conditions along Vangorda Flume Diversion. • Seepage observed on northwest pit wall.	• Continue visual monitoring of pit wall conditions with photos taken at same vantage points at least at yearly interval. • Have pit slope stability reviewed periodically.
Grum Dump	• Waste dump undergoing reclamation	• Visited surface water storage pond .on top of Grum Dump, and dump slope above top bench.	• Continue regular monitoring
Vangorda Waste Rock Dump	• Six transverse drains installed beneath the till starter dyke to collect dump seepage into a seepage collection ditch. • Collected seepage drains into a pond retained by the Little Creek Dam	• Visited Drains No. 1 to No. 4. • Seepage collection ditch free of snow from Drain No. 1 to downstream of Drain No. 3. • Drain No. 4 covered by snow.	• Continue to monitor seepage flows at drains , and improve conditions at weirs, as required. • Continue to monitor dump slope, especially in areas where slope slump was observed in the past.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities

STRUCTURE	DESCRIPTIONS	OBSERVATIONS	COMMENTS AND RECOMMENDATIONS
Grum Interceptor Ditch	• The Interceptor ditch consists of 3 reaches: - 900 m long ditch upslope of Grum Pit to divert clean water away from the pit; - 900 m long ditch along the northeast toe of Grum Overburden Dump; and - 650 m long ditch to convey flow downhill to Vangorda Creek.	• Stable channel and side slopes.	• Continue routine monitoring of ditch
North East Interceptor Ditch above Vangorda Pit	• Located uphill of the Vangorda Pit. • Diverts surface runoff away from the pit.	• Minor ditch side-slope slumps observed along lower reach of the ditch.	• Continue to monitor ditch side slopes, especially along reaches with slope slumps. • Check existing ditch dimensions for upstream portion of the ditch against design dimensions to confirm that the ditch is equal to or larger than design.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities			
STRUCTURE	**DESCRIPTIONS**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Vangorda Creek (Flume) Diversion	• Diverts Vangorda Creek around Vangorda Pit via a CSP half-pipe (flume). • Headworks for flume include a main culvert and trashrack. • Headworks also include 2 emergency culverts at a higher level, c/w rashrack. • Flume discharges to a plunge pool, and flow is carried across the haul road via a CSP culvert and drop box to Vangorda Creek channel.	• Trashracks for the main culvert and emergency culverts at the headworks were clear. • Surface runoff entered into creek at culvert entrance. • Visited additional source of inflow into flume along middle reach. • Flume is damaged along lower reach, likely from ice removal activities during the winter (CSP is dented, has holes and pipe bracings are bent or broken). We understand that no ice removal has been taking place in recent years.	• Consider to divert surface runoff further upstream away from the culvert entrance to prevent bank slope erosion. • Check as-built drawings to determine if main culvert has a vertical bend. • Monitor trashracks and remove debris and sediment, as required, to maintain discharge capacity. • Monitor corrosion and abrasion along the culvert inverts. • Monitor culverts for deformation and separation of plates at joints. • Monitor condition of the flume. Try and avoid further damage to the flume during ice removal activities, if possible.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities			
STRUCTURE	**DESCRIPTIONS**	**OBSERVATIONS**	**COMMENTS AND RECOMMENDATIONS**
Little Creek Dam	• Water dam to collect Vangorda mine site waste-contact water to be pumped to the Vangorda Pit lake.	• Stable dam slopes with rill erosions developed on the downstream and upstream crest shoulders and slopes. • Culvert spillway in good condition. • Submersible pump in place for drawing down pond level.	• Consider repair of rill erosion on both dam slopes. • Request information on downstream piezometers installed in 2009.
Sheep Pad Sediment Ponds	• Facility consists of 2 ponds which collect surface runoff from upslope areas, including the Grum Overburden Dump. • The upstream pond discharges into the downstream pond via a CMP half-round pipe. • The lower pond discharges towards the plunge pool for the Vangorda Flume via a riprap lined spillway channel.	• Stable pond retaining dyke embankment. • The upstream section of the spillway channel has no riprap in the bottom, and the underlying geotextile is exposed.	• Replace missing riprap in spillway channel.
Grum Settling Pond	• Pond discharges to Grum Interceptor ditch via a riprap lined spillway channel	• Spillway channel appeared to be in good condition.	• Continue to monitor spillway channel for erosion and vegetation growth. • Continue to monitor embankments.

Table 1 Faro Mine Site Complex – 2012 Spring Site Visit Summary (cont'd)

Vangorda Plateau Site Facilities

STRUCTURE	DESCRIPTIONS	OBSERVATIONS	COMMENTS AND RECOMMENDATIONS
V-15 Seep Ditch and Moose Pond	• Seepage water from Grum Dump daylights at V-15 Pond. • Bentomat lined V-15 ditch diverts water from V-15 Pond to Moose Pond.	• Sedimentation caused by excess inflow in 2011 sealed off the Moose Pond bottom, and raised pond level and caused excess seepage through a retaining esker, and slumping of esker downstream slope. • Exfiltration from Moose Pond has probably changed from the pond bottom to the bank slope at higher elevations. • Standby sump pump was not required to operate during 2012 spring freshet.	• Consider to improve riprap protection of the side slopes and bottom of V-15 ditch, at the location where ditch flow descends towards the Moose Pond, as required. • Prevent future inflow into Moose Pond from extraneous sources not in existence prior to 2011. • Determine Moose Pond bathymetry. • Continue to monitor water quality of Moose Pond downstream seepage to confirm that the Moose Pond retains its exfiltration function. • Continue to monitor the slope stability and vegetation condition in the disturbed area of the esker downstream slope. • Evaluate the long-term impact of the 2011 excess-inflow incident on the normal exfiltration operation of the Moose Pond, and consider if any remedial measures such as slope stabilization of the esker downstream slope that may be required.
Sludge Pond Embankment at Vangorda Water Treatment Plant	• Rectangular-shaped sludge pond retained by embankment dyke.	• Low pond level.	• Continue existing monitoring.

Faro Pit

Photo 1 East wall of Faro Pit – northern segment as seen from "eye-in-the-sky" (May 30, 2012)

Photo 2 East wall of Faro Pit - southern segment as seen from "eye-in-the-sky" (May 30, 2012)

Faro Creek Diversion Channel

Photo 3 Faro Creek Diversion Channel above Faro Pit - looking upstream (May 29, 2012)

Photo 4 Diversion Channel above Faro Pit - looking downstream (May 29, 2012)

Faro Creek Diversion Channel

Photo 5 Close up of channel bottom and bank slopes (May 29, 2012)

Photo 6 Slope erosions and slumps on channel bank slope (May 29, 2012).

North Valley Wall Interceptor Ditch

Photo 7 North Valley Wall Interceptor Ditch along upper reach - looking upstream (May 30, 2012)

Photo 8 Channel upstream of Potable Water Well access road culverts - note sediment deposits at channel bottom (May 30, 2012)

North Valley Wall Interceptor Ditch

Photo 9 Channel downstream of Potable Water Well access road culverts - note sediment deposits at channel bottom (May 30, 2012)

Photo 10 End of upper reach of man-made Interceptor Ditch (May 30, 2012)

North Valley Wall Interceptor Ditch

Photo 11 Beginning of middle reach of man-made Interceptor Ditch (May 30, 2012)

Photo 12 Middle reach of Interceptor Ditch (May 30, 2012)

North Valley Wall Interceptor Ditch

Photo 13 End of middle reach of man-made Interceptor Ditch (May 30, 2012)

Photo 14 Entrance to culvert leading to lower reach of Interceptor Ditch (May 30, 2012).

North Valley Wall Interceptor Ditch

Photo 15 Discharge end of culvert leading to lower reach of Interceptor Ditch - note snow remaining inside culvert (May 30, 2012)

Photo 16 Interceptor Ditch lower reach adjacent to Cross Valley Pond (May 30, 2012)

Mose Creek Diversion Channel

Photo 17 Rose Creek Diversion Channel upstream of fuse plug (May 29, 2012)

Photo 18 Channel downstream of fuse plug (May 29, 2012)

Mose Creek Diversion Channel

Photo 19 Diversion Channel adjacent to Cross Valley Dam looking upstream (May 29, 2012)

Photo 20 Diversion Channel adjacent to Cross Valley Dam looking downstream (May 29, 2012)

North Fork Rock Drain

Photo 21 Wood debris on upstream slope of access road between Faro and Vangorda Plateau at North Fork Rock Drain (May 29, 2012)

Photo 22 Downstream slope of access road at North Fork Rock Drain (May 29, 2012)

K8 Creek Rock Drain

Photo 23 K8 Creek Rock Drain upstream pool (May 29, 2012)

Photo 24 K8 Creek Rock Drain downstream outlet (May 29, 2012)

Secondary Tailings Dam

Photo 25 **Secondary Tailings Dam crest and downstream slope - longitudinal cracks reappeared along road surface of downstream berm (May 29, 2012)**

Photo 26 **Longitudinal crack along downstream berm road surface towards Canal Dyke (May 29, 2012)**

Secondary Tailings Dam

Photo 27 **Longitudinal crack along downstream berm road surface towards Mine Access Road (May 29, 2012)**

Photo 28 **Secondary Tailings Dam and beach downstream of fuse plug (May 29, 2012).**

Intermediate Tailings Dam

Photo 29 Intermediate Dam spillway at right abutment of dam looking upstream (May 29, 2012)

Photo 30 Intermediate Dam upstream slope – looking southwest (May 29, 2012)

Intermediate Tailings Dam

Photo 31 Dam crest and upstream slope - note damfill adjustment in area of hard hat along upstream crest shoulder (May 29, 2012)

Photo 32 Canal Dyke slope upstream of Intermediate Dam (May 29, 2012)

Intermediate Tailings Dam

Photo 33 **Rill erosions along downstream slope - note stakes used to assist ongoing monitoring by DES and deposits of eroded damfill on downstream berm surface (May 29, 2012)**

Photo 34 **Rill erosions along downstream dam slope (May 29, 2012).**

Intermediate Tailings Dam

Photo 35 Sign of damfill adjustment near area of hard hat along crest shoulder (May 29, 2012)

Photo 36 Downstream slope of downstream berm (May 29, 2012)

Cross Valley Dam

Photo 37 Cross Valley Dam crest and upstream slope (May 29, 2012)

Photo 38 Dam crest and downstream slope (May 29, 2012)

Cross Valley Dam

Photo 39 Longitudinal crack in the middle of crest along southwest segment (May 29, 2012)

Photo 40 Canal Dyke slope upstream of Cross Valley Dam (May 29, 2012)

Cross Valley Dam

Photo 41 Downstream seepage along northeast segment of dam (May 29, 2012)

Photo 42 Downstream seepage along middle segment of dam (May 29, 2012)

Vangorda Waste Rock Dump

Photo 43 Grum Pit south segment of east wall as seen from northwest wall (May 29, 2012)

Photo 44 Grum Pit north segment of east wall as seen from northwest wall (May 29, 2012)

Vangorda Waste Rock Dump

Photo 45 **Vangorda Pit southeast wall as seen from northwest wall (May 30, 2012)**

Photo 46 **Vangorda Pit southwest wall as seen from northwest wall (May 30, 2012)**

Vangorda Waste Rock Dump

Photo 47 Vangorda Pit northwest wall lower segment - note Vangorda Flume behind the wall (May 30, 2012).

Photo 48 Vangorda Pit northwest wall upper segment - note Vangorda Flume behind the wall (May 30, 2012)

Vangorda Waste Rock Dump

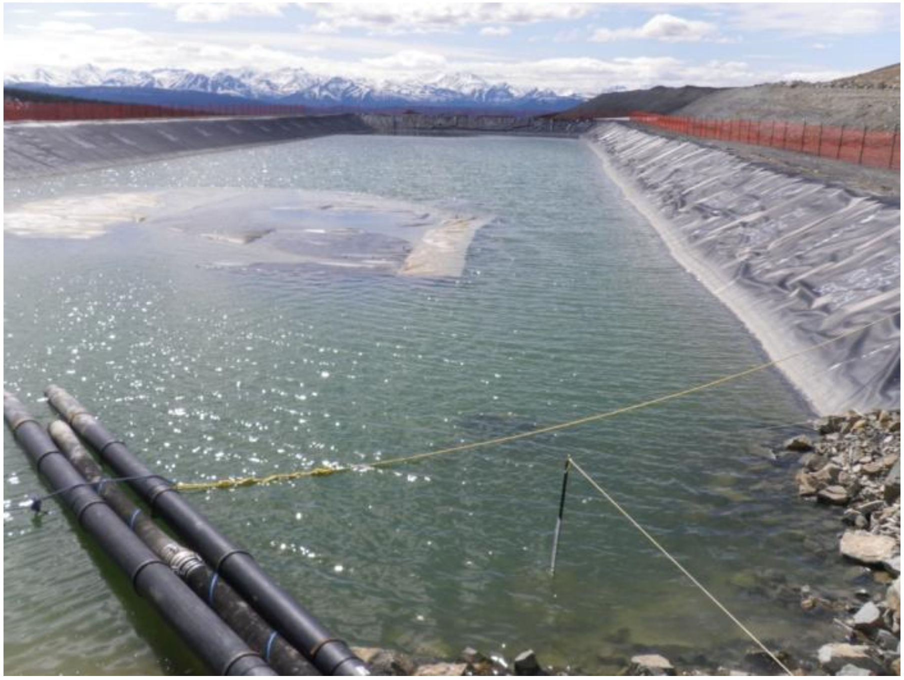

Photo 49 Grum Dump surface water storage pond (May 30, 2012)

Photo 50 Grum Dump side slope, water retention pond on bench and access ramp (May 30, 2012).

Vangorda Waste Rock Dump

Photo 51 Vangorda Waste Dump at distance - looking from north (May 30, 2012)

Photo 52 Vangorda Waste Rock Dump drain no. 3 (May 30, 2012)

Vangorda Waste Rock Dump

Photo 53 Dump face with previously marked slope slump (May 30, 2012)

Photo 54 Seepage collection ditch between drain nos. 3 and 4. (May 30, 2012)

Vangorda Waste Rock Dump

Photo 55 Dump slope and seepage collection ditch at drain no. 4 (May 30, 2012)

Photo 56 Toe of dump slope in area above Little Creek Dam (May 30, 2012)

Grum Interceptor Ditch

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Photo 57 Grum Pit brim monitoring south pin array (May 30, 2012)

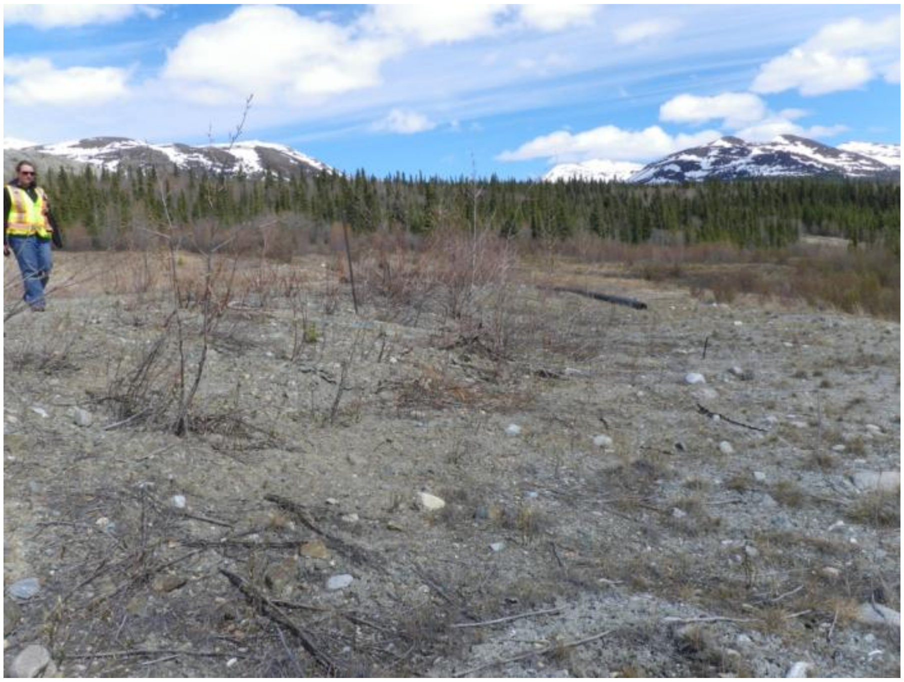

Photo 58 Grum Pit brim monitoring north pin array (May 30, 2012)

Grum Interceptor Ditch

Photo 59 Grum Pit Interceptor Ditch in vicinity of power substation(May 30, 2012)

Photo 60 Ditch along Grum Overburden Dump (May 30, 2012)

Grum Interceptor Ditch

Photo 61 **Grum Interceptor Ditch – Grum Overburden Dump test plot in background (May 30, 2012)**

Photo 62 **Interceptor Ditch flowing towards Sheep Pad Sediment Ponds (May 30, 2012).**

North-East Diversion Ditch above Vangorda Pit

Photo 63 Vangorda North-East Interceptor Ditch upper reach (May 30, 2012)

Photo 64 Ditch bank slopes – note bank slope erosion condition (May 30, 2012)

North-East Diversion Ditch above Vangorda Pit

Photo 65 Increase of ditch flow downstream of confluence of a tributary stream (May 30, 2012)

Photo 66 Ditch bank slope slump (May 30, 2012)

North-East Diversion Ditch above Vangorda Pit

Photo 67 Ditch bank slope slump (May 30, 2012)

Photo 68 Ditch flow discharging into natural stream (May 30, 2012)

Vangorda Creek (Flume) Diversion

Photo 69 Vangorda Flume Diversion culvert inlet - note runoff entering into creek near culvert entrance (May 30, 2012)

Photo 70 Culvert flow into Vangorda Flume Diversion (May 30, 2012)

Vangorda Creek (Flume) Diversion

Photo 71 Inflow to Flume Diversion by pumping from intercepted runoff collected below access road (May 30, 2012)

Photo 72 Pipeline below access road to convey collected surface runoff as seen on Photo 73 (May 30, 2012)

Vangorda Creek (Flume) Diversion

Photo 73 Excavated trench to collect surface runoff for pumping into Flume Diversion as seen in Photo 72 (May 30, 2012)

Photo 74 Battered section along lower reach of Vangorda Flume (May 30, 2012)

Vangorda Creek (Flume) Diversion

Photo 75 Battered section along lower reach of Vangorda Flume (May 30, 2012)

Photo 76 Battered section along lower reach of Vangorda Flume (May 30, 2012)

Vangorda Creek (Flume) Diversion

Photo 77 End reach of Vangorda Flume (May 30, 2012)

Photo 78 Culvert inlet to Vangorda Flume drop box (May 30, 2012)

Vangorda Creek (Flume) Diversion

Photo 79 Vangorda Flume drop box (May 30, 2012)

Photo 80 Discharge of Vangorda Flume flow via culvert leading from drop box as seen on Photo 79 (May 30, 2012)

Little Creek Dam

Photo 81 Little Creek Dam crest, upstream slope and Vangorda Dump seepage collection pond (May 30, 2012)

Photo 82 Dam crest and downstream slope (May 30, 2012)

Little Creek Dam

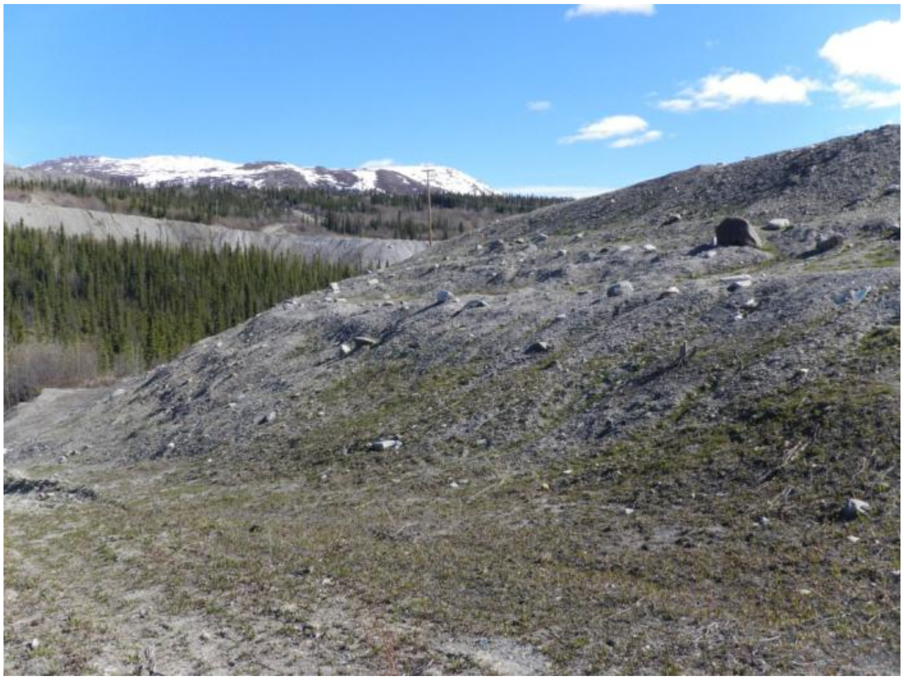

Photo 83 Downstream dam and berm slope (May 30, 2012)

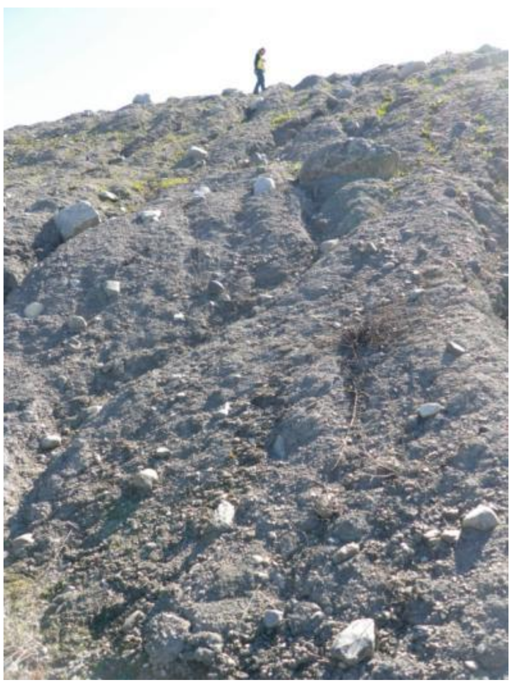

Photo 84 Downstream slope rill erosions (May 30, 2012)

Little Creek Dam

Photo 85 Culvert spillway outlet (May 30, 2012)

Photo 86 Downstream piezometers (May 30, 2012)

Sheep Pad Sediment Ponds

Photo 87 Flow entering Upper Sheep Pad Sediment Pond (May 30, 2012)

Photo 88 Upper (foreground) and Lower (background) Sheep Pad Ponds (May 30, 2012)

Sheep Pad Sediment Ponds

Photo 89 Flume flow from Upper to Lower Sheep Pad Pond (May 30, 2012)

Photo 90 Lower Sheep Pad Pond (May 30, 2012)

Grum Settling Pond

Photo 91 Grum Settling Pond (May 30, 2012)

Photo 92 Grum Settling Pond and flow through spillway channel (May 30, 2012)

V-15 Seepage Diversion Ditch and Moose Pond

Photo 93 V-15 Diversion Ditch and weir flow (May 30, 2012)

Photo 94 V-15 Enclosed Sump Pump for pumping excess water during spring freshet into Vangorda Pit (May 30, 2012)

V-15 Seepage Diversion Ditch and Moose Pond

Photo 95 Water flow from diversion ditch down slope towards Moose Pond (May 30, 2012)

Photo 96 Sediment deposits at entrance to Moose Pond (May 30, 2012)

V-15 Seepage Diversion Ditch and Moose Pond

Photo 97 **Downstream slope of esker - note seepage daylighting from slope (May 29, 2012)**

Photo 98 **Seepage rate increased further down slope from the upslope daylighting location (May 29, 2012)**

V-15 Seepage Diversion Ditch and Moose Pond

Photo 99 Seepage rate increased about ten-fold near entrance to Vangorda Creek (May 29, 2012)

Photo 100 Disturbed esker slope and vegetation (May 29, 2012)

Sludge Pond Embankment - Vangorda Water Treatment Plant

Photo 101 Sludge Pond and sludge inflow pipe - note freshly removed sludge surface (May 30, 2012)

Photo 102 Sludge Pond (May 30, 2012)